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# Community-based falls prevention for older persons: a case study in economic modelling of geriatric public health interventions

**APPENDICES**

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# Author contributions

**Chapter 2:** Kwon, J., Lee, Y., Young, T., Squires, H., and Harris, J. Qualitative research to inform economic modelling: a case study in older people’s views on implementing the NICE falls prevention guideline. *BMC Health Services Research* September (2021) 21:1020; DOI: 10.1186/s12913-021-07056-1.

JK conceived the research idea. All authors were involved in the design of the qualitative research. JK and JH recruited participant groups. JK and YL conducted the focus groups and interviews for data collection, transcribed the audio recordings and conducted thematic analysis. All authors were involved in the manuscript writing process and read and approved the final published article.

**Appendix C:** Kwon, J., Squires, H., Franklin, M., Lee, Y., and Young, T. Economic evaluation of community-based falls prevention interventions for older populations: a systematic methodological overview of systematic reviews. *BMC Health Services Research* (2022) 22:401; https://doi.org/10.1186/s12913-022-07764-2.

JK conceived the research idea. JK and YL conducted the systematic search for study identification and appraised the reporting and methodological quality of included studies using a checklist. JK conducted other data extraction and synthesis. JK wrote the first manuscript draft. JK, HS, TY and MF contributed to the writing of subsequent drafts until manuscript submission. All authors read and approved the final manuscript.

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JK conceived the research idea; all authors were involved in the systematic review design. JK and YL conducted the systematic search for study identification and data extraction. JK wrote the first manuscript draft. HS, TY and MF contributed to the writing of subsequent drafts. All authors read and approved the final manuscript.

**Chapter 4:** Kwon, J., Squires, H., Franklin, M., and Young, T., 2021. Systematic review and critical methodological appraisal of community-based falls prevention economic models. *Cost Effectiveness and Resource Allocation* (2022) 20:33; https://doi.org/10.1186/s12962-022-00367-y.

JK conceived the research idea. JK wrote the first manuscript draft. HS, MF and TY were involved in the writing of subsequent drafts. All authors read and approved the final manuscript.

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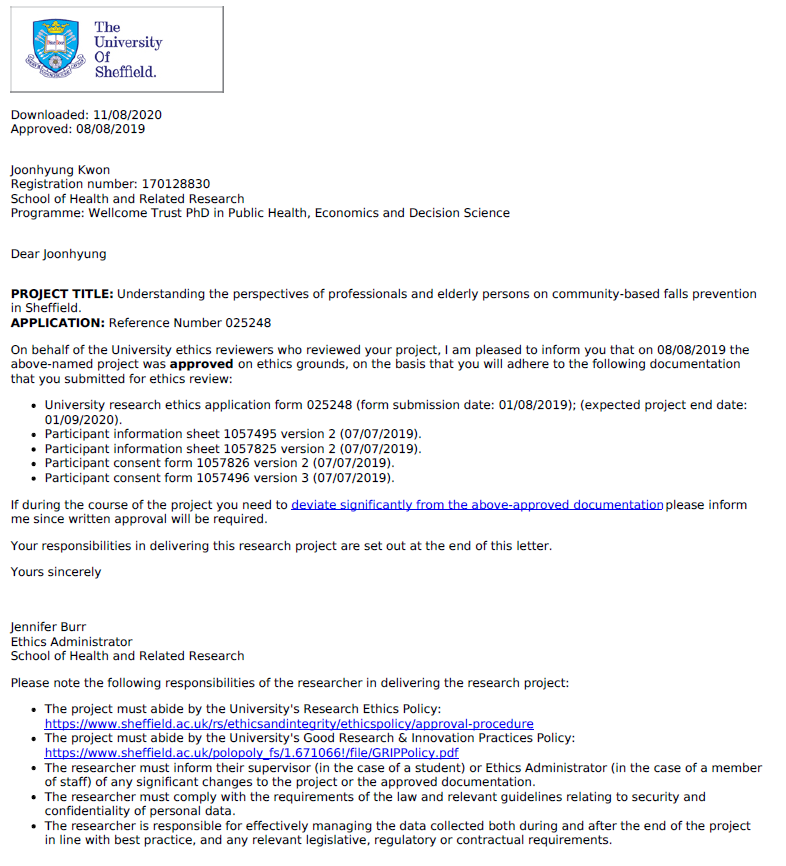
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# Appendix A: Qualitative study in Sheffield

## Research ethics approval

Note that the original ethics approval covered focus groups and interviews with professionals as well as older persons in Sheffield. Research with professionals was not implemented due to insufficient professional interest and the Covid-19 pandemic.



## Participant information sheet

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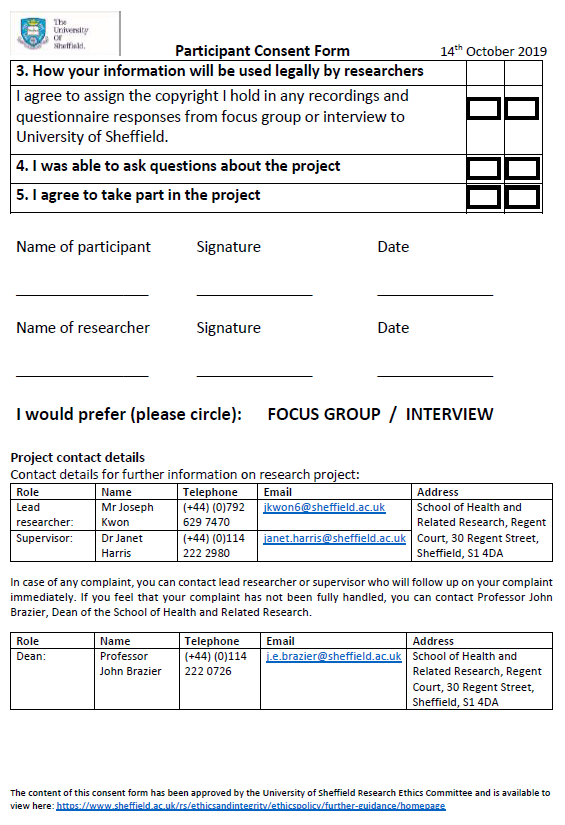
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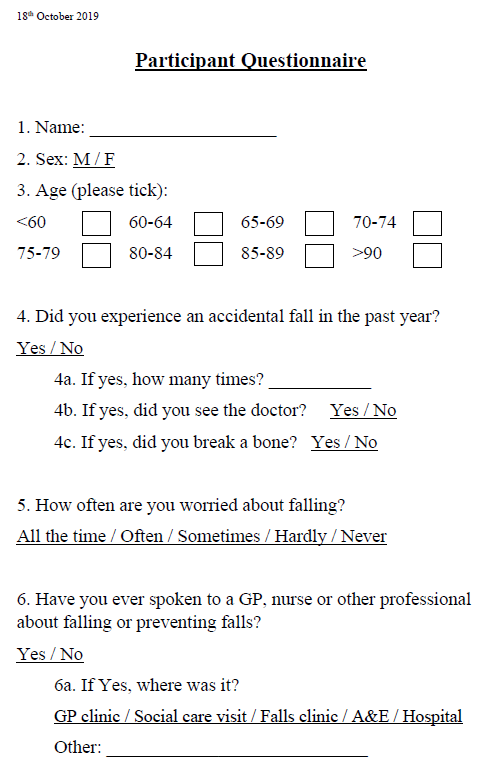
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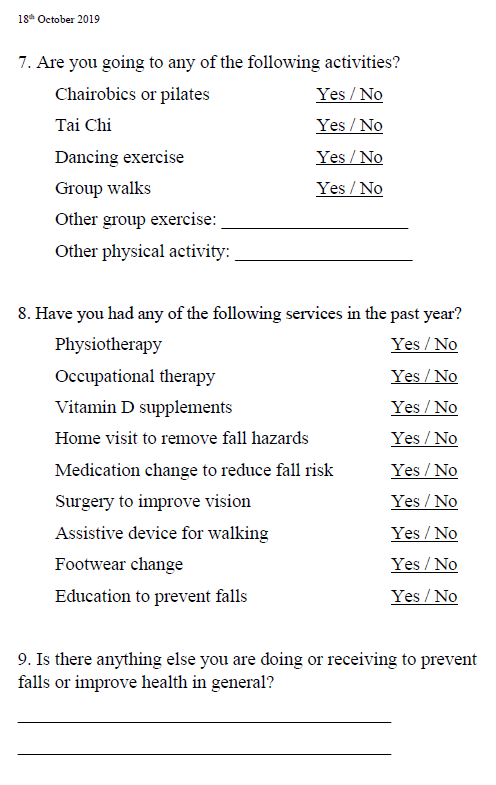
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## Informed consent form



## Participant questionnaire





## Topic guide

**Discussion [40 minutes]**

So we will now move to the group discussion part of the day. Is everyone OK with that? We will start recording this part

[Turn on Recorder; State focus group date and venue]

The first part of the discussion will about journey you or others have taken or might take *before* taking part in any falls prevention treatment. So that concerns issues to do with talking with NHS or social care professionals about the risk of falling and being referred to services or activities. Or you could refer yourself to services – then it’s about how people come to recognise their risk of falling.

The second part of our discussion will be about what things help you take up these activities or services – regardless of whether you were referred by professionals or self-referred – and then about what keeps you taking part in them and completing them.

* Things that make take-up easier might be: good transport to exercise classes; free equipment for home changes; short waiting times for surgery; your GP being aware of your needs
* Things that helped completion might be: having a personalised exercise programme; having understanding instructors; having social contact through group exercise or group walks

If you could also think about what makes take-up and completion difficult

* Things that make take-up harder might be: bad timing for exercise classes; bad location for exercise classes; you don’t want changes to your home; patronising tone of professionals
* Things that didn’t help might include: cold weather; no space for exercise at home; cost of maintaining home equipment

Topic 1: Falls risk identification

So as I mentioned we will talk first about our journey towards falls prevention treatment.

**Q1.** Falls risk screening/assessment by professionals: What was the experience like or what would it be like of talking with your GP or any other care professional about your risk of falling?

1. Do you think NHS is right to ask about falls and testing people’s risk even before they experience a serious fall? If not, why not?

[Maximum 8 minutes]

**Q2.** Falls risk awareness: Besides through the NHS, how else do you think we can raise awareness of falls and falls prevention among senior persons in Sheffield?

1. Would you say this awareness is high in Sheffield?

[Maximum 8 minutes]

Topic 2: Falls prevention treatments

So we will now move on to the second part about falls prevention treatments – taking them up and completing them.

**Q1.** What are, or what would be, the things that help you take up any of these falls prevention treatments? [Which things didn’t help or wouldn’t help you take part?]

[If required, remind examples of enablers and barriers to participation]

1. How important were, or would be, professional recommendation from GP, nurse, consultants or care workers? Would you simply refer yourself to treatments?
2. Would you recommend any of the treatments to your friends? If they are not so keen, how would you persuade them to take them up?

[Maximum 12 minutes]

**Q2.** Suppose you are already participating in a treatment like exercise [Dance to Health]. What are, or what would be, the things that help you complete the programme and make it your own? [What were, or what would be, the things that doesn’t help you complete the programme?]

[If required, remind examples of enablers and barriers to adherence/completion]

1. How important were, or would be, professional help?
2. How would you motivate your friends to complete the programmes?

[Maximum 12 minutes]

**Conclusion [5 minutes]**

That’s done! Thank you once again for taking part in this research. We will ensure that your private information is kept safe. I’m sure the NHS and the Council will be very grateful to hear your views on this topic. And don’t forget to pick up your shopping vouchers and travel expenses!

## Framework (II): Potential commissioning strategies

Diagram

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**Figure A1** Combined CICI-HNA framework for organising qualitative data. **Abbreviation**: CICI: Context and Implementation of Complex Interventions. HNA: Health Needs Assessment.

The CICI framework highlights eight domains of context, ranging from the immediate intervention setting to political influences [1]. Context influences the implementation mechanisms of provider, organisation, funding and health system-wide policy, shown in the ‘Supply’ circle of the HNA Venn diagram. Providers and organisations are micro- and meso-level entities delivering the commissioned interventions. Funding supports these entities as well as wider, auxiliary implementation strategies (e.g., community marketing to influence demand). Policies concern macro-, system-level changes to facilitate implementation (e.g., changes to GP reimbursement structure to facilitate regular falls risk screening). The implementation context also presents priority setting challenges to the decision-maker. The three main priority setting criteria highlighted by an international panel of experts and stakeholders are reducing social inequities of health, prioritising the frailest and reducing the non-health costs [2].

The key consideration for formulating commissioning strategies is the decision space that defines which contextual factors and mechanisms are modifiable and to what extent. The decision space is determined by the combination of context and priority setting challenges, range of stakeholders involved, decision time horizon, and any budget and capacity constraints. For example, improving professional competence requires the cooperation of professional training institutions and may not be feasible in the short run; conversely, changing housing regulations may be feasible if the local Council and housing associations are actively involved in decision-making. The decision space may be largely pre-established prior to the qualitative study; the qualitative findings may also inform the decision space.

Intervention need/eligibility in the HNA Venn diagram is chiefly determined by normative clinical and public health guidelines and intervention studies that have demonstrated the ability to benefit from the interventions [3]. Yet, eligibility may fall within the decision space if there is flexibility in how the criteria are applied. The CG161, for example, does not prescribe any specific care pathway for cognitively impaired persons [4]; hence, the commissioners may design a locally specific pathway. Framework (II) similarly sought major determinants of demand including personal factors underlying uptake/adherence decisions (e.g., health-related motives for healthy behaviour [5]) and external influences on demand (e.g., community marketing, self-efficacy promotions [6, 7]). The implications on commissioning were inferred from the types of demand-side factors and whether these fall within the decision space.

## Facilitators and barriers to the falls prevention pathway

|  |  |  |
| --- | --- | --- |
| **Table A1** Transcript quotes for themes regarding facilitators and barriers to the falls prevention pathway components | | |
| **Pathway component [Theme #]** | **Facilitator [Theme #]** | **Barrier [Theme #]** |
| Falls risk screening and assessment by professionals [1] | **General approachability of professionals [1-1]**  (FG4) “Well, I haven’t had an experience [of talking about falls], but I think my GP is very open for me to go and talk to them about it. I don’t think it would be a problem.” | **Lack of proactive professional approach [1-5]**  (INT2) “I think [the professionals] ought to check things like stairs and back steps. And not expect the older people to report it, because they are probably so used to these things when they’ve lived in the house all the time and are not necessarily aware of how less well coordinated they are from before.” |
| **Proactive, data-based approach to risk screening [1-2]**  (FG1) “And with regards to hooking people in, when flu jab time comes up, we all get a text or a message or we get told that we need a flu jab. So, follow that lead. I’m sure there’s a record showing age groups and then tell them ‘Look, this service is available. Come on in!’” | **Lack of professional attention to environmental risk factors [1-6]**  (FG1) “I’d think it was important if somebody went to a health professional, the health professional would check on a whole lot of background information apart from immediate health thing – you know, what is your living, housing situation.” |
| **Specialist expertise and equipment [1-3]**  (FG4) “[The Falls Clinic] is very impressive because you have a very detailed session with the professionals, and they ask you about all sort of things to do with your history. And from that, I got adaptation to my house. And I got the stick that I walk with.” | **Time constraint in routine practice [1-7]**  (FG4) “But after that fall, I went to the doctor, and they checked blood pressure and it was lower than required. But they didn’t give any medication. After that, about two weeks ago, again I started feeling I’m losing my balance at times [...] and I [went] to the doctors; but they only had 10 mins and they said they can’t check all these things but, at the same time, there was no problem [with balance].” |
| **Older person’s motivation to maintain health [1-4]**  (FG4) “If I was at risk, I would be happy to talk to [the professionals]. Because I would be happy to take any advice on anything that keeps me good as possible for as long as possible, if that makes sense.” | **Older person’s lack of falls risk awareness [1-8]**  (FG2) “Well, most of the people seem to…well, they haven’t got a problem of falling. They don’t consider it. So, they don’t sort of think about it.” |
| Raising awareness of falls risk [2] | **Awareness from earlier life-course stage [2-1]**  (FG1) “It’s not an over-65 issue. I’m under 65. I have issues. There’s quite a few of us here, I’m sure, that would benefit from [falls risk awareness].” | **Lack of awareness of the ageing process [2-3]**  (FG1) “Well, it happens so gradually, doesn’t it… when it is part of ageing and degenerative thing, it’s not like they go over night from being perfect to being in a wheelchair. It’s such a gradual thing. And you get used to stuff. You get used to the fact that the rug was curled up at the end.” |
| **Awareness of falls risk by informal caregivers [2-2]**  (INT1) “But my carer, who is a close friend, found [a non-protruding bed] for me on eBay. She could hardly get around the bedroom for cleaning. So she was quite aware that I needed to do something about sorting out the bedroom furniture.” |  |
| Initial uptake of falls prevention treatments [3] | **Older person’s experience of falling [3-1]**  (FG3) “I started coming [to falls prevention intervention] because of a fall. I had a dramatically awful fall and it’s just about a year ago. I was in hospital for 12 days and I had three carers a day for ages.” | **Older person’s lack of falls risk awareness [3-15]**  (FG4) “The only time I had fallen over is if I’m standing up suddenly. I go dizzy and I had a blackout and fall over. The nurse at the medical centres offered for me to go on a course to avoid falling. But I thought it wasn’t really necessary because I only fall in *that* situation. So I didn’t go on the course. I just have to be careful when I stand up.” |
| **Older person’s experience of the physical ageing process [3-2]**  (FG2) “Before taking up [falls prevention exercise], I was virtually stiff with arthritis and I didn’t get much exercise at all. And I was getting less and less…more relying on my husband to do everything.” | **Low motivation of older persons [3-16]**  (INT1) “[At the residence meeting] I talked about Dance to Health and what it is and said if anybody wants to come with me then just get in touch. But it hasn’t produced anybody. There just seems to be so much apathy now.” |
| **Older person’s motivation to maintain health [3-3]**  (FG4) “I will look for something because I know how important it is that I keep myself as healthy as I can possibly do.” | **Lack of information in community [3-17]**  (FG3) “I think that’s the biggest drawback. It’s getting people here. Because I can’t remember how I first heard [about the intervention].” |
| **Community marketing [3-4]**  (INT1) “Well, I always kept an eye out for the noticeboard in the sheltered scheme – and there was what you might call a flyer about the meeting for dancing in the city centre. I think it was at the library. So I went to that out of interest, and it turned out to be a flyer for the [falls prevention exercise] group I ended up with.”  (FG3) “I’ve started down this route through U3A, the University of the Third Age, which I am a member of.”  (FG3) “[Researcher: How can we increase uptake?] A poster in a library. Some sort of that will help. Or in the post offices. Somewhere people go.” | **Barriers related to socioeconomic class [3-18]**  (FG3) “I think it’s the actual area, and I do actually think it’s class related in terms of whether people would actually get up and go to something even if it’s advertised, unless there’s somebody actually suggesting having it up in GP surgeries.”  (INT1) “Group exercise in my view is quite a middle-class activity, and there isn’t much of a middle-class attitude here. One-to-one exercise might be most likely to get [non-middle-class individuals].” |
| **Peer recommendations [3-5]**  (FG3) “About two years ago, I was diagnosed with various diseases which did impact my balance quite considerably. A friend, a mutual friend, here today, suggested to me that something that might help would be Dance to Health. So, I came on and tried that.” | **Linguistic barriers to information uptake [3-19]**  (INT1) “Part of the problem is, some of the people here, I can’t communicate with anyway because they can’t speak English. And they don’t come to [the sheltered scheme residents’] meeting – no point coming if you can’t speak English.” |
| **Marketing health benefits of interventions [3-6]**  (FG1) “You have to make people realise the benefit of [exercise]. Especially the quality of their health. So you have to sell the benefit of exercise to the people. And make them realise that by doing that exercise it doesn’t only bring you the short-term benefits but medium- and long-term benefits.” | **High intervention cost [3-20]**  (FG3) “Alright, for us [exercise attendees], five pounds [per week] might be nothing, but if all of your expenses are coming from pension, five pounds is a lot!”  (FG1) “The government says everyone is obese and more exercises is needed and everything. And then there’s things like paying for swimming lessons.” |
| **Intervention is free/cheap [3-7]**  (INT1) “I mean we pay five pounds per session at [falls prevention exercise]. If you turn it around and say you get paid five pounds then that might be more interesting!” | **Inconvenient timing of intervention [3-21]**  (FG4) “Well, I know that there is a Pilates class here [local community centre]. It’s just not on the very good day for me.” |
| **Intervention is enjoyable [3-8]**  (FG3) “I do think people would find the three odd pounds if they found [the intervention] absorbed them and really interested them.”  (FG2) “Basically, I’ve always done dancing since I was 4. I’ve always danced. I wanted something that was going be suited my needs, really. Dance to Health seems to offer that. It really has made a huge difference to me.” | **Lack of safe venues for intervention [3-22]**  (FG4) “[The Pilates teacher] had a studio with stairs going to it and no handrail. And I just can’t, because I had my accident on steps, I really feel nervous at getting up at any steps without something that I can hold onto.” |
| **Intervention is of suitable difficulty [3-9]**  (FG2) “What kept me going was the fact that when I retired, a few people retired with me and they started in a [gym] group and things like that. And there was no way that I could’ve joined in anything like that. So, I came [to the falls prevention exercise group] instead.” | **Transport access and cost issues [3-23]**  (FG3) “If it’s planned properly and they are in the right places and people can get to them… this is the main thing that’s preventing people – people who would like to come but who can’t get here because they haven’t got their own transport.”  (FG1) “And also, money and transport, not a lot of us can afford to go, because it’s usually, what, a fiver to get you where you want to go and back and return. Not a lot of people can afford to. When you are on universal credit or job seeker’s allowance and benefit, I think when you’ve got a disability like I have long enough. I think it should be like the over 60s [person was under 60], they have a bus pass.” |
| **Intervention is safe [3-10]**  (INT2) “[At dementia-friendly walking groups] you’ve got people there who are ready to deal with an emergency.” | **Lack of professional awareness of community initiatives [3-24]**  (FG3) “What I think probably one of the problems is… like the health professionals, they don’t know what’s going on sometimes, do they?” |
| **Intervention is conveniently located [3-11]**  (INT2) “[The Pilates course is] just at the library around the corner and it is definitely meant for older people.” | **Commandeering attitude of professionals [3-25]**  (FG1) “So [the home visit professionals] came and they said ‘Right. We want. That carpet. We don’t want your rugs down. We don’t want that. You want another arm rail.’ And it invaded [my mother’s] space.” |
| **Professional recommendations are more important than peer recommendations [3-12]**  (INT1) “[Researcher: Do you think professional recommendation to exercise would be more effective than peer recommendation?] Yeah I think that might be more effective.” | **Reactive professional approach [3-26]**  (FG2) “I’ve got loads of medication variation problems. For me, I don’t really expect GPs to improve things, but they never told me ‘Oh we could change this into that’. He [the GP] just expects me to just keep pre-ordering the medications. So I leave it that way.” |
| **Professional awareness of community initiatives [3-13]**  (FG3) “When I was having as many as things I’ve had, I had to see Professor [name] at Hallamshire [Teaching Hospital]. So actually, I sent him details of [Dance to Health] and he wrote me to send me a very brief letter back saying ‘Thank you for this. I think I can put this to my other patients who have got a similar thing.’” | **Mismatch between area-based demand and supply [3-27]**  (FG3) “Now, to be honest, this [well-off] area doesn’t usually have anything. You know, I mean, all the money and the grant has been put into only deprived areas.” |
| **Person-centred professional referral [3-14]**  (FG1) “One person when we had a meeting found out that so many doctors were handing out too many drugs instead of an alternative. There was an alternative. [My doctor at surgery] said, ‘I’d want you to go and do an aquarobics’ and that helped me, that helped me so much that I didn’t need the drugs.” |  |
| Long-term adherence to falls prevention treatments [4] | **Older person’s motivation to maintain health [4-1]**  (FG3) “Wanting to maintain what you’ve got. Not wanting to lose your independence. And hang on [to] independence as long as possible because I live alone as well.” | **Older person’s illness and comorbidities [4-10]**  (FG4, Person 4) “Well, I used to go swimming a lot every week. But then, since a long period of illness, I stopped going.”  (FG4, Person 1) “I used to go swimming but I have a problem with IBS [Inflammatory Bowel Syndrome]. It’s one of the things that seems really hard to talk about, IBS, but it does affect one’s ability to exercise in all sorts of fields, particularly, swimming.” |
| **Experience of intervention reducing falls risk [4-2]**  (FG3) “Occasionally you’d feel you are going to fall over. You’d look drunk. But with doing [Dance to Health], it’s has now virtually gone and I haven’t had an attack over a year. I put it down the balancing techniques learnt in these classes. So, for me, with that particular condition, it’s been absolutely invaluable.” | **High intervention cost [4-11]**  (FG4) “Yes, I used to go to Pilates class, but I didn’t go for very long. But to my circumstances, I just couldn’t really afford to go. You know, five pounds an hour was a lot more than my budget allowed for.”  (FG1) “Everything comes down to costs. You can’t afford to go to gym or you can’t afford to keep [going to] fitness class. Everything comes down to whether you can afford to go.” |
| **Experience of wider health benefits of interventions [4-3]**  (FG2) “Lots of my family have noticed the difference in my posture, in my walk; things like, I used to struggle bending down, picking things up from the floor. It gets you down. It affects your mental health. So yeah, my family have noticed a huge difference.”  (FG1) “You’ve got satisfaction [from exercise] that you were feeling better without being pumped [with medications]. These exercises mean so much to me and it’s real.”  (FG3) “I gave up driving for a quite considerable time but now I have gone back driving because I feel I am a safe person on the road. And because of Dance to Health and these other factors, I now feel that my balance is… it’s not brilliant but it’s 500% better than it was.” | **Intervention is of unsuitable difficulty [4-12]**  (FG3) “[The GP] set up [a programme] for people to stop falls. And I was in a group of about 8 people. And it was like a small version of going to the gym. And I went to that once and then I postponed it because it’s too hard for my hands.” |
| **Intervention is enjoyable [4-4]**  (INT2) “Well people do tend to drop off if it’s boring stuff. I was given a sheet of exercises for home use but it’s boring. It’s much more pleasant in a group, you know.” | **Intervention is not individually tailored [4-13]**  (FG1) “If you go to like a leisure centre [Pilates] class or whatever, sometimes it might be 30 or 40 people in the room. And particularly if you’ve got a medical condition, they can’t give you that attention. You might be worried you are doing more harm than good, if they can’t direct correctly.” |
| **Intervention enables high social participation [4-5]**  (FG2) “A friendly group. It’s important. It’s not clinical. And it makes you want to come back and exercise.”  (INT1) “The other thing is the social side, the social contact. Everybody is obviously enjoying themselves and quite often says so. And so many good friendships being made. So there is a really active social side to it.” | **Inconvenient timing of intervention [4-14]**  (FG1) “And they altered the day [for Yoga classes]. So the day came and I couldn’t go anymore.” |
| **Intervention is individually tailored [4-6]**  (INT1) “If I’m having a bad morning, not moving all that well, I’m quite happy to tell [the instructor], and she’s quite happy to know that and take that into account when we do the exercises.” | **Transport access issues [4-15]**  (INT1) “Well, before I started taking the taxis regularly, I used to go by bus – and there were some difficulties. The bus didn’t always turn up and didn’t always stop.” |
| **Availability of staff [4-7]**  (INT2) “But with these walks which are organised by the Alzheimer’s Society is that there are qualified people leading the walks.” | **Lack of professional and volunteer staff [4-16]**  (FG1, Person 9) “And then this, um, Yoga teacher. She was an older lady. They sacked her because, they said, she was too old, and she was an absolute gem! They wanted a younger environment and person.”  (FG1, Person 1) “Volunteers have been cut down [for walking group]. A lot of volunteers have given up. We used to have two. But we only have one now. And if that one person is sick, then there won’t be a leader. Then we are just left walk ourselves. So the volunteers have [left]. They don’t get paid for it. They are just volunteering.” |
| **Proactive professional approach to sustain adherence [4-8]**  (FG3) “I think [the physiotherapist] was supposed to only come twice. But ended up with six times. And then she passed it onto a junior therapist. So, what they were doing was trying to check that I was doing it properly.” | **Insufficient public sector funding [4-17]**  (FG3) “They definitely got us [to enrol on falls prevention exercise] on the grant. So we didn’t pay when we started. There were a lot of pilot schemes all over Sheffield. And then the money ran out. We decided that we wanted to carry on and the church has been very supportive.”  (FG4) “I paid to go to physio privately because I will never be referred to go. I’ve got arthritis like everybody else. They are being referred to have physio on the NHS. They won’t continue with it. Whereas if you pay, you can go regularly.” |
| **Good professional-participant relationship [4-9]**  (INT1) “She [the Dance to Health instructor] goes out of her way to have friendly relationship with everyone that goes. And I think it works. You always get a cuddle when you arrive. And she always shows interest in you, what you are doing and what difficulties you have, and so on.” |
| **Abbreviation:** FG: focus group; INT: interview | | |

## Mapping, re-mapping and interpretation of themes across thematic frameworks

Diagram

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**Figure A2** Themes mapped and re-mapped across three thematic frameworks and interpreted for commissioning and modelling. **Abbreviation**: TC: thematic category.

## Contextual factors influencing the falls prevention pathway

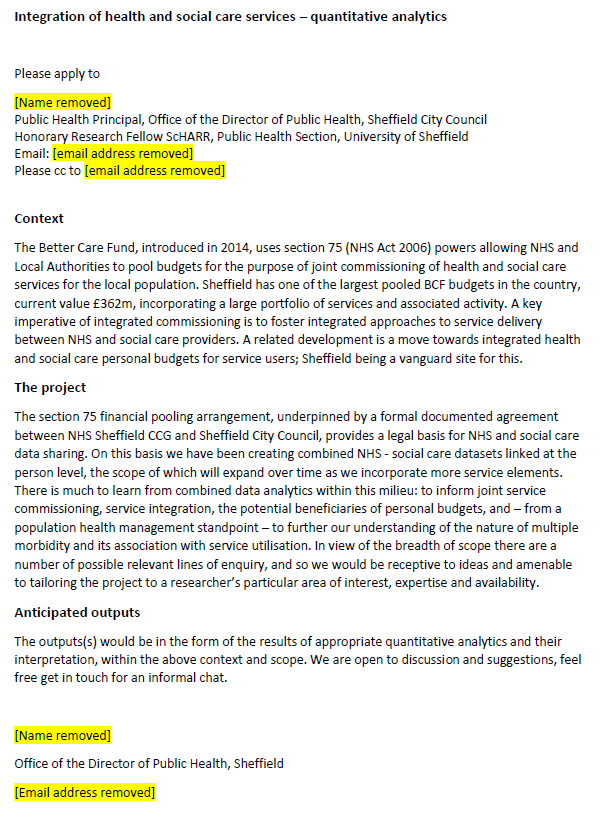
|  |  |
| --- | --- |
| **Table A2** Transcript quotes for contextual factors influencing the falls prevention pathway | |
| **Intersectoral issues [Theme #5]** | **Prioritising the vulnerable groups [Theme #6]** |
| **Safety concerns with local public spaces [5-1]**  (FG1) “And there’s lots of trees. And they all have shrubs cut. And they don’t sweep them up. And then they rot. And it’s right by the doctor’s surgery and I can’t tell you how many people have fallen there. People are frightened to go out in Autumn and Winter.”  (FG4) “We go up on the park and a lack of handrails on the steps. It’s just absolutely atrocious! There are certain steps which are quite steep, not handrails in sight.” | **Persons with complex comorbidities [6-1]**  (FG1) [Participant was aged below 65 and had diabetes-related complications that impaired her mobility, vision and mental health] “If I had a bad day with my high sugar levels. I’ve had my bad day with blurriness. And I come down a lot of stairs and I fell X times coming down from attic and obviously coming out of my building which is a high old building. And then you’ve got to come down some more which is always full of leaves.” [Despite this, public support was denied:] “I’ve just been through an [housing] assessment and it got turned down saying that I’m capable of doing everything for myself, saying ‘you can walk up to 100 meters without any problem’” [Other professionals were similarly disorganised:] “And I do mention [the falls risks] every time to my doctor and it’s the same thing every time: ‘Has anybody contacted you? Has a care worker contacted you?’” |
| **Health-promoting local public spaces [5-2]**  (FG1) “[In Hong Kong,] every building, at the bottom, they’ve got like an exercise machines and little gardens. And there’s old people doing exercises and they are getting together as well.” | **Persons experiencing cognitive decline [6-2]**  (INT2) [Participant was recently diagnosed with Alzheimer’s disease and experienced falls when she did not take her food supplements at the appropriate dose. But she repeatedly received lower dose and then faced difficulties in having the dose corrected:] “When it’s known that you have Alzheimer’s… People just shy off. You can very easily not be taken seriously if you make a fuss. You have to be very measured and careful in what you say.” |
| **Home ownership and modification [5-3]**  (FG4) “And I couldn’t [modify my house] because I live in a rented property. It’s not mine. I’m not allowed to do anything.”  (FG1) “Landlords haven’t really got time to be doing stuff like that [making sure stairways in house are safe.]” | **Socially isolated persons [6-3]**  (FG4) “I just think the main thing is I’ve got to try to make myself as healthy as I can, because you know, there’s only me to look after me. There isn’t anyone else. So, I’ve got to do best I can.” |
| **Communitarian approaches [5-4]**  (FG1, Person 5) “It would also be nice to raise… something like a funding for a charity so that we can all meet to raise motivation and participate.”  (FG1, Person 9) “I don’t think neighbours are neighbours anymore, either. When we were younger, I remember when snow came here, all the men of each family would come and make a path. And they don’t do that now.” |  |
| **Abbreviation:** FG: focus group; INT: interview | |

# Appendix B: Developing the conceptual model

## Documentations for the conceptual model development

### Document 1: Project proposal by the Sheffield City Council Public Health Principal

Date received: 23rd May 2018



### Document 2: Meeting regarding CCG routine data access

Date: 20th September 2019

Text

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### Document 3: Discussion with the Public Health Principal

Date: 16th October 2018

Text

Description automatically generated

### Document 4: Sheffield CCG Falls Planning Group

Date: 24th October 2018

Graphical user interface, text, application

Description automatically generated

Text

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### Document 5: Discussion with Sheffield City Council health economist

Date: 8th March 2019

Text

Description automatically generated

### Document 6: Discussion with falls modelling expert

Date: Meeting took place on 11th October 2018

Text, letter

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### Document 7: Discussion with PT and OT leads at Sheffield Teaching Hospitals

Date: 2nd April 2019

Text, letter

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### Document 8: Response to independent scientific review

Date: 28th November 2018

Text

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Text

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Text

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### Document 9: Discussion with falls specialist geriatrician

Date: Meeting with the falls specialist geriatrician took place on 4th October 2018 and the visit to the Sheffield Falls Clinic took place on 22nd October 2018

Text

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Text

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### Document 10: Results of preliminary ELSA analysis

Table

Description automatically generatedDate: 11th September 2019

Text

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A picture containing table

Description automatically generated

A picture containing table

Description automatically generated

Graphical user interface, text

Description automatically generated

Chart, box and whisker chart

Description automatically generated

Table

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A picture containing table

Description automatically generated

Table

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### Document 11: List of falls prevention interventions in Sheffield

Date: 5th December 2018

A picture containing timeline

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### Document 12: Notes on the Sheffield Perfect Patient Pathway report

Date: 5th November 2018

Text

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### Document 13: Age UK Sheffield falls prevention

Text

Description automatically generatedDate: 10th January 2019

## UK guidelines on community-based falls prevention

|  |  |  |
| --- | --- | --- |
| **Table B1** Summary of the recommended falls prevention pathway in the UK community setting based on clinical and public health guidelines. | | |
| **Pathway** | **Reference** | **Recommendation** |
| Reactive pathway | NICE CG161 [1.1.2.1] | * “Older people who present for medical attention because of a fall should be offered a multifactorial falls risk assessment.” |
|  | NICE CG161 [1.1.3.2] | * “Following treatment for an injurious fall, older people should be offered a multidisciplinary assessment to identify and address future risk and individualized intervention aimed at promoting independence and improving physical and psychological function.” |
|  | NICE CG161 [1.1.6.1] | * “Older people who have received treatment in hospital following a fall should be offered a home hazard assessment and safety intervention/modifications by a suitably trained healthcare professional. Normally this should be part of discharge planning and be carried out within a timescale agreed by the patient or carer, and appropriate members of the health care team.” |
| Proactive pathway – Falls risk screening | NICE CG161 [1.1.1.1]1 | * “Older people in contact with healthcare professionals should be asked routinely whether they have fallen in the past year and asked about the frequency, context and characteristics of the fall(s).” |
|  | NICE CG161 [1.1.2.1] | * “Older people who report recurrent falls in the past year or demonstrate abnormalities of gait and/or balance should be offered a multifactorial falls risk assessment.” |
|  | NICE CG161 [1.1.1.2] | * “Older people reporting a fall or considered at risk of falling should be observed for balance and gait deficits [using balance and gait tests] and considered for their ability to benefit from interventions to improve strength and balance.” |
|  | NICE CG161 [Section 3.3] | * Tests for balance and gait which can be used in any setting include Timed up and go (TUG) test and Turn 180. Clinical expertise is still required for setting the cut-off levels. |
|  | NICE SR  [p. 4] | * Tools based on clinical characteristics may lack sensitivity and/or specificity. New technologies may improve gait assessment. * There is a need to include frailty and fracture history as risk factors for falls. These may not predict falls risk but fall injury severity. |
| Proactive pathway – Falls risk assessment within multifactorial intervention | NICE CG161 [1.1.2.1] | * “[Multifactorial risk assessment] should be performed by a by a healthcare professional with appropriate skills and experience, normally in the setting of a specialist falls service. This assessment should be part of an individualized, multifactorial intervention.” |
| NICE CG161 [1.1.2.2] | * Multifactorial assessment may include the following: identification of falls history; assessment of gait, balance, mobility and muscle weakness; assessment of osteoporosis risk; assessment of the older person’s perceived functional ability and fear relating to falling; assessment of visual impairment; assessment of cognitive impairment and neurological examination; assessment of urinary incontinence; assessment of home hazards; cardiovascular examination and medication review |
| NICE CG161 [Section 3.3] | * Berg balance test, Tinetti scale, Functional reach and Dynamic gait test offer more detailed assessment and higher diagnostic value but take longer to administer and need both equipment and clinical expertise. They are hence recommended for multifactorial risk assessment. |
| NICE CG161 [1.1.3.1] | * “All older people with recurrent falls or assessed as being at increased risk of falling [from multifactorial assessment] should be considered for an individualized multifactorial intervention.” |
| Proactive pathway – Therapeutic treatments within multifactorial intervention | NICE CG161 [1.1.3.1] | * “In successful multifactorial intervention programmes the following specific components are common: strength and balance training; home hazard assessment and intervention; vision assessment and referral; medication review with modification or withdrawal.” |
| NICE CG161 [1.1.4.1] | * “Strength and balance training is recommended. Those most likely to benefit are older people living in the community with a history of recurrent falls and/or balance and gait deficit. A muscle-strengthening and balance programme should be offered. This should be individually prescribed and monitored by an appropriately trained professional.” |
| PHE Consensus  [p. 15] | * “To be effective, [strength and balance exercise programmes] should comprise a minimum of 50 hours or more delivered for at least two hours per week. They should involve highly challenging balance training and progressive strength training. […] At the end of the programme, older people should be assessed and offered a range of follow-on classes. These should suit their needs and abilities, include strength and balance, and support their progression.” [References omitted.] |
| NICE CG161 [1.1.7.1] | * “Older people on psychotropic medications should have their medication reviewed, with specialist input if appropriate, and discontinued if possible to reduce their risk of falling.” |
|  | NICE CG161 [1.1.4.1] | * “Cardiac pacing should be considered for older people with cardioinhibitory carotid sinus hypersensitivity who have experienced unexplained falls.” |
| Self-referred pathway | NICE SR  [p. 4] | * The updated NICE guideline should consider how to encourage people at risk of falls to achieve physical activity level recommended by the UK CMO and how to maintain benefits after the exercise interventions end. |
| PHE Consensus  [p. 12-13] | * “The [UK] Chief Medical Officers [referring to 2011 CMO report] recommend adults aged 65 and older should aim to be active daily and should aim for at least 150 minutes of moderate (or 75 minutes of vigorous activity) per week […] Activities that improve muscle strength, and balance and coordination should be undertaken on at least two days per week and extended sedentary periods should be minimized.” |
| UK CMO  [p. 42] | * “Older adults should maintain or improve their physical function by undertaking activities aimed at improving or maintaining muscle strength, balance and flexibility on at least two days a week. […] Evidence-based strength and balance exercise programmes reduce falls rate and risk, are cost-effective, increase confidence, and can increase habitual moderate physical activity towards meeting the [physical activity] guidelines. They can be group or home-based, and strength and balance activities can be embedded within everyday activities. [References omitted.]” * “Each week older adults should aim to accumulate at least 150 minutes of moderate intensity aerobic activity, building up gradually from current levels. […] For those who are already regularly active, a combination of moderate and vigorous aerobic activity brings greater benefit. 75 minutes of vigorous aerobic activity spread across the week can produce comparable benefits to 150 minutes of moderate intensity activity. [References omitted.]” |
| UK CMO [p. 40] | * “In older adults with frailty, moderate-to-severe dementia, or a history of vertebral fractures or regular falls, it might be more appropriate for any new exercises to be initially supervised by a trained professional, to ensure efficacy and safe techniques to avoid injury.” |
| UK CMO [p. 45] | * “Frailer older adults are those who are identified as being frail or have very low physical or cognitive function […] For this group, more strenuous activities are less likely to be feasible. A programme of activities could focus instead on reducing sedentary behaviour and engaging in regular sit-to-stand exercise and short walks, stair climbing, embedding strength and balance activities into everyday life tasks, and increasing the duration of walking, rather than concentrating on intensity.” [References omitted.] |
| Implementation factors | NICE CG161 [1.1.9.1] | * “To promote the participation of older people in falls prevention programmes the following should be considered: (i) Healthcare professionals involved in the assessment and prevention of falls should discuss what changes a person is willing to make to prevent falls. (ii) Information should be relevant and available in languages other than English. (iii) Falls prevention programmes should also address potential barriers such as low self-efficacy and fear of falling and encourage activity change as negotiated with the participant.” |
|  | NICE CG161 [1.1.9.2] | * “Practitioners who are involved in developing falls prevention programmes should ensure that such programmes are flexible enough to accommodate participants’ different needs and preferences and should promote the social value of such programmes.” |
|  | NICE CG161 [1.1.10.1] | * “All healthcare professionals dealing with patients known to be at risk of falling should develop and maintain basic professional competence in falls assessment and prevention.” |
|  |  | * “Individuals at risk of falling, and their carers, should be offered information orally and in writing about: what measures they can take to prevent further falls; how to stay motivated if referred for falls prevention strategies that include exercise or strength and balance components; the preventable nature of some falls; the physical and psychological benefits of modifying falls risk; where they can seek further advice and assistance; [and] how to cope if they have a fall, including how to summon help and how to avoid a long lie.” |
| **Abbreviation:** NICE CG161: NICE falls prevention clinical guideline [4]; NICE SR: NICE surveillance report [8]; PHE Consensus: falls and fracture consensus statement by Public Health England and National Falls Prevention Coordination Group [9]; UK CMO: UK Chief Medical Officers’ physical activity guidelines [10]  1 For NICE CG161, the numbers in square brackets are the reference numbers used by the guideline to enumerate its key recommendations in p. 13-22. | | |

# Appendix C: Systematic overview of previous systematic reviews

## Section outline

This section aims to conduct a systematic overview of previous systematic reviews of falls prevention economic evaluations. The objectives of the overview are to:

1. Systematically search for and identify previous systematic reviews of community-based falls prevention economic evaluations.
2. Describe the methods and findings of previous systematic reviews, including their aim, search strategy and results, data extracted, quality assessment and commissioning and research recommendations.
3. Critically appraise the methodology of previous systematic reviews and highlight areas of improvement for future systematic reviews.

In this thesis, the overview will inform the methods of the systematic review in Chapter 4. Specifically, learnings from objective (3) will be applied.

This section was accepted for publication in *BMC Health Services Research* in 2021 [11]. The article will be published open access following the requirement of the Wellcome Trust who financially sponsored this work [grant reference 108903/B/15/Z]. The conditions of the open access publishing allow use of the final published PDF, original submission or accepted manuscript in this thesis (including in any electronic institutional repository or database).

The content of this chapter largely overlaps with that of the published article. The latter formulated commissioning recommendations based on the data extracted from previous systematic reviews. Because these overlapped in content with the commissioning recommendations in Chapter 4, they were removed from this section. See Author contributions above for respective contributions.

## Systematic overview methods

A systematic overview uses explicit and systematic methods to identify previous systematic reviews in a topic area [12]. It thus provides the highest level of economic evidence that can inform commissioning decisions as well as the opportunity for critically appraising the methodology of previous systematic reviews, specifically regarding how well they have performed functions (A) and (B) described in Section 4.2. This would improve the methodological quality of: (i) future systematic reviews in the topic area; (ii) commissioning decisions based on the reviews; and (iii) future economic evaluations that utilise the reviews to conceptualise, implement, and improve the evaluation methodologies.

The systematic overview followed the Cochrane guideline on overview of reviews [12] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyse (PRISMA) 2020 guideline [13]; the PRISMA checklist is reported in the Supplementary material of the published article [11]. The review protocol is registered in the Prospective Register of Systematic Reviews (CRD42021234379).

### Data sources and study selection

The search covered the period between January 2003 and December 2020 and 12 academic databases: Medline, Embase, PubMed, CDSR, CENTRAL, EconLit, CINAHL, PsycInfo, ASSIA, CRD, CEA Registry and PEDro. Grey literature studies were searched from online sites of Department of Health, Chartered Society of Physiotherapy, College of Occupational Therapy, Royal College of Nursing and Age UK. The start date was chosen based on background knowledge that the number of economic evaluations before 2003 is low [14]. The search strategy was an intersection between terms for falls, older people, and economic evaluation. All search strategies are presented in Supplementary 1 section below (Tables CS1.1-CS1.8 and text). References and citations of included studies were also searched.

The PhD researcher and Ms Lee independently reviewed the titles and abstracts of identified articles at the first stage and the full texts of approved article at the second stage. Those that received two second-stage approvals were included for data extraction. Prof Young arbitrated in case of disagreement.

Included studies must have conducted a systematic review – i.e., involving the use of explicit, reproducible methodology, comprehensive search strategy and acceptable methods for data extraction and validity assessment of included studies by two or more researchers [12]. Additionally, more than 50% of the review’s included studies must have all of the following characteristics: (i) target population of community-dwelling older persons (aged 60+) and/or high-risk individuals aged 50-59, from any country or sub- or trans-national regions; (ii) intervention(s) designed to reduce the number of falls or related injuries, excluding specific disease rehabilitation (e.g., for stroke) with minor falls prevention component; (iii) any comparator(s); (iv) full economic evaluations (i.e., comparative analyses of interventions in terms of their relative costs and consequences [15]), including single-vehicle evaluations (SVEs) (e.g., alongside RCTs) and decision models; and (v) full text in English.

### Data extraction and synthesis

Following the Cochrane guideline [12], the following data were extracted primarily by the PhD researcher from the included reviews and narratively synthesised: (1) author(s), publication year and review aim; (2) search strategy and results – period, databases, eligible study designs, eligible interventions, other eligibility criteria, and number of economic evaluations identified; (3) reference and characteristics of economic evaluations identified by reviews; (4) data fields extracted from economic evaluations by reviews; (5) methods and results for quality assessment of economic evaluations by reviews; and (6) commissioning and research recommendations made by reviews.

### Quality assessment of previous systematic reviews

As recommended by the Cochrane guideline [12], the 16-item AMSTAR 2 checklist [16] was applied independently by the PhD researcher and Ms Lee to assess the reporting and methodological qualities of previous systematic reviews. Items 2, 9 and 13 in the AMSTAR 2 checklist that concerned the systematic reviews’ risk of bias assessment of included evaluations were expanded to concern the reviews’ broader methodological quality assessment of the evaluations, i.e., category (5) of extracted data above. This was because risk of bias in effectiveness estimation is only one of many factors determining the evaluation credibility, albeit an important one. For item 8 that concerned whether the reviews extracted ‘adequate detail’ from the economic evaluations, the number of data fields in Table C1 (described below) extracted by the reviews was used to score the item.

The methodological quality of reviews was further critically appraised narratively by the PhD researcher. Specifically, the conceptual model in Chapter 3 was used to establish what methodological features and outcomes (data fields) of falls prevention economic evaluations should be extracted and analysed by the systematic reviews. Further attention was paid to existing expert guidelines on economic evaluation and modelling in falls prevention and other areas [17-21]. Table C1 shows the data fields grouped into higher categories. Strengths and limitations stated by the systematic review authors were also noted by the PhD researcher.

|  |  |
| --- | --- |
| **Table C1** Key data fields that should be extracted and narratively synthesised by systematic reviews of falls prevention economic evaluations. | |
| **Category** | **Data field** |
| (A) Setting, population and evaluation framework | 1. Bibliography: author(s); publication year 2. Setting and aim: country; region; decision-maker; evaluation aim 3. Study design: e.g., decision model 4. Target population/sample demographics and comorbidities: e.g., residence – community-dwelling and/or institutionalised; age; sex; SES; health conditions unrelated to falls risk 5. Type of analysis: e.g., CUA, CEA, CBA, ROI 6. Perspective: e.g., public sector, societal 7. Cost-effectiveness threshold 8. Time horizon of analysis/model 9. Discount rates (if time horizon is longer than 1 year) |
| (B) Falls epidemiology | 1. Target population/sample falls risk factors/profile at baseline 2. Fall type: definition; recording method 3. Health consequences of falls: injury type; long-term consequences (e.g., institutionalisation, excess mortality risk) 4. Health utility measurement: acute vs. long-term impact of falls on health utility; comorbidity-related impact on health utility 5. Economic consequences of falls: care resource types; unit costs; all-cause and fall-related costs1 6. Wider/societal consequences of falls: e.g., social isolation from fear of falling; informal caregiver burden; productivity loss of older persons and caregivers |
| (C) Falls prevention intervention | 1. Intervention characteristics: type (e.g., exercise, multifactorial); reach;2 primary vs. secondary prevention; main components; staff type; duration, frequency and dose; mutual exclusivity;comparator(s) 2. Intervention pathway: type (e.g., reactive, proactive, self-referred); recruitment method; falls risk identification method; mutual exclusivity 3. Intervention resource use: e.g., staff labour and training; transport; overheads 4. Intervention costs: variable vs. fixed costs; economies of scale; societal costs (e.g., time opportunity cost, private co-payment) 5. Intervention implementation: uptake rate; adherence rate; sustainability rate 6. Intervention efficacy: risk of bias in estimation; match with incidence metric;3 efficacy fall type;4 efficacy durability;5 wider health benefits; side effects 7. Intervention study characteristics: study design (e.g., RCT, meta-analysis); population/sample characteristics6 |
| (D) Decision model features | 1. Model type and justification of type 2. Model cycle length and justification of length 3. Methods for adopting a long-term model horizon 4. Methods for characterising baseline demographics and falls risk of target population 5. Methods for characterising multiple falls in a year (recurrent falls) 6. Methods for characterising dynamic progression of falls risk factors, long-term consequences of falls, and falls prevention intervention need 7. Methods for characterising dynamic progression in comorbidities and care costs, mortality risks, institutionalisation risks, and health utilities 8. Methods for incorporating psychological and sociological variables (e.g., motives for healthy behaviour, community institutions) as determinants of falls risk, falls prevention access and model outcomes 9. Methods for incorporating budget and capacity constraints 10. Methods for reducing structural uncertainty of model prospectively 11. Model validation methods/results: face; internal; external |
| (E) Evaluation methods and results | 1. Cost-per-unit ratios (e.g., incremental cost per QALY gained) 2. Aggregate health and cost outcomes (e.g., total intervention cost, total QALY gained, total number of falls prevented) 3. Currency: original type/year; conversion to same currency for comparison 4. Handling heterogeneity: subgroup analyses; targeting analyses (under budget or capacity constraint) 5. Handling parameter uncertainty: deterministic sensitivity analysis; probabilistic sensitivity analysis 6. Scenario analyses: testing structural assumptions; scenario suggestions by stakeholders/decision-maker; value of implementation analysis [22] 7. Equity analyses: intervention impact on social inequities in health; estimating efficiency cost or joint equity-efficiency impact of prioritising vulnerable groups(e.g., via distributional cost-effectiveness analysis (DCEA) [23]) 8. Model cross-validity: comparison of results to previous models |
| (F) Discussions by evaluation authors | 1. Discussion on issues of generalisability and policy implementation 2. Discussion on strengths and limitations of evaluation |
| **Abbreviation:** CBA: cost-benefit analysis; CEA: cost-effectiveness analysis; CUA: cost-utility analysis; QALY: quality-adjusted life year; RCT: randomised controlled trial; ROI: return on investment; SES: socioeconomic status  1 Expert guideline on falls prevention economic evaluation recommends that evaluations report all-cause/total healthcare costs in the base case and fall-related costs in sensitivity analysis [17].  2 Intervention reach refers to the number/proportion of persons in the target population accessing the intervention. It is a function of intervention’s *normative* reach defined by its eligibility criteria and its *implementation* reach determined by implementation level (e.g., uptake rates) within the eligible population.  3 This only concerns decision models that import falls efficacy evidence from external intervention studies. Main falls incidence metrics are falls risk and falls rate, and their matching efficacy metrics are relative risk (RR) and rate ratio (RaR), respectively. Models should ensure that the external efficacy metric matches the internal falls incidence metric.  4 Like note 3, this again only concerns decision models using external efficacy evidence. The fall type (e.g., hospitalised fall, fall-induced fracture) for the efficacy data should match that for the model incidence.  5 Durability of intervention efficacy should not extend beyond the timespan of the intervention study unless the intervention receipt is sustained [17].  6 Decision models should ensure that the characteristics of the external intervention study’s target population/sample (e.g., inclusion/exclusion criteria) match those of the model population. | |

### Formulating commissioning recommendations

The results from a subset of primary economic evaluations were extracted and re-analysed to inform the commissioning recommendations made by the systematic overview. Specifically, outcomes were extracted from general population models (as opposed to models targeting specific patient groups) analysed over lifetime horizons since these are most informative for jurisdiction-level commissioning decisions on falls prevention [17, 24]. Such re-analysis of primary study outcomes is recommended by the Cochrane guideline if this suits the purpose of the systematic overview [12]. Key methodological features likely to influence the model outcomes were considered while formulating the commissioning recommendations. As mentioned in Section outline, because the contents covered here overlapped closely with commissioning recommendations in Chapter 4, the outcomes are presented in Section 4.5.5 and the recommendations in Section 4.6.2.

## Systematic overview results

### Search results

Figure C1 presents the PRISMA flow diagram: 15,715 titles and abstracts were screened; and 55 full texts screened from which seven systematic reviews were identified (two from grey literature and references). Table CS2 in Supplementary 2 lists the 48 studies excluded at the full text screening stage and the reasons for exclusion.

Reports assessed for eligibility

(n = 53)

Reports excluded (n = 48)

Systematic reviews of falls prevention interventions with <50% economic evaluations (n = 16)

General reviews on falls epidemiology and intervention strategies (n = 32)

Reports assessed for eligibility

(n = 2)

Reports excluded (n = 0)

Studies included in review

(n = 7)

Reports of included studies

(n = 7)

**Included**

Reports sought for retrieval

(n = 53)

Reports not retrieved

(n = 0)

Reports sought for retrieval

(n = 2)

Reports not retrieved

(n = 0)

Records screened

(n = 15,715)

Records excluded

(n = 15,662)

Records identified from (n):

Medline (4,009); Embase (2,785); PubMed (8,159); CDSR & CENTRAL (3,107); EconLit (259); CINAHL (1,552); PsycInfo (1,012); ASSIA (462); CRD (61); CEA Registry (100); PEDro (260); **Total (21,766)**

Records removed before screening:

Duplicates removed (n = 6,051)

Records identified from:

Grey literature/Websites (n = 1)

References (n = 1)

**Identification of studies via databases**

**Identification of studies via other methods**

**Identification**

**Screening**

**Figure C1** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram for systematic overview of systematic reviews of falls prevention economic evaluations.

### Methods and findings of previous systematic reviews

The methods and findings are described under the following categories: review aim, search strategy and search result; data fields extracted; quality assessment methods; and commissioning and research recommendations formulated.

#### Review aim, search strategy and search result

Table C2 summarises the aim, search strategy and search results of previous systematic reviews. The reviews shared the aim of assessing the cost-effectiveness evidence within their targeted intervention area. Two reviews specifically targeted community-based falls prevention interventions [25, 26]; three targeted falls prevention in both community and institutionalised settings [14, 27, 28]; and two targeted a broader range of geriatric public health interventions, more than 50% of which were community-based falls prevention interventions [29, 30]. One only included RCT-based evaluations of falls prevention exercise [28]. Several reviews had further aims of informing: the development of the NICE falls prevention clinical guideline [14]; the development of a new falls prevention decision model [26]; the practice of and research on falls prevention exercise [28]; and the methodologies of subsequent falls prevention economic evaluations [27, 29, 30]. All searches covered at least four academic databases, while three further covered grey literature sites.

Overall, the reviews identified 44 economic evaluations of community-based falls prevention interventions, of which 21 were decision models. All SVEs except one [31] were evaluations alongside RCTs. Four models used effectiveness evidence from quasi-experimental or observational studies [32-35]; two used efficacy assumptions [36, 37]; the rest relied on efficacy data from individual RCTs or meta-analyses. The recent decade has seen a significant increase in the evaluation number, rising from nine evaluations identified by the Davis review [25] in 2008 to 26 identified by the PHE review in 2018 [26]. Table CS3 in Supplementary 3 provides the reference and characteristics of identified economic evaluations, including their target population, type(s) of analysis, perspective(s), analysis time horizon, intervention(s) and comparator(s). No evaluation was identified by all seven reviews owing to the varying review search strategies (e.g., different coverage periods).

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| --- | --- | --- | --- | --- | --- |
| **Table C2** Aim, search strategy and search results of previous systematic reviews of community-based falls prevention economic evaluations | | | | | |
| **Review** | **Aim** | **Search strategy** | | | **Search results** |
| **Coverage period** | **Source** | **Target intervention/setting** |
| RCN review [14] | (1) Assess cost-effectiveness of falls prevention interventions (any setting)  (2) Inform the NICE clinical guideline on falls prevention for older people | Database inception to April 2003 | 4 academic databases | Falls prevention interventions in community and extended care | 7 evaluations, of which 5 CB falls prevention including 1 model |
| Davis review [25] | (1) Assess cost-effectiveness of community-based falls prevention interventions | Database inception to July 2008 | 4 academic databases | Community-based falls prevention interventions | 9 evaluations, all CB falls prevention including 3 models |
| DJ review [29] | (1) Assess cost-effectiveness of public health interventions for older people (any setting)  (2) Evaluate methodological features and quality of falls prevention economic evaluations | 2000 to July 2015 | 5 academic databases and 23 grey literature sites | Health promotion and primary prevention interventions (except vaccination) for older people in community and extended care | 29 evaluations, of which 22 CB falls prevention  including 10 models |
| PHE review [26] | (1) Assess cost-effectiveness of community-based falls prevention interventions  (2) Inform development of falls prevention economic model for English community setting | 2003 to December 2016 | 13 academic databases and 7 grey literature sites | Community-based falls prevention interventions recommended by 2013 NICE guideline (CG161) [4]2 | 26 evaluations, all CB falls prevention including 12 models |
| Olij review [27] | (1) Assess cost-effectiveness of falls prevention interventions (any setting)  (2) Evaluate methodological features and quality of falls prevention economic evaluations | Database inception to May 2017 | 6 academic databases and Google Scholar | Falls prevention interventions in community and extended care | 31 evaluations, of which 28 CB falls prevention including 10 models |
| Huter review [30] | (1) Evaluate how economic evaluations of public health interventions for older people (any setting) handled key methodological challenges1 | 2000 to March 2018 | 5 academic databases and 23 grey literature sites | Health promotion and primary prevention interventions (except vaccination) for older people in community and extended care | 37 evaluations, of which 25 CB falls prevention  including 11 models |
| Winser review [28] | (1) Assess cost-effectiveness of exercise-based falls prevention interventions (any setting)  (2) Evaluate implications for clinical practice and future research on falls prevention exercise dosage | Database inception to February 2019 | 6 academic databases | Exercise-based falls prevention interventions evaluated by RCTs in community and extended care | 12 evaluations, all CB falls prevention including 1 model3 |
| **Abbreviation:** CB: community-based; DJ: Dubas-Jakobczyk; NICE: National Institute for Health and Care Excellence; PHE: Public Health England; RCN: Royal College of Nursing; RCT: randomized controlled trial  1 These are: (i) measurement and valuation of informal caregiving; (ii) accounting for productivity costs (including unpaid work); (iii) accounting for unrelated cost in added life years; and (iv) accounting for wider non-health effects of interventions.  2 This excludes interventions such as vitamin D, hip protectors and cognitive behavioural therapy [26].  3 One evaluation developed a decision tree model using data from a single falls prevention trial [38]. This was classified as a trial-based evaluation by Winser review. | | | | | |

#### Data fields extracted by systematic reviews

Table C3 shows the data fields extracted from economic evaluations by previous reviews. There was a marked variation across reviews in the number of data fields extracted, ranging from eight to 33. Data fields for model features were the most limited, restricted to model type and evidence source. No review quantitatively pooled the evaluation outcomes due to significant underlying methodological differences.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table C3** Data fields extracted by previous systematic reviews of community-based falls prevention economic evaluations. | | | | | | | |
| **Data fields1** | **Systematic reviews** | | | | | | |
| RCN [14] | Davis [25] | DJ [29] | PHE [26] | Olij [27] | Huter [30] | Winser [28] |
| ***(A) Setting, population and evaluation framework*** | | | | | | | |
| Author(s) and publication year | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ |
| Country/region | ˟ | ˟ |  | ˟ | ˟ |  | ˟ |
| Study design (e.g., model, RCT) | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| TP/sample residence | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| TP/sample age and sex | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| Type of analysis (e.g., CUA) |  | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ |
| Perspective (e.g., societal) |  | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ |
| Time horizon/Follow-up period |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| Discount rates |  | ˟ |  | ˟ | ˟ |  | ˟ |
| *Number of fields* | 5 | 9 | 7 | 9 | 9 | 3 | 9 |
| ***(B) Falls epidemiology*** | | | | | | | |
| TP/sample falls risk factor(s) |  | ˟ |  | ˟ | ˟ |  | ˟ |
| Baseline falls risk estimates |  |  |  |  | ˟ |  |  |
| Main health event (e.g., fall type) | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| Health utility instrument |  |  |  |  | ˟ |  | ˟ |
| Wider (e.g., non-health) outcomes |  |  |  |  |  | ˟ |  |
| Health and social care consequence types |  | a | ˟ |  | ˟ |  | ˟ |
| Societal consequence types |  | a | ˟ |  | ˟ | ˟ | ˟ |
| All-cause/comorbidity costs |  | a |  |  |  | ˟ |  |
| Cost measurement method in RCT |  |  |  |  | ˟ |  |  |
| *Number of fields* | 1 | 5 | 3 | 2 | 7 | 3 | 5 |
| ***(C) Falls prevention intervention*** | | | | | | | |
| Intervention type | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| Primary vs. secondary prevention |  |  |  | ˟ |  |  |  |
| Intervention components |  | ˟ |  | ˟ | ˟ |  | ˟ |
| Intervention duration |  | ˟ |  | ˟ |  |  | ˟ |
| Exercise intervention dosage |  |  |  |  |  |  | ˟ |
| Professional staff involved |  | ˟ |  | ˟ |  |  | ˟ |
| Comparator |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| Participant recruitment method/setting |  | ˟ |  | ˟ |  |  | ˟ |
| Falls risk identification method |  |  |  | ˟ |  |  |  |
| Intervention resource use |  | ˟ |  | ˟ |  |  | ˟ |
| Intervention cost |  | b | ˟ | ˟ |  |  | ˟ |
| Societal intervention resource/cost |  |  |  |  |  | ˟ | ˟ |
| Intervention fall-related efficacy |  | ˟ |  | ˟ |  |  | ˟ |
| Intervention study sample size |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| *Number of fields* | 1 | 10 | 4 | 12 | 4 | 1 | 12 |
| ***(D) Decision model features*** | | | | | | | |
| Model type |  |  | ˟ | ˟ | ˟ |  |  |
| Model data sources |  |  | ˟ | ˟ |  |  |  |
| Characterising baseline falls risk estimates |  |  |  |  | ˟ |  |  |
| *Number of fields* | 0 | 0 | 2 | 2 | 2 | 0 | 0 |
| ***(E) Evaluation methods and results*** | | | | | | | |
| Cost-per-unit ratio (e.g., ICER) | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ |
| Aggregate cost and health outcomes2 |  | ˟ |  | ˟ |  |  | ˟ |
| Original currency type |  | ˟ | ˟ |  |  |  | ˟ |
| Converted results into same currency |  | ˟ | ˟ |  | ˟ |  |  |
| Subgroup/targeting methods/results |  | ˟ |  | ˟ | ˟ |  | ˟ |
| Handling parameter uncertainty3 |  | ˟ |  | ˟ | ˟ |  | ˟ |
| Scenario analysis methods/results4 |  |  |  | ˟ |  |  |  |
| Equity analysis methods/results |  |  |  | ˟ |  |  |  |
| *Number of fields* | 1 | 6 | 3 | 6 | 4 | 0 | 5 |
| ***(F) Discussions by evaluation authors*** | | | | | | | |
| Generalisability and policy implementation |  |  | ˟ | ˟ |  |  |  |
| Strengths and limitations |  |  | ˟ | ˟ |  | ˟ |  |
| *Number of fields* | 0 | 0 | 2 | 2 | 0 | 1 | 0 |
| *Total number of fields* | 8 | 30 | 21 | 33 | 26 | 8 | 31 |
| **Abbreviation:** CUA: cost-utility analysis; DJ: Dubas-Jakobczyk; ICER: incremental cost-effectiveness ratio; PHE: Public Health England; RCN: Royal College of Nursing; RCT: randomised controlled trial; TP: target population  1 This table does not account for data fields extracted by reviews when applying a quality assessment checklist(s).  2 Includes outcomes such as total intervention cost and total number of falls prevented.  3 Includes one-/two-way deterministic sensitivity analysis and probabilistic sensitivity analysis.  4 Analysis of alternative modelling assumptions: e.g., whether fear of falling exerts a health utility decrement.  a Distinguished between fall-related and all-cause care cost and reported detailed list: emergency department; hospitalization; outpatient visit; GP visit; district nurse visit; home care; equipment; meal-on-wheel; day care centre; residential care; nursing home; patient and caregiver’s cost (out-of-pocket expenditure, time cost).  b Reported detailed list of intervention resources for costing: recruitment; marketing; printing; development; administration; overheads; staff labour; staff transport; training; equipment; home modification; specialist service (e.g., cataract operation); comparator intervention resource/cost. | | | | | | | |

#### Quality assessment of economic evaluations by systematic reviews

All reviews except RCN (which mentioned applying the Drummond checklist [15] but did not report the scores) applied one or more checklist to assess the reporting and methodological quality of their included studies. In total, four checklists were applied, all of them generic (i.e., all disease areas) and all-design (i.e., SVEs and models). Table CS4 in Supplementary 4 lists the items of the checklists used, and Table CS5 in Supplementary 5 shows the quantitative checklist scores given to individual evaluations by the reviews. The scores were converted to percentage to ease comparison.

Thirteen of 24 SVEs and 11 of 21 models received scores from multiple reviews. The last column of Table CS5 shows the standard deviation (SD) of scores per evaluation. The SD varied markedly between evaluations, ranging from 0.9 to 45.0. The average checklist scores were also calculated for each review by study design. By comparing an individual evaluation’s score against the average, its relative quality ranking (above or below average) within each review could be determined. There were potential differences in how the reviews perceived the relative quality of their included evaluations based on the checklist scores. For example, Hektoen (2009) received the Drummond checklist score of 90.0% in the DJ review which was above the review’s average score for models (70.9%); but it received NICE checklist score of 26.3% in the PHE review which was markedly below the average (59.6%).

In addition to checklists, the DJ review narratively synthesised limitations of its included evaluations around the following methodological themes: identifying and measuring costs and benefits; uncertainty over input variables; short time horizon; problems with sample (e.g., low participation); and problems with generalisability. The PHE review noted the main limitations of evaluations as perceived by the evaluation authors or reviewers but did not group them by themes. The Huter review narratively synthesised how evaluations handled the challenges of societal analysis, namely the incorporation of: (1) informal caregiving cost; (2) productivity cost; (3) unrelated cost in added life years; and (4) wider non-health effects. It was found that these challenges were handled in few evaluations; and when handled, were done using very heterogenous methods.

#### Commissioning and research recommendations by systematic reviews

Table C4 summarises the commissioning and research recommendations made by previous reviews.

|  |  |  |
| --- | --- | --- |
| **Table C4** Commissioning recommendations and research implications from previous systematic reviews of community-based falls prevention economic evaluations. | | |
| **Review** | **Commissioning recommendations** | **Research recommendations/implications** |
| RCN [14] | * No commissioning recommendation based on systematic review results | * Development of a *de novo* decision model to inform NICE clinical guideline [14] |
| Davis [25] | * “We conclude that single interventions (such as the Otago Exercise Programme) targeted at high-risk groups can prevent the greatest number of falls at the lowest incremental costs.” (p. 89) | * “We recommend that future economic evaluations be guided in part by the checklists available for assessing economic evaluations.” (p. 88) * Development of guideline and checklist for falls prevention economic evaluations [17] |
| DJ [29] | * Cost-effective/cost-saving interventions in ‘Good’ quality studies: resistance exercise; Otago exercise; Tai Chi; citywide non-pharmaceutical multifactorial programme * “The existing studies are characterized by huge differences in the methods applied as well as overall quality which limits the comparability and generalizability of the results.” (p. 670) | * “There is a need for… methods adjusted to particular character of health promotion and primary prevention strategies for older population.” (p. 670) |
| PHE [26] | * Exercise interventions (p. 39-40): Tai Chi is consistently most cost-effective for mobile older persons; group exercise for women aged 70+ cost-effective; Otago home exercise may be cost-saving with high adherence; other home exercises are not cost-effective * Multifactorial interventions (p. 40): paramedic-implemented protocol that followed NICE guideline was cost-saving and is generalizable to English setting; risk assessment without treatments not cost-effective * HAM likely cost-effective but current evidence not generalizable to English setting (p. 40-41) * Medication review likely cost-effective (p. 41) | * Falls prevention economic model should carefully consider whether the intervention being modelled is appropriate for English setting and given target population (p. 44). * Development of a *de novo* decision model to inform commissioning of falls prevention by CCGs/local authorities [39] |
| Olij [27] | * “Home assessment programs were most cost-effective type of program [based on CUA] for community-dwelling older adults.” (p. 2197) * “Multifactorial programs and other [e.g., exercise] programs were less favourable [based on CUA].” (p. 2202) * “Older populations reported more favourable ICERs… [but] it is not possible to draw firm conclusions about age differences.” (p. 2202) * “Methodological differences between studies hampered direct comparison of the cost-effectiveness of program types.” (p. 2197) | * “Future economic evaluations of falls prevention should be designed, conducted, and reported in accordance with current guidelines for economic evaluations to increase comparability.” (p. 2202) * “Future studies should clearly report whether they target high-risk, low-risk, or mixed populations because the baseline fall risk is an important determinant of cost-effectiveness.” (p. 2202) * Models should directly compare different falls intervention types (p. 2202) |
| Huter [30] | * “A comparison of results of different economic evaluations, even of similar interventions, has to be carried out with great caution.” (p. 8) * “A comparison of the cost-effectiveness results with… other age groups is not possible and therefore not advisable.” (p. 9) | * “Disregarding [the four features1] could implicitly lead to a discrimination of health promotion and disease prevention against older people.” (p. 9) * “More research is necessary on the different approaches for [the four features’] inclusion and on their respective effects on the outcomes.” (p. 9) |
| Winser [28] | * “A tailored exercise program including strengthening of lower extremities, balance training, cardiovascular exercise, stretching and functional training of moderate intensity performed twice per week with each session lasting 60 min for 6 or more months delivered in groups of 3 to 8 participants [by PT or nurse trained by PT] with home-based follow-up appears to be cost-effective in preventing falls in older people.” (p. 69) * “Exercise-only programs were more cost-effective than multifactorial falls prevention programs.” But “there were not enough studies of each to draw firm conclusions.” (p. 75, 78) | * “We recommend future studies to test the benefits of adding scheduled walking to the falls prevention exercise protocol.” (p. 76) * “Research is needed to evaluate the efficacy of [group-based learning and home-based practice] programs, in particular in comparison to other programs that may require more resources.” (p. 76) * “Further research is needed… in developing and underdeveloped countries.” (p. 69) * “Future research is needed to systematically compare [exercise-only and multifactorial programs].” (p. 78) |
| **Abbreviation:** CCG: clinical commissioning group; CUA: cost-utility analysis; HAM: home assessment and modification; NICE: National Institute for Health and Care Excellence; PT: physiotherapist  1 These are: (i) measurement and valuation of informal caregiving; (ii) accounting for productivity costs (including unpaid work); (iii) accounting for unrelated cost in added life years; and (iv) accounting for wider non-health effects of interventions. | | |

Scarce cost-effectiveness evidence from the UK setting prevented the RCN review from making commissioning recommendations. The Davis review recommended single-component Otago home exercise based on the most favourable cost-per-unit ratio (e.g., ICER). The DJ review reported three exercise interventions and a citywide multifactorial intervention that produced the lowest cost-per-unit ratios from ‘Good’ quality evaluations (those that received 90-100% Drummond checklist score). The PHE review formulated recommendations by intervention type based on cost-per-unit ratios. The Olij review recommended HAM over exercise and multifactorial interventions for community-dwelling older persons based on ICERs under CUA. The Winser review listed the characteristics of an ideal exercise intervention based on those of interventions that yielded favourable cost-per-unit ratios. It also found that single-component exercises produced more favourable ratios than exercises within multifactorial interventions but called for further direct comparisons.

For research implications, the RCN and PHE reviews determined that a *de novo* model is required to assist commissioning due to lack of current evidence. The Davis and Olij reviews recommended that future evaluations follow a validated guideline or checklist for economic evaluations. The Davis review later informed the development of the expert guideline/checklist for falls prevention economic evaluations [17]. The Huter review stressed that future evaluations should incorporate the four methodological challenges associated with societal analyses (given above) to counteract the indirect bias of economic evaluations against older age groups (e.g., due to reduced scope of QALY gain). It should nevertheless be noted that societal analysis does not necessarily counteract the bias: inclusion of productivity costs, for example, likely favours economically active/younger populations.

### Critical appraisal of previous systematic reviews

Table CS6 in Supplementary 6 shows the results of applying the 16-item AMSTAR 2 checklist to the systematic reviews. No review conducted meta-analysis due to methodological heterogeneity among included evaluations. Therefore, the maximum potential number of ‘Yes’ (i.e., full adherence to item criteria) or ‘Partial Yes’ was 13 since items 11, 12 and 15 only concerned meta-analyses. The RCN review had the lowest number of ‘Yes’ at two, followed by the Davis review at seven. The five later reviews had nine or 10 ‘Yes’, suggesting that the review methods have improved over time. The most prevalent issue was the omission of a list of excluded studies (item 7), with only two reviews providing it. The second most prevalent issue was the lack of consideration of methodological quality of evaluations when discussing and formulating review conclusions (item 13). The Olij review, for example, applied the CHEC methodological quality checklist but did not discuss the checklist scores when comparing the ICERs of evaluations.

Limitations acknowledged by the review authors included: limited search coverage [26-29]; lack of quantitative meta-analysis [26, 28]; non-assessment of publication bias [26, 27]; and limited assessment of quality of underlying clinical studies [26, 27].

Two further limitations of systematic reviews can be noted by this systematic overview:

1. The limited range of methodological features extracted from studies, particularly models; and
2. The limited range of evaluation outcomes extracted to inform commissioning.

The first limitation is made clear by comparing Tables C1 and C3. There was a marked difference between what data fields could or should have been extracted by systematic reviews according to the conceptual falls prevention model and expert guidelines [17-21] (Table C1) and those extracted (Table C3). Decision modelling features were the most neglected category. One particularly important (yet neglected) set of modelling features were methods for characterising the dynamic progression in falls risk and falls prevention intervention need. As far as time and resources permit, systematic reviews should account for how such features were modelled, including the data sources and parameters used and structural assumptions made. Insofar as models – and particularly population-level long-horizon models – provide the most relevant information to commissioners, the reviews’ limited focus on the modelling features reduces their capacity to inform not only the commissioning decisions but also the conceptualisation of future falls prevention economic models.

The second limitation concerns the way in which reviews’ commissioning recommendations were based chiefly on cost-per-unit ratios without considering aggregate outcomes. For example, the Davis review recommended the Otago home exercise for population aged 80+ based on a single SVE result that the intervention produced a net cost saving [40]. Yet another evaluation in the review reported a similar cost saving from a citywide intersectoral intervention over a five-year horizon [33]. Even with comparable cost-per-unit ratios, consideration of aggregate impact would favour the citywide intervention. The cost-per-unit ratio also provides little information on the coverage of priority subgroups within the target population. For example, the Olij and Winser reviews recommended HAM and exercise, respectively, over multifactorial interventions based on comparisons of cost-per-unit ratios alone. Yet multifactorial interventions may achieve greater coverage of the most vulnerable patient groups (e.g., those contraindicated for exercise) and hence may be preferred by commissioners who aim to prioritise the care of such groups. Alternatively, HAM/exercise and multifactorial intervention may be commissioned as non-mutually exclusive options, with the more cost-effective option subsidising the lesser. Cost-per-unit ratios estimated in the absence of any capacity constraint should also be interpreted with caution since they would rise quickly once the intervention reaches its capacity limit.

## Discussion

This systematic overview identified seven systematic reviews containing 44 falls prevention intervention economic evaluations for older people living in community. The number of data fields extracted from studies differed markedly across reviews, ranging from eight to 33. Four checklists were applied by reviews, while narrative quality assessment was conducted at varying levels of detail and topic range. Commissioning recommendations were based primarily on cost-per-unit ratios. Research recommendations ranged from a call for greater adherence to pre-established guidelines for economic evaluations to development of *de novo* decision models. This systematic overview critically appraised the methods of previous reviews, particularly regarding the extraction of methodological features and the synthesis of evaluation outcomes.

Application of the AMSTAR 2 checklist showed some evidence of an improvement in systematic review methods, from full adherence to only two checklist items in the RCN review in 2005 to nine or 10 items in the five reviews published in 2017 or later. The low performance of the RCN review is of particular concern given that it informed the development of NICE CG161. Certain aspects of AMSTAR 2 were mainly relevant to systematic reviews of intervention effectiveness studies rather than of economic evaluations. Thus, the checklist items 11, 12 and 15 concerning meta-analysis were less relevant to the reviews that did not pool outcomes due to the underlying methodological heterogeneity in economic evaluations. Moreover, items 2, 9 and 13 concerning risk of bias assessment had to be expanded to address the reviews’ broader methodological quality assessment of evaluations. The question in item 8 of whether the reviews described the evaluations in ‘adequate detail’ required background knowledge of the important features of falls prevention economic evaluations: i.e., the data fields in Table C1 informed by the conceptual model. A previous overview in community pharmacy economic evaluation similarly combined the AMSTAR 2 checklist with methodological criteria drawn from the broader literature [41]. Accounting for the *volume* of extracted detail in item 8 nevertheless does not capture the *type* of detail (e.g., dynamic model features, equity analyses). Hence narrative synthesis should supplement the checklist application for the appraisal of systematic reviews.

A noticeable finding of this overview was that the extraction and analysis of decision model features by previous systematic reviews was highly limited, although this was intentional in a couple of cases: Huter review focused on a pre-specified list of methodological challenges, while Winser review focused on RCT-based SVEs. The limited appraisal greatly compromises the ability of systematic reviews to inform decision-making at the population level over a time horizon long enough to capture all relevant costs and consequences of a preventive intervention [24, 42]. As discussed in Section 3.8.1, the key methodological challenges for public health modelling include: (I) incorporating non-health outcomes and societal intervention costs; (II) considering heterogeneity and dynamic complexity; (III) considering theories of human behaviour and implementation; and (IV) considering issues of equity [20]. The Huter review covered only (I), while the PHE review only (IV). Future systematic reviews of public health economic models should endeavour to cover as many of these aspects as possible. This would help judge the structural validity and credibility of identified models before they inform commissioning decisions and/or conceptualisation of *de novo* models.

A possible contributory factor to the neglect of decision model features is the nature of checklists used by previous reviews to assess the reporting and methodological quality of their identified evaluations. All four checklists used by the reviews were designed for all disease areas and for all study designs. Although reviewers are not confined to extracting only the checklist items, the use of a generic, all-design checklist would likely reduce the effort spent in identifying how evaluations captured the disease- and modelling-specific features. Thus, using the fall-specific (but all-design) checklist designed by falls prevention experts [17] may improve the attention paid to features of falls epidemiology and falls prevention intervention by future reviews, while using the model-specific (but generic) HTA checklist [18] may similarly improve the attention on modelling features. However, any quantitative checklist is likely too limited to serve as the main methodological assessment tool. Specifically, its use of binary/ordinal item scores, followed by aggregation to a single index, conceals the highly idiosyncratic nature of methodological issues and the way and extent to which they affect the evaluation outcomes [25]. Hence, checklist application is necessary but insufficient to analyse the methodological quality of economic evaluations and must be complemented by a narrative synthesis of methodological features. This dual approach was adopted by few previous systematic reviews in this overview (see AMSTAR 2 item 9 in Table CS6) and hence remains a research priority.

The sole reliance on cost-per-unit ratios would generate incomplete and misleading commissioning recommendations. As noted, single-component HAM or exercise may generate very favourable cost-per-unit ratios and yet perform poorly in terms of aggregate impact and/or coverage of priority groups relative to a multifactorial intervention. This observation contributes to an ongoing debate on whether less resource-intensive exercise should be preferred over (the widely recommended) multifactorial interventions [43, 44]. The debate is primarily centred around efficacy estimates and cost-per-unit ratios, but the final verdict cannot and should not be reached without considering the aggregate impact [45, 46] and decisional priorities beyond cost-effectiveness [2]. Consideration of aggregate outcomes is also important for informing targeting strategies (under budget/capacity constraints) and assessing the returns on implementation scale-up [22]. Systematic reviews should therefore endeavour to extract a wide range of economic evaluation outcomes, although the feasible range would largely depend on the methodological and reporting practices of underlying evaluations.

This systematic overview is the first of its kind in the falls prevention economic evaluation context. It covered 12 academic databases and grey literature between 2003 and 2020 and followed the Cochrane guideline [12]. It critically appraised the methodological quality of previous systematic reviews, and this would help improve the quality of prospective systematic reviews and economic evaluations, particularly those employing decision models.

The overview nevertheless has limitations, including non-coverage of the period before 2003, non-inclusion of systematic reviews of falls prevention RCTs that contained a minority of studies that were economic evaluations [47-49], and non-inclusion of reviews that targeted specific patient groups such as those with neurological disorders [50]. The systematic reviews of falls prevention RCTs could have contained SVEs not captured by the seven systematic reviews included in this overview. However, their methods for data extraction and synthesis and methodological appraisal would have differed substantially from the reviews that mainly targeted and included economic evaluations. Their inclusion would thus have over-extended the boundary of the review methods appraisal by this overview.

## Section summary

The systematic overview in this section found significant limitations in the methodological quality of existing systematic reviews of falls prevention economic evaluations which could misinform commissioning decisions and hinder future evaluation designs. Systematic reviews should: be as comprehensive as possible in the extraction and narrative synthesis of evaluation features associated with falls epidemiology, falls prevention intervention and decision modelling; they should also base the commissioning recommendations on the full range of reported outcomes and equity objectives to avoid incomplete information being provided to decision-makers. The systematic review in Chapter 4 aims to apply these learnings.

## Supplementary 1: Database search strategies

The systematic overview and the systematic review in Chapter 4 share the same database search strategies but different inclusion and exclusion criteria. Tables CS1.1 to CS1.8 show the search strategies for Medline, Embase, PubMed, Cochrane Library (CDSR and CENTRAL), EconLit, CINAHL, PsycInfo and ASSIA. The search strategies for CRD, CEA Registry, PEDro and grey literature websites are shown in text. Presenting all strategies meets the PRISMA 2020 guideline [13].

|  |  |  |  |
| --- | --- | --- | --- |
| **Table CS1.1** Medline search strategy for systematic overview and systematic review. | | | |
| Medline (Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R)) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | (fall or falls or falling or faller\* or fallen or fell or slip\* or trip\* or stumbl\*).ti,ab. |
|  | MeSH | 2 | exp Accidental falls/ |
|  |  | 3 | 1 or 2 |
| Older and frailty | Free text1 | 4 | (old or older or senior\* or elder\* or aged or geriatric\* or frail\* or pensioner).ti,ab. |
|  | MeSH | 5 | exp Aged/ or Frailty/ |
|  |  | 6 | 4 or 5 |
| Economic evaluation | Free text1 | 7 | (economic or decision or Markov or cost-effectiveness or cost-utility or cost-benefit or cost or budget or expenditure or pric\* or ROI).ti,ab. |
|  | MeSH | 8 | exp Models, economic/ or exp Economics/ or exp Economics, medical/ or exp Economics, nursing/ or exp Economics, pharmaceutical/ or exp Decision trees/ or exp Cost-benefit analysis/ or exp Costs and cost analysis/ or exp Budgets/ |
|  |  | 9 | 7 or 8 |
|  |  | 10 | 3 AND 6 AND 9 |
| Exclusions |  | 11 | Limit to Humans |
|  |  | 12 | (news or comment or editorial or letter or case reports).pt. or case report.ti. |
|  |  | 13 | 11 NOT 12 |
|  |  | 14 | Limit to English |
|  |  | 15 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** MeSH: medical subject heading; Ref: reference  1 Covering title and abstract. | | | |

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| **Table C1.2** Embase search strategy for systematic overview of systematic reviews of falls prevention economic evaluation. | | | |
| Embase (source: OvidSP) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | (fall or falls or falling or faller\* or fallen or fell or slip\* or trip\* or stumbl\*).ti,ab,kw. |
|  | MeSH | 2 | exp falling/ OR exp fall risk/ |
|  |  | 3 | 1 or 2 |
| Older and frailty | Free text1 | 4 | (old or older or senior\* or elder\* or aged or geriatric\* or frail\* or pensioner).ti,ab. |
|  | MeSH | 5 | exp Aged/ or Frailty/ |
|  |  | 6 | 4 or 5 |
| Economic evaluation | Free text1 | 7 | (economic OR evaluation OR budget OR expenditure OR cost\* OR ROI).ti,ab,kw. |
|  | MeSH | 8 | exp Health economics/ OR exp Economic model/ OR exp Economic evaluation/ OR exp Health care cost/ OR Pharmacoeconomics/ OR Cost effectiveness analysis/ OR Cost utility analysis/ OR Cost benefit analysis/ OR Cost minimization analysis/ OR Cost of illness/ |
|  |  | 9 | 7 or 8 |
|  |  | 10 | 3 AND 6 AND 9 |
| Exclusions |  | 11 | Limit to Humans |
|  |  | 12 | (news or comment or editorial or letter or case reports).pt. or case report.ti. |
|  |  | 13 | 11 NOT 12 |
|  |  | 14 | Limit to English |
|  |  | 15 | Exclude Medline journals |
|  |  | 16 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** MeSH: medical subject heading; Ref: reference  1 Covering title and abstract. | | | |

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| **Table C1.3** PubMed search strategy for systematic overview and systematic review. | | | |
| PubMed – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | [tiab] fall or falls or falling or fallen or fell or slip or trip or stumbl\* |
|  | MeSH | 2 | Accidental falls |
|  |  | 3 | 1 or 2 |
| Older and frailty | Free text1 | 4 | [tiab] old or older or senior or elder or aged or geriatric or frail or pensioner |
|  | MeSH | 5 | Aged or Frailty |
|  |  | 6 | 4 or 5 |
| Economic evaluation | Free text1 | 7 | [tiab] economic or budget or expenditure or evaluation or cost or markov or model or ROI |
|  | MeSH | 8 | Model, economic or Economics, medical or Economics, nursing or Economics, pharmaceutical or Costs and cost analysis or Costs and benefits or Budget or Markov chain or Decision analysis |
|  |  | 9 | 7 or 8 |
|  |  | 10 | 3 AND 6 AND 9 |
| Exclusions |  | 11 | Limit to Humans |
|  |  | 12 | (news or comment or editorial or letter or case reports).pt. or case report.ti. |
|  |  | 13 | 11 NOT 12 |
|  |  | 14 | Limit to English |
|  |  | 15 | Remove [Child: Birth-18 years], [Infant: 1-23 months] |
|  |  | 16 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** MeSH: medical subject heading; Ref: reference; tiab: titles and abstract  1 Covering title and abstract. | | | |

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| **Table C1.4** Cochrane Library (CSDR and CENTRAL) search strategy for systematic overview and systematic review. | | | |
| Cochrane Library (Cochrane Database of Systematic Reviews and CENTRAL trials registry) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | (fall or falls or falling or fallen or fell or slip or trip or stumbl\*).ti,ab,kw. |
|  | MeSH | 2 | exp Accidental falls/ |
|  |  | 3 | 1 or 2 |
| Older and frailty | Free text1 | 4 | (old or older or senior or elder or aged or geriatric or frail or pensioner).ti,ab,kw. |
|  | MeSH | 5 | exp Aged/ or exp Aging/ or exp Frailty/ or exp Frail elderly/ |
|  |  | 6 | 4 or 5 |
| Economic evaluation | Free text1 | 7 | (economic OR evaluation OR budget OR expenditure OR cost\* OR ROI).ti,ab,kw. |
|  | MeSH | 8 | exp Economics/ or exp Economics, nursing/ or exp Economics, pharmaceutical/ or exp Economics, medical/ or exp Models, Economic/ or exp Costs and cost analysis/ or exp Cost-benefit analysis/ or exp Cost of illness/ or exp Budgets/ or exp Health expenditures/ |
|  |  | 9 | 7 or 8 |
|  |  | 10 | 3 AND 6 AND 9 |
| Exclusions |  | 11 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** MeSH: medical subject heading; Ref: reference  1 Covering title and abstract. | | | |

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| **Table C1.5** EconLit search strategy for systematic overview and systematic review. | | | |
| EconLit (source: OvidSP) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | (fall or falls or falling or fallen or fell or slip or trip or stumbl\*).ti,ab,kw. |
| Older and frailty | Free text1 | 2 | (old or older or senior or elder or aged or geriatric or frail or pensioner).ti,ab,kw. |
| Economic evaluation | Free text1 | 3 | (economic OR evaluation OR budget OR expenditure OR cost\* OR ROI).ti,ab,kw. |
|  |  | 4 | 1 AND 2 AND 3 |
| Exclusions |  | 5 | Limit to English |
|  |  | 6 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** MeSH: medical subject heading; Ref: reference  1 Covering title and abstract. | | | |

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| **Table C1.6** CINAHL search strategy for systematic overview and systematic review. | | | |
| CINAHL (source: EBSCO) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | TI(fall or falls or falling or fallen or fell or slip or trip or stumbl\*) |
|  | Free text | 2 | AB(fall or falls or falling or fallen or fell or slip or trip or stumbl\*) |
|  | MeSH | 3 | MH(Accidental falls) |
|  |  | 4 | 1 or 2 or 3 |
| Older and frailty | Free text1 | 5 | TI(old or older or senior or elder or aged or geriatric or frail or pensioner) |
|  | Free text | 6 | AB(old or older or senior or elder or aged or geriatric or frail or pensioner) |
|  | MeSH | 7 | MH(Aged+) |
|  |  | 8 | 5 or 6 or 7 |
| Economic evaluation | Free text1 | 9 | TI(economic or evaluation or budget or expenditure or cost\* or ROI) |
|  | Free text | 10 | AB(economic or evaluation or budget or expenditure or cost\* or ROI) |
|  | MeSH | 11 | MH(Economics or Economic aspects of illness or Economics, pharmaceutical or Accidental falls economics) |
|  |  | 12 | 9 or 10 or 11 |
|  |  | 13 | 4 AND 8 AND 12 |
| Exclusions |  | 14 | Limit to Humans |
|  |  | 15 | PT(news or comment or editorial or letter or case reports) |
|  |  | 16 | 14 NOT 15 |
|  |  | 17 | Limit to English |
|  |  | 18 | Limit to Academic Journals (remove Dissertations, Magazines and CEUs) |
|  |  | 19 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** AB: abstract; MeSH: medical subject heading; Ref: reference; TI: title.  1 Covering title and abstract. | | | |

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| **Table C1.7** PsycInfo search strategy for systematic overview and systematic review. | | | |
| PsycInfo (source: OvidSP) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | (fall or falls or falling or fallen or fell or slip or trip or stumbl\*).ti,ab. |
|  | MeSH | 2 | Falls/ |
|  |  | 3 | 1 or 2 |
| Older and frailty | Free text1 | 4 | (old or older or senior or elder or aged or geriatric or frail or pensioner).ti,ab. |
|  | MeSH | 5 | exp Aging/ or Geriatrics/ or Gerontology/ |
|  |  | 6 | 4 or 5 |
| Economic evaluation | Free text1 | 7 | (economic OR evaluation OR budget OR expenditure OR cost\* OR ROI).ti,ab. |
|  | MeSH | 8 | exp Economics/ or exp “Costs and cost analysis”/ or “Resource allocation”/ or exp “Decision making”/ |
|  |  | 9 | 7 or 8 |
|  |  | 10 | 3 AND 6 AND 9 |
| Exclusions |  | 11 | Limit to Humans |
|  |  | 12 | (news or comment or editorial or letter or case reports).pt. or case report.ti. |
|  |  | 13 | 11 NOT 12 |
|  |  | 14 | Limit to English |
|  |  | 15 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** MeSH: medical subject heading; Ref: reference  1 Covering title and abstract. | | | |

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| **Table C1.8** ASSIA search strategy for systematic overview and systematic review. | | | |
| ASSIA (source: ProQuest) – run on 7th January 2021 | | | |
| **Theme** | **Type** | **Ref** | **Search Term** |
| Falls | Free text1 | 1 | ti(fall or falls or falling or fallen or fell or slip or trip or stumbl\*) |
|  | Free text | 2 | ab(fall or falls or falling or fallen or fell or slip or trip or stumbl\*) |
|  | SH | 3 | Mainsubject.Exact(“falls” OR “accidental falls” OR “fall prone elderly people”) |
|  |  | 4 | 1 or 2 or 3 |
| Older and frailty | Free text1 | 5 | ti(old or older or senior or elder or aged or geriatric or frail or pensioner) |
|  | Free text | 6 | ab(old or older or senior or elder or aged or geriatric or frail or pensioner) |
|  | SH | 7 | Mainsubject.Exact(“aged, 80 & over” or “aged” or “frailty” or “frail elderly” or “frail elderly people” or “frail”) |
|  |  | 8 | 5 or 6 or 7 |
| Economic evaluation | Free text1 | 9 | ti(economic or evaluation or budget or expenditure or cost\* or ROI) |
|  | Free text | 10 | ab(economic or evaluation or budget or expenditure or cost\* or ROI) |
|  | SH | 11 | Mainsubject.Exact(“economic costs” or “economic aspects” or “economic analysis” or “economic impact” or “economic” or “budgets” or “benefit cost analysis” or “costs” or “cost-benefit analysis” or “cost effectiveness” or “costing” or “cost utility analysis” or “cost minimization analysis” or “cost benefit analysis” or “costs & cost analysis” or “cost analysis” or “cost of illness”) |
|  |  | 12 | 9 or 10 or 11 |
|  |  | 13 | 4 AND 8 AND 12 |
| Exclusions |  | 14 | Exclude commentary, news and editorial |
|  |  | 15 | Limit to English |
|  |  | 16 | Limit to 1st January 2003 – 31st December 2020 |
| **Abbreviation:** AB: abstract; Ref: reference; SH: subject heading; TI: title.  1 Covering title and abstract. | | | |

**Other databases**

Search strategy for Centre for Reviews and Dissemination (CRD) – search run on 7th January 2021

Title: “Fall” AND Limit publication year to 2003-2020

Result #: 61

Search strategy for Cost-Effectiveness Analysis (CEA) Registry – search run on 7th January 2021

“Fall” as search term

Result #: 100 (only the most recent 100 hits available)

Search strategy for Physiotherapy Evidence Database (PEDro) – search run on 7th January 2021

Title: “Fall” AND Limit publication year to 2003-2020

Result #: 226

**Grey literature**

The following sites were searched with term “Falls prevention”

* Age UK: <https://www.ageuk.org.uk/>
* Chartered Society of Physiotherapy: <https://www.csp.org.uk/>
* College of Occupational Therapy: <https://www.rcot.co.uk/>
* Department of Health: <https://www.gov.uk/government/organisations/department-of-health-and-social-care>
* Royal College of Nursing: <https://www.rcn.org.uk/>

## Supplementary 2: Excluded studies

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| **Table CS2** Studies excluded from systematic overview at full text screening and exclusion reason. | | |
| **First author (year)** | **Title** | **Main exclusion reason** |
| Annweiler (2010) | Fall prevention and vitamin D in the elderly: an overview of the key role of the non-bone effects | General review on falls epidemiology and prevention |
| Arnold (2008) | Exercise for fall risk reduction in community-dwelling older adults: a systematic review | SR with <50% of studies that are FP economic evaluations |
| Avenell (2014) | Vitamin D and vitamin D analogues for preventing fractures in post‐menopausal women and older men | SR with <50% of studies that are FP economic evaluations |
| Beswick (2010) | Complex interventions to improve physical function and maintain independent living in elderly people: a systematic review and meta-analysis | SR with <50% of studies that are FP economic evaluations |
| Bischoff-Ferrari (2004) | Effect of Vitamin D on Falls: A Meta-analysis | SR with <50% of studies that are FP economic evaluations |
| Bischoff-Ferrari (2009) | Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials | SR with <50% of studies that are FP economic evaluations |
| Boonen (2006) | Addressing the musculoskeletal components of fracture risk with calcium and vitamin D: a review of the evidence | General review on falls epidemiology and prevention |
| Boye (2013) | The impact of falls in the elderly | General review on falls epidemiology and prevention |
| Boyle (2010) | Medication and falls: risk and optimization | General review on falls epidemiology and prevention |
| Campbell (2010) | Comprehensive approach to fall prevention on a national level: New Zealand | General review on falls epidemiology and prevention |
| Chang (2004) | Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomised clinical trials | SR with <50% of studies that are FP economic evaluations |
| Chase (2012) | Systematic review of the effect of home modification and fall prevention programs on falls and the performance of community-dwelling older adults | SR with <50% of studies that are FP economic evaluations |
| Clemson (2008) | Environmental interventions to prevent falls in community-dwelling older people: a meta-analysis of randomized trials | SR with <50% of studies that are FP economic evaluations |
| Gillespie (2012) | Interventions for preventing falls in older people living in the community | SR with <50% of studies that are FP economic evaluations |
| Goodwin (2014) | Multiple component interventions for preventing falls and fall-related injuries among older people: systematic review and meta-analysis | SR with <50% of studies that are FP economic evaluations |
| Guirguis-Blake (2018) | Interventions to prevent falls in older adults: updated evidence report and systematic review for the US Preventive Services Task Force | SR with <50% of studies that are FP economic evaluations |
| Hackney (2014) | Impact of Tai Chi Chu'an practice on balance and mobility in older adults: an integrative review of 20 years of research | General review on falls epidemiology and prevention |
| Hanley (2011) | Community-based health efforts for the prevention of falls in the elderly | General review on falls epidemiology and prevention |
| Hempel (2014) | Evidence map of Tai Chi | General review on falls epidemiology and prevention |
| Hiligsmann (2015) | A systematic review of cost-effectiveness analyses of drugs for postmenopausal osteoporosis | SR with <50% of studies that are FP economic evaluations |
| Hill (2012) | Psychotropic drug-induced falls in older people | General review on falls epidemiology and prevention |
| Hopewell (2018) | Multifactorial and multiple component interventions for preventing falls in older people living in the community | SR with <50% of studies that are FP economic evaluations |
| Huang (2012) | Medication-related falls in the elderly | General review on falls epidemiology and prevention |
| Karinkanta (2010) | Physical therapy approaches to reduce fall and fracture risk among older adults | General review on falls epidemiology and prevention |
| Karlsson (2013) | Prevention of falls in the elderly—a review | General review on falls epidemiology and prevention |
| Lord (2006) | Home environment risk factors for falls in older people and the efficacy of home modifications | General review on falls epidemiology and prevention |
| Lord (2010) | Vision and falls in older people: risk factors and intervention strategies | General review on falls epidemiology and prevention |
| Marcelli (2015) | Beneficial effects of vitamin D on falls and fractures: is cognition rather than bone or muscle behind these benefits? | General review on falls epidemiology and prevention |
| Montero-Odasso (2018) | Falls in cognitively impaired older adults: implications for risk assessment and prevention | General review on falls epidemiology and prevention |
| Nowak (2009) | Falls and frailty: lessons from complex systems | General review on falls epidemiology and prevention |
| Pega (2016) | A systematic review of health economic analyses of housing improvement interventions and insecticide-treated bednets in the home | SR with <50% of studies that are FP economic evaluations |
| Pisani (2016) | Major osteoporotic fragility fractures: Risk factor updates and societal impact | General review on falls epidemiology and prevention |
| Pynoos (2010) | Environmental assessment and modification as fall-prevention strategies for older adults | General review on falls epidemiology and prevention |
| Reed-Jones (2013) | Vision and falls: a multidisciplinary review of the contributions of visual impairment to falls among older adults | General review on falls epidemiology and prevention |
| Rose (2008) | Preventing falls among older adults: No "one size suits all" intervention strategy | General review on falls epidemiology and prevention |
| Rubenstein (2006) | Falls and their prevention in elderly people: what does the evidence show? | General review on falls epidemiology and prevention |
| Rubenstein (2006b) | Falls in older people: epidemiology, risk factors and strategies for prevention | General review on falls epidemiology and prevention |
| Shaw (2007) | Prevention of falls in older people with dementia | General review on falls epidemiology and prevention |
| Sherrington (2017) | Exercise to prevent falls in older adults: an updated systematic review and meta-analysis | SR with <50% of studies that are FP economic evaluations |
| Sleet (2008) | CDC's research portfolio in older adult fall prevention: a review of progress, 1985-2005, and future research directions | General review on falls epidemiology and prevention |
| Soriano (2007) | Falls in the community-dwelling older adult: a review for primary-care providers | General review on falls epidemiology and prevention |
| Tinetti (2003) | Preventing falls in elderly persons | General review on falls epidemiology and prevention |
| Tinetti (2006) | Fall-risk evaluation and management: challenges in adopting geriatric care practices | General review on falls epidemiology and prevention |
| Tinetti (2010) | The patient who falls: “It's always a trade-off” | General review on falls epidemiology and prevention |
| Tofthagen (2012) | Strength and balance training for adults with peripheral neuropathy and high risk of fall: current evidence and implications for future research | General review on falls epidemiology and prevention |
| Tricco (2017) | Comparisons of interventions for preventing falls in older adults: a systematic review and meta-analysis | SR with <50% of studies that are FP economic evaluations |
| Ungar (2013) | Fall prevention in the elderly | General review on falls epidemiology and prevention |
| Vieira (2016) | Prevention of falls in older people living in the community | General review on falls epidemiology and prevention |
| **Abbreviation:** FP: falls prevention; SR: systematic review. | | |

## Supplementary 3: Primary economic evaluations identified by previous systematic reviews

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| **Table CS3** Primary economic evaluations of community-based falls prevention interventions included in previous systematic reviews. | | | | | | | | |
| **#** | **Economic evaluation** | **Systematic review1** | **Target population** | **Type of analysis** | **Perspective** | **Time horizon (Model type)** | **Intervention** | **Comparator** |
| ***Single-vehicle evaluations (SVEs) (e.g., alongside randomised controlled trial)*** | | | | | | | | |
| 1 | Campbell (2005) [51] | Davis; PHE; Olij | New Zealand CD adults aged 75+ with severe visual impairment | CEA | Societal | 1 year | Home assessment and modification (HAM)2 | Usual care |
| 2 | Cockayne (2017) [52] | Olij | UK and Ireland CD adults aged 65+ with fall in past year, hospitalised fall in past two years or FoF | CUA | PS; Societal | 1 year | Multiple-component podiatry | Usual care |
| 3 | Davis (2011) [53] | DJ; Olij; Winser | Canadian CD adults aged 65 to 75 | CEA; CUA | PS | 1 year | Once-weekly resistance training; twice-weekly resistance training | Twice-weekly resistance training with tone classes |
| 4 | Davis (2011b) [54] | Winser | Canadian CD adults aged 65 to 75: follow-up study to Davis (2011) | CUA | PS | 1 year | (In preceding trial) Once-weekly resistance training; twice-weekly resistance training | Twice-weekly balance and tone classes |
| 5 | Farag (2015) [55] | Olij | Australian CD adults aged 60+ recently discharged from hospital | CEA; CUA | PS | 1 year | Home exercise | Usual care |
| 6 | Farag (2016) [56] | PHE | Australian CD Parkinson’s disease patients, aged 40+ | CEA; CUA | PS | 6 months | Minimally supervised exercise | Usual care |
| 7 | Fletcher (2012) [57] | PHE | UK Parkinson’s disease patients (mean age 71) with 2+ falls in past 12 months | CUA | PS | 20 weeks | Group and home exercise | Usual care |
| 8 | Hendriks (2008) [58] | DJ; PHE; Olij; Winser | Dutch CD adults aged 65+ who experienced a fall requiring A&E/GP attention | CEA; CUA | Societal | 1 year | Multifactorial risk assessment (MRA) | Usual care |
| 9 | Irvine (2010) [59] | DJ; PHE; Olij; Winser | UK CD adults aged 70+ screened as high falls risk by GPs | CEA | PS | 1 year | Multifactorial int. | Usual care |
| 10 | Isaranuwatchai (2017) [60] | Huter; Winser | Canadian CD adults aged 75+ screened as high falls risk | CEA | Societal | 6 months | Multifactorial int. | Usual care |
| 11 | Jenkyn (2012) [61] | DJ; PHE; Olij | Canadian CD older veterans screened as high falls risk by postal questionnaire | CEA | Societal | 1 year | MRA | Usual care |
| 12 | Kenkre (2002) [62] | DJ | UK CD adults aged 65+ | ROI | PS | 1 year | Falls prevention education | Usual care |
| 13 | Li (2015) [63] | PHE | US CD mild-to-moderate Parkinson’s disease patients aged 40-85 | CEA; CUA | Societal | 9 months | Tai Chi | Resistance exercise; Stretching |
| 14 | Patil (2016) [64] | PHE; Olij | Finnish CD women aged 70-80 who have fallen at least once in past year and low physical activity | CEA | Societal | 2 years | Exercise and Vit. D; Exercise alone; Vit. D alone | Usual care |
| 15 | Peeters (2011) [65] | PHE; Olij | Dutch CD and RC adults aged 65+ screened as high falls risk by questionnaire | CEA; CUA | Societal | 1 year | Multifactorial int. | Usual care |
| 16 | Polinder (2016) [66] | PHE | Dutch CD adults aged 65+ who visited A&E after a fall and use fall-risk-increasing medications | CUA | Societal | 1 year | Med. modification | Usual care |
| 17 | Rizzo (1996) [67] | RCN; Davis; Olij | UK CD and RC adults aged 60+ who have fallen and called an ambulance but did not require A&E | CEA; CUA | PS; Societal | 1 year | MRA | Usual care |
| 18 | Robertson (2001a) [40] | RCN; Davis; DJ; Olij | New Zealand CD adults aged 75+ | CEA | PS3 | 1 year | Home exercise (delivered by nurse home visits) | Usual care |
| 19 | Robertson (2001b) [31] | RCN; Davis; DJ; Olij | New Zealand CD adults aged 80+ | CEA | PS | 1 year | Centre-based exercise | Usual care |
| 20 | Robertson (2001c) [68] | Davis; DJ; Olij | New Zealand CD women aged 80+ | CEA | PS3 | 2 years | Home exercise (individually tailored) | Usual care |
| 21 | Sach (2012) [69] | PHE | UK CD and RC adults aged 60+ who have fallen and called ambulance but do not need A&E/inpatient stay | CEA; CUA | PS; Societal | 1 year | Referral to community-based multifactorial intervention following NICE guideline by ambulance paramedics | Usual care |
| 22 | Salkeld (2000) [70] | RCN; Davis; DJ; Olij | Australian CD adults aged 65+ recruited mostly from inpatient setting | CEA | Societal | 1 year | HAM delivered by occupational therapist | Usual care |
| 23 | Timonen (2008) [71] | Winser | Finnish CD women aged 75+ with mobility and balance issues admitted for acute illness to primary care | ROI | PS | 1 year | Group-based exercise program | Usual care |
| ***Decision models*** | | | | | | | | |
| 1 | Albert (2016) [32] | PHE | US CD adults aged 50+ (mean age 75.5) | CUA | PS | 1 year (DT) | Multifactorial int. | Usual care |
| 2 | Beard (2006) [33] | Davis; PHE | Australian CD adults aged 60+ | ROI; CBA | PS; Societal | 5 years (Binary4) | Multiple-component (intersectoral) int. | Usual care |
| 3 | Carande-Kulis (2015) [72] | DJ; PHE | US CD adults aged 65+ | ROI | US healthcare5 | 1 year (Binary) | Exercise (2 forms); Multiple-component int. (Stepping On) | Usual care |
| 4 | Church (2011) [73] | DJ; PHE; Olij | Australian CD and RC adults aged 65+ | CEA; CUA | PS | 10 years (Markov cohort) | Exercise (3 forms); Stepping On; Multifactorial int.; MRA; Exp. cataract surgery; Med. modification; Cardiac pacing | Usual care |
| 5 | Church (2012) [74] | DJ; PHE; Olij | US CD adults aged 65+ | CEA; CUA | PS | Lifetime (Markov cohort) | Exercise (4 forms); Multiple-component int.; Multifactorial int. (2 forms); MRA; HAM; Exp. cataract surgery; Med. modification; Cardiac pacing | Usual care; Comparison between int. |
| 6 | Day (2009) [46] | DJ | Australian CD adults aged 50+ (age and characteristics differ by intervention type)6 | CEA | PS | 1 year (DT) | Exercise (2 forms); HAM; Multifactorial int.; Med. modification; Cardiac pacing | Usual care |
| 7 | Farag (2015b) [36] | DJ; PHE; Olij | Australian CD adults aged 65+ without falls history | CUA | PS | Lifetime (Markov cohort) | Non-specific intervention | Usual care |
| 8 | Frick (2010) [75] | DJ; PHE; Olij | US CD adults aged 65+ | CUA | PS | 1 year (Binary) | Exercise (2 forms); HAM; Multifactorial int. (2 forms); Med. modification; Vit. D | Comparison between int. |
| 9 | Hektoen (2009) [76] | DJ; PHE | Norwegian CD women aged 80+ | CEA | Societal | 1 year (Binary) | Exercise | Usual care |
| 10 | Johansson (2008) [34] | DJ | Swedish CD adults aged 65+ | CUA | Societal | Lifetime (Markov cohort) | Multiple-component (intersectoral) int. | Usual care |
| 11 | Lee (2013) [77] | Olij | US CD adults aged 65-80 without falls history | CBA | PS | 3 years (DT + Markov cohort) | Targeted Vit. D; Universal Vit. D | Usual care; Comparison between int. |
| 12 | Ling (2008) [78] | DJ | US CD adults aged 65+ with falls history or other risk factors | ROI | US healthcare5 | 1 year (Binary) | HAM | Usual care |
| 13 | McLean (2015) [38] | PHE; Olij; Huter; Winser | Australian CD adults aged 70+ | CEA; CUA | PS | 18 months (DT) | Exercise | Usual care |
| 14 | Mori (2017) [79] | Olij | US CD women aged 65+ without previous osteoporotic fracture | CUA | Societal | Lifetime (DT + Markov patient) | Exercise (alone or with bisphosphonate) | Comparison between int. |
| 15 | OMAS (2008) [80] | DJ | Canadian CD adults aged 65+ | CEA; ROI | PS | Lifetime (Markov cohort) | Exercise; HAM; Vit. D and calcium; Med. modification; gait-stabilizing device | Usual care |
| 16 | Pega (2016) [81] | PHE; Olij | New Zealand CD adults aged 65+ | CUA | PS | Lifetime (Markov cohort) | HAM | Usual care |
| 17 | Poole (2015) [82] | Olij | UK CD adults aged 60+ | CUA; ROI | PS | 5 years (Markov cohort) | Vit. D | Usual care |
| 18 | Sach (2007) [83]7 | Davis; Olij | UK women aged 70+ with bilateral cataracts | CEA; CUA | PS; Societal | Lifetime extrapolation (Binary) | Exp. cataract surgery (first eye) | Routine cataract surgery |
| 19 | Smith (1998) [37] | RCN; Davis; Olij | Australian CD adults aged 75+ | CEA | PS | 10 years (DT + Markov cohort) | HAM | Usual care |
| 20 | van der Velde (2008) [35] | PHE | Dutch CD geriatric outpatient population with falls history (mean age 78) | CEA | PS | 1 year (Binary) | Med. modification | Usual care |
| 21 | Wu (2010) [84] | PHE | US CD Medicare beneficiaries aged 65+ with falls history | CEA; ROI | PS; Societal | 1 year (Binary) | Multifactorial int. | Usual care |
| **Abbreviations:** CB: community-based; CBA: cost-benefit analysis; CEA: cost-effectiveness analysis; CUA: cost-utility analysis; DJ: Dubas-Jakobczyk; DT: decision tree; FoF: fear of falling; HAM: home assessment and modification; Int.: intervention; Med.: medication; MRA: multifactorial risk assessment without tailored treatments; NICE: National Institute for Health and Care Excellence; OMAS: Ontario Medical Advisory Secretariat; PHE: Public Health England; PS: public sector; RC: residential care; RCN: Royal College of Nursing; RCT: randomized controlled trial; ROI: return on investment; Vit. D: vitamin D supplementation  1 References for systematic reviews: RCN [14]; Davis [25]; DJ [29]; PHE [26]; Olij [27]; Huter [30]; Winser [28]  2 The study also included exercise and exercise and HAM, but economic evaluation was conducted only on HAM.  3 The study classified itself as a societal analysis but contained no societal resource/cost items.  4 Binary decision models include two scenarios, with and without intervention, and no time-based cycles or probability trees.  5 These US-based studies did not specify public Medicare/Medicaid as the main payer. The payers would hence include private health insurances and patients.  6 Cardiac pacing targeted population aged 50+ due to their high falls risk. Other interventions targeted populations aged 65+.  7 This study was included as a decision model because it extrapolated the results of a trial over a lifetime horizon. | | | | | | | | |

## Supplementary 4: Quality assessment checklists used by previous systematic reviews

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table CS4** Items contained in checklists used for quality assessment of economic evaluations included in systematic reviews. | | | | |
|  | **Drummond checklist [15]** | **QHES checklist [85]** | **NICE checklist (adapted) [86]** | **CHEC checklist (adapted) [87]** |
| Review | Davis review [25]; DJ review [29] | Davis review [25]; Winser review [28] | PHE review [26] | Olij review [27] |
| Item # | 10 | 15 (Davis); 16 (Winser) | 19 | 20 |
| Item score | (DJ review) Yes [1]; No [0]; Unclear [0]; N/A [1] | Yes; No [Points per item] | Yes; No; Partly; Unclear; N/A | Yes [1]; Suboptimal [0.5]; No [0]; N/A |
| Overall score/grade | 10  (DJ review) ‘Good’ if 9-10; ‘Moderate’ if 6-8; ‘Poor’ if 0-5 | 99 (Davis); 100 (Winser)  ‘Good’ if total score +75% | Applicability: directly; partially; not  Limitations: minor; potentially serious; very serious | 20 converted to % |
| Items | (1) Well-defined research question | (1) Study objectives clearly presented [7 points] | (1) Relevant study population for topic | (1) Study population clearly described |
|  | (2) Comprehensive description of alternatives | (2) Select perspective reasonably [4] | (2) Appropriate interventions for topic | (2) Competing alternatives clearly described |
|  | (3) Well-estimated effectiveness | (3) Best source for input estimates [8] | (3) Relevant to UK context | (3) Well-defined research question posed in answerable form |
|  | (4) All relevant costs and effects identified | (4) Subgroups prespecified at start of study [1] | (4) Perspective clearly stated | (4) Appropriate economic study design for stated objective |
|  | (5) All relevant costs and effects measured accurately | (5) Sensitivity analysis conducted to assess uncertainty & assumptions [9] | (5) All direct health and other effects included | (5) Model structural assumptions and validity properly reported |
|  | (6) All relevant costs and effects valued credibly | (6) Appropriate incremental analysis conducted [6] | (6) Appropriate discounting of future costs and outcomes | (6) Appropriate time horizon for costs and consequences |
|  | (7) Account for differential timing of costs and effects | (7) Methods for data use/abstraction clearly stated [5] | (7) Value health effects in QALYs | (7) Appropriate perspective |
|  | (8) Appropriate incremental analysis conducted | (8) Appropriate time horizon and discounting [7] | (8) Non-health costs/outcomes appropriately measured/valued | (8) All important and relevant costs for alternatives identified |
|  | (9) Allowance for uncertainty | (9) Appropriate cost measurement and unit costs described [8] | (9) Valid model structure for topic | (9) All costs measured in physical units |
|  | (10) Include all issues for evaluation users in results and discussion | (10) Primary outcome measures clearly stated with justification [6] | (10) Appropriate time horizon for costs and outcomes | (10) All costs valued appropriately |
|  |  | (11) Valid health outcome measures used [7] | (11) All relevant outcomes included | (11) All important and relevant outcomes for alternatives identified |
|  |  | (12) Model structure clearly presented [8] | (12) Baseline health outcome estimates from best available source | (12) All outcomes measured appropriately |
|  |  | (13) Main model assumptions and limitations of model justified [7] | (13) Effectiveness estimates from best available source | (13) CUA/CBA outcomes valued appropriately |
|  |  | (14) Discuss direction and magnitude of potential biases [6] | (14) All important and relevant costs included | (14) Conduct appropriate incremental analysis |
|  |  | (15) State recommendations and conclusions based on results [8] | (15) Resource use estimates from best available source | (15) Discount all future costs and outcomes appropriately |
|  |  | (16) Disclose source of funding [3] | (16) Unit cost estimates from best available source | (16) Uncertain variable values subjected to sensitivity analysis |
|  |  |  | (17) Present appropriate incremental analysis | (17) Conclusions that follow data |
|  |  |  | (18) Conduct sensitivity analysis | (18) Discuss generalizability of results to other settings/patients |
|  |  |  | (19) Report potential conflict of interest | (19) Report potential conflict of interest |
|  |  |  |  | (20) Discuss ethical and distributional issues |
| **Abbreviation:** CBA: cost-benefit analysis; CHEC: Consensus on Health Economic Criteria; CUA: cost-utility analysis; NICE: National Institute for Health and Care Excellence; QALY: quality-adjusted life-year; QHES: Quality of Health Economics Studies | | | | |

## Supplementary 5: Quality assessment checklist scores

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table CS5** Results of quality assessment by previous systematic reviews of community-based falls prevention economic evaluations. | | | | | | | | | | |
| **#** | **Primary study** | **Systematic review1** | **Quality assessment results by checklist2** | | | | | | | |
| Davis Drummond [15] | DJ/Huter Drummond [15] | Davis QHES [85]3 | Winser QHES [85] | PHE NICE (Yes #) [86]4 | PHE NICE verdict [86] | Olij CHEC [87]6 | Standard deviation of % scores |
| Max: 10 items converted % | Max: 10 items converted % | Max: 100% | Max: 100% | Max: 19 items converted % | Categories5 | Max: 100% |
| ***Single-vehicle evaluations (SVEs) (e.g., alongside randomized controlled trials)*** | | | | | | | | | | |
| 1 | Campbell (2005) [51] | Davis; PHE; Olij | 90.0 |  | 100 |  | 47.4 | Partially / Minor | 78.0 | 22.8 |
| 2 | Cockayne (2017) [52] | Olij |  |  |  |  |  |  | 63.0 |  |
| 3 | Davis (2011) [53] | DJ; Olij; Winser |  | 100 |  | 99.0 |  |  | 89.0 | 6.1 |
| 4 | Davis (2011b) [54] | Winser |  |  |  | 87.0 |  |  |  |  |
| 5 | Farag (2015) [55] | Olij |  |  |  |  |  |  | 92.0 |  |
| 6 | Farag (2016) [56] | PHE |  |  |  |  | 57.9 | Partially / Minor |  |  |
| 7 | Fletcher (2012) [57] | PHE |  |  |  |  | 57.9 | Directly / Minor |  |  |
| 8 | Hendriks (2008) [58] | DJ; PHE; Olij; Winser |  | 100 |  | 93.0 | 84.2 | Partially / Minor | 89.0 | 6.7 |
| 9 | Irvine (2010) [59] | DJ; PHE; Olij; Winser |  | 100 |  | 79.0 | 52.6 | Partially / Minor | 92.0 | 20.7 |
| 10 | Isaranuwatchai (2017) [60] | Huter; Winser |  | 70.0 |  | 91.0 |  |  |  | 14.8 |
| 11 | Jenkyn (2012) [61] | DJ; PHE; Olij |  | 90.0 |  |  | 42.1 | Partially / Minor | 79.0 | 25.1 |
| 12 | Kenkre (2002) [62] | DJ |  | 50.0 |  |  |  |  |  |  |
| 13 | Li (2015) [63] | PHE |  |  |  |  | 57.9 | Partially / Minor |  |  |
| 14 | Patil (2016) [64] | PHE; Olij |  |  |  |  | 52.6 | Partially / Minor | 97.0 | 31.4 |
| 15 | Peeters (2011) [65] | PHE; Olij |  |  |  |  | 73.7 | Directly / Minor | 92.0 | 13.0 |
| 16 | Polinder (2016) [66] | PHE |  |  |  |  | 63.2 | Directly / Minor |  |  |
| 17 | Rizzo (1996) [67] | RCN; Davis; Olij | 80.0 |  | 75.0 | 61.0 |  |  | 62.0 | 9.5 |
| 18 | Robertson (2001a) [40] | RCN; Davis; DJ; Olij | 90.0 | 80.0 | 100 | 66.0 |  |  | 91.0 | 13.0 |
| 19 | Robertson (2001b) [31] | RCN; Davis; DJ; Olij | 90.0 | 90.0 | 92.0 |  |  |  | 91.0 | 1.0 |
| 20 | Robertson (2001c) [68] | Davis; DJ; Olij | 90.0 | 80.0 | 100 | 93.0 |  |  | 94.0 | 7.3 |
| 21 | Sach (2012) [69] | PHE |  |  |  |  | 68.4 | Directly / Minor |  |  |
| 22 | Salkeld (2000) [70] | RCN; Davis; DJ; Olij | 60.0 | 80.0 | 73.0 |  |  |  | 85.0 | 10.8 |
| 23 | Timonen (2008) [71] | Winser |  |  |  | 39.0 |  |  |  |  |
|  |  | *Average:* | 83.3 | 84.0 | 90.0 | 78.7 | 59.8 |  | 85.3 | 11.5 |
| ***Decision models*** | | | | | | | | | | |
| 1 | Albert (2016) [32] | PHE |  |  |  |  | 47.4 | Partially / Potentially serious |  |  |
| 2 | Beard (2006) [33] | Davis; PHE | 70.0 |  | 59.0 |  | 52.6 | Directly / Minor |  | 8.8 |
| 3 | Carande-Kulis (2015) [72] | DJ; PHE |  | 80.0 |  |  | 42.1 | Partially / Minor |  | 26.8 |
| 4 | Church (2011) [73] | DJ; PHE; Olij |  | 70.0 |  |  | 78.9 | Partially / Minor | 83.0 | 6.7 |
| 5 | Church (2012) [74] | DJ; PHE; Olij |  | 50.0 |  |  | 68.4 | Directly / Minor | 83.0 | 16.5 |
| 6 | Day (2009) [46] | DJ |  | 70.0 |  |  |  |  |  |  |
| 7 | Farag (2015b) [36] | DJ; PHE; Olij |  | 70.0 |  |  | 68.4 | Partially / Minor | 75.0 | 3.4 |
| 8 | Frick (2010) [75] | DJ; PHE; Olij |  | 60.0 |  |  | 68.4 | Partially / Minor | 68.0 | 4.7 |
| 9 | Hektoen (2009) [76] | DJ; PHE |  | 90.0 |  |  | 26.5 | Partially / Potentially serious |  | 45.0 |
| 10 | Johansson (2008) [34] | DJ |  | 90.0 |  |  |  |  |  |  |
| 11 | Lee (2013) [77] | Olij |  |  |  |  |  |  | 90.0 |  |
| 12 | Ling (2008) [78] | DJ |  | 30.0 |  |  |  |  |  |  |
| 13 | McLean (2015) [38] | PHE; Olij; Huter; Winser |  | 90.0 |  | 94.0 | 73.7 | Directly / Minor | 95.0 | 9.9 |
| 14 | Mori (2017) [79] | Olij |  |  |  |  |  |  | 93.0 |  |
| 15 | OMAS (2008) [80] | DJ |  | 80.0 |  |  |  |  |  |  |
| 16 | Pega (2016) [81] | PHE; Olij |  |  |  |  | 84.2 | Directly / Minor | 83.0 | 0.9 |
| 17 | Poole (2015) [82] | Olij |  |  |  |  |  |  | 75.0 |  |
| 18 | Sach (2007) [83]7 | Davis; Olij | 100 |  | 92.0 |  |  |  | 89.0 | 5.7 |
| 19 | Smith (1998) [37] | RCN; Davis; Olij | 70.0 |  | 47.0 |  |  |  | 76.0 | 15.3 |
| 20 | van der Velde (2008) [35] | PHE |  |  |  |  | 52.6 | Directly / Minor |  |  |
| 21 | Wu (2010) [84] | PHE |  |  |  |  | 52.6 | Directly / Minor |  |  |
|  |  | *Average:* | 80.0 | 70.9 | 66.0 | 94.0 | 59.6 |  | 82.7 | 12.5 |
| **Abbreviation:** CHEC: Consensus on Health Economic Criteria; DJ: Dubas-Jakobczyk; FoF: fear of falling; HAM: home assessment and modification; NICE: National Institute for Health and Care Excellence; OMAS: Ontario Medical Advisory Secretariat; PHE: Public Health England; PS: public sector; QHES: Quality of Health Economic Studies; RCN: Royal College of Nursing; RCT: randomized controlled trial.  **Shading:** Evaluations shaded in light grey received consistent quality ranking across multiple reviews that applied a quantitative quality checklist. Consistent ranking is defined as receiving quality scores that are all above or below the average score for each checklist by study design. Evaluations in dark grey received inconsistent ranking.  1 References for systematic reviews: RCN [14]; Davis [25]; DJ [29]; PHE [26]; Olij [27]; Huter [30]; Winser [28]  2 Contents of the checklists are given in Table D in Supplementary material.  3 Davis review removed item 4 from the QHES checklist to produce a maximum score of 99. But it also calculated the percentage which is reported here.  4 This column reports the number of ‘Yes’ in a 19-item checklist given to a study by the PHE review. Potential options are: ‘Yes’; ‘No’; ‘Partly’; ‘Unclear’; ‘N/A’. PHE review added an extra item (item 8; see Table D in Supplementary material) to the original checklist.  5 Categories for applicability: ‘Directly’; ‘Partially’; ‘Not’. Categories for general limitations: ‘Minor’; ‘Potentially serious’; ‘Very serious’.  6 Olij review added an extra item (item 5; see Table D in Supplementary material) to the original checklist.  7 This study was included as a decision model because it extrapolated the results of a trial over a lifetime horizon. | | | | | | | | | | |

## Supplementary 6: Reporting and methodological quality of systematic reviews

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table CS6** AMSTAR 2 checklist for reporting and methodological quality of systematic reviews [16]. | | | | | | | |
| **Checklist item** | **Systematic review – publication year** | | | | | | |
| RCN [14] – 2005 | Davis [25] – 2010 | DJ [29] – 2017 | PHE [26] – 2018 | Olij [27] – 2018 | Huter [30] – 2018 | Winser [28] – 2019 |
| (1) Did the research questions and inclusion criteria include the components of PICO? (Response: Yes; No) | No (a) | Yes | Yes | Yes | Yes | Yes | Yes |
| (2) Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol? (Response: Yes; Partial Yes; No)1 | No (b) | Partial Yes (e) | Partial Yes (e) | Partial Yes (e) | Yes | Partial Yes (e) | Yes |
| (3) Did the review authors explain their selection of the study designs for inclusion in the review? (Response: Yes; No) | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| (4) Did the review authors use a comprehensive literature search strategy? (Response: Yes; Partial Yes; No)2 | Partial Yes (c) | Partial Yes (c) | Yes | Partial Yes (c) | Yes | Yes | Partial Yes (c) |
| (5) Did the review authors perform study selection in duplicate? (Response: Yes; No) | No | No | Yes | Yes | Yes | Yes | Yes |
| (6) Did the review authors perform data extraction in duplicate? (Response: Yes; No) | No | Yes | Yes | Yes | Yes | Yes | Yes |
| (7) Did the review authors provide a list of excluded studies and justify the exclusions? (Response: Yes; Partial Yes; No)3 | Partial Yes (d) | No | No | Yes | No | No | No |
| (8) Did the review authors describe the included studies in adequate detail? (Response states the number of data fields extracted; see manuscript Table 3).4 | No | Yes | Partial Yes | Yes | Partial Yes | Yes (j) | Yes |
| (9) Did the review authors use a satisfactory technique for assessing the risk of bias in individual studies that were included in the review? (Response: Yes; Partial Yes; No)5 | No (b) | Partial Yes | Yes | Yes | Partial Yes | Yes | Partial Yes |
| (10) Did the review authors report on the sources of funding for the studies included in the review? (Response: Yes; No) | No | Yes (f) | No | Yes (f) | Yes (f) | No | Yes (f) |
| (11) If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results? (Response: Yes; No; No meta-analysis conducted) | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an |
| (12) If meta-analysis was performed, did the review authors assess the potential impact of risk of bias in individual studies on the results of the meta-analysis or other evidence synthesis? (Response: Yes; No; No meta-analysis conducted) | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an |
| (13) Did the review authors account for risk of bias in individual studies when interpreting/discussing the results of the review? (Response: Yes; No)6 | No | No | Yes (g) | No (h) | No (i) | Yes (k) | Yes |
| (14) Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review? (Response: Yes; No) | No | Yes | Yes | Yes | Yes | Yes | Yes |
| (15) If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review? (Response: Yes; No; No meta-analysis conducted) | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an | No meta-an |
| (16) Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review? (Response: Yes; No) | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Number of ‘Yes’ or ‘Partial Yes’** | 4 | 10 | 11 | 12 | 11 | 11 | 12 |
| **Number of ‘Yes’** | 2 | 7 | 9 | 10 | 9 | 10 | 10 |
| **Abbreviation:** AMSTAR: assessment of multiple systematic reviews; Meta-an: meta-analysis; QHES: Quality of Health Economics Studies.  1 For Partial Yes, included: review question; search strategy; inclusion/exclusion criteria; risk of bias assessment. For Yes, as for Partial Yes, plus protocol registration and specified: meta-analysis/synthesis plan; plan for investigating causes of heterogeneity; justification for any deviations from the protocol. See footnote 5 concerning the relevance of risk of bias to reviews of economic evaluations.  2 For Partial Yes: searched at least two databases; provided keywords and/or search strategy; justified publication restrictions (e.g., language). For Yes, as for Partial Yes, plus done all of the following: searched the reference lists of included studies; searched trial/study registries (not relevant to this study); included/consulted content experts in the field; searched for grey literature where relevant; conducted search within 24 months of completion of the review.  3 For Partial Yes, provided a list of all potentially relevant studies that were read in full-text form but excluded from the review. For Yes, justified the exclusion from the review of each potentially relevant study.  4 The AMSTAR 2’s lists of details to be described by reviews did not adequately cover features relevant to economic evaluations. Hence, this item was judged based on the number of data fields extracted from evaluations as reported in Table C3: Yes if 30 or more fields extracted; Partial Yes if 20-29 fields extracted; No if <20 fields extracted. An exception is the Huter review which deliberately extracted a limited number of data fields. This is given a Yes.  5 In AMSTAR 2, this item chiefly concerns the risk of bias in intervention effectiveness estimate in randomised and non-randomised studies. Although clinical effectiveness is an important parameter for economic evaluation, a broader set of factors (e.g., costing of resource use) determine the credibility of economic outcomes. Therefore, Partial Yes was given if the review applied a methodological/reporting quality checklist to included evaluations; Yes was given if in addition to checklist, a narrative synthesis of methodological features was conducted.  6 See footnote 5 concerning the relevance of risk of bias to reviews of economic evaluations.  (a) Does not specify the intervention and comparator.  (b) Does not state the method of risk of bias (i.e., methodological quality) assessment. The review states that the Drummond checklist was applied but the scores are not reported.  (c) Does not mention searching grey literature and/or included studies’ reference lists.  (d) Results suggest that 14 full texts were assessed, and Table 18 presents 8 articles; but the section ‘Excluded studies’ only discusses 4 excluded articles. Hence, the review gives the exclusion reason only for a subset of excluded studies.  (e) Does not mention registering the review protocol.  (f) Funding source or conflict of interest was an item in the checklist used by the review to assess the reporting/methodological quality of included evaluations.  (g) Evaluation outcomes were grouped by categories of methodological quality of evaluations: ‘Good’, ‘Moderate’ and ‘Poor’ based on Drummond checklist score (see Table CS4 above).  (h) Applied checklist and listed several methodological caveats per evaluation but these were not mentioned when describing the ‘key messages’ by intervention type in Section 5.3.  (i) Does not discuss the methodological quality checklist scores when describing the evaluation outcomes.  (j) Given a Yes because the review deliberately limited the number of data fields extracted; eight fields were extracted as the result.  (k) Methodological features of individual evaluations described in Table CS3. | | | | | | | |

# Appendix D: Systematic review of falls prevention models

## Checklist for assessing quality of falls prevention economic models

Table D1 shows the 32 items contained in checklist applied to studies included in this systematic review. The items are drawn from a checklist developed by an international group of falls prevention experts [17]. All items are drawn from Table 1 of the guideline document which displays the checklist [17]. Final column of Table D1 details the original numbering of the items. Each study is given a score of 1 if deemed to have followed the item recommendation fully, 0.5 if partially and 0 if not followed. The total potential score is hence 32.

|  |  |  |
| --- | --- | --- |
| **Table D1** Items for model quality assessment drawn from expert-validated checklist for conducting and reporting economic evaluation of falls prevention interventions. | | |
| **#** | **Item1,2** | **Reference in guideline [17]** |
| **Define the type of study and the main objective(s)** | | |
| 1 | State whether a cost-effectiveness, cost-utility, or cost-benefit analysis and state the main outcomes of the analysis | Table 1, Item 1.1 |
| 2 | State whether carried out as part of a clinical trial or a model | Table 1, Item 1.2 |
| 3 | State the aim of the economic evaluation | Table 1, Item 1.3 |
| 4 | State the viewpoint [perspective] of the analysis and justify choice of viewpoint.3 | Table 1, Item 1.4 |
| **Describe competing alternatives** | | |
| 5 | Describe the intervention(s): (1) who delivered the intervention(s); (2) the components; (3) staff training; (4) how and where it was delivered; (5) frequency and dose; (6) whether sample in intervention study is similar to model population; (7) whether method of recruitment in intervention study is similar to intervention access method in model; (8) whether inclusion and exclusion criteria in intervention study are similar to intervention eligibility criteria in model.4 | Table 1, Item 2.1 |
| 6 | Classify the intervention(s) as single, multiple or multifactorial | Table 1, Item 2.2 |
| 7 | Include the justification for the intervention(s) and the comparator.5 | Table 1, Item 2.3 |
| 8 | Justify rationale for either including or excluding a “do-nothing” alternative.5 | Table 1, Item 2.4 |
| **Describe the method used to establish effectiveness** | | |
| 9 | State the source of the estimate for the effectiveness used: e.g., randomized controlled trial, systematic review | Table 1, Item 3.1 |
| 10 | State the definition of a fall used | Table 1, Item 3.2 |
| 11 | State the definition of a fall injury used.6 | Table 1, Item 3.4 |
| 12 | Provide the total number of falls (injuries) in each comparison group | Table 1, Item 3.5 |
| 13 | [Incorporate] uncertainty surrounding the effectiveness estimate | Table 1, Item 3.6 |
| 14 | If effectiveness is measured using a quality of life outcome such as QALYs, describe the method used for estimating QALY values | Table 1, Item 3.7 |
| **Identify all relevant costs and consequences for each alternative and comparator evaluated** | | |
| 15 | Identify all relevant total health resource utilisation costs for each alternative and comparator evaluated. Use total health resource utilisation costs for base case analysis. | Table 1, Item 4.1 |
| 16 | Identify all relevant fall-related costs and consequences for each alternative and comparator evaluated. Use fall-related costs for sensitivity analysis. | Table 1, Item 4.2 |
| **Ensure costs and consequences are measured accurately and in appropriate units** | | |
| 17 | Provide the units used for all cost items and sources for identifying these items | Table 1, Item 5.2 |
| 18 | Define fall-related costs as those incurred directly as a result of the fall. Provide the definition used for defining cost items as fall-related | Table 1, Item 5.3 |
| **Value costs and consequences credibly** | | |
| 19 | State the year and currency that costs were collected | Table 1, Item 6.1 |
| 20 | Use actual costs or validated methods to value each cost item if available | Table 1, Item 6.2 |
| 21 | Report total health resource utilisation costs, fall-related healthcare costs, and intervention costs separately. Report these costs both as a total and mean value broken down by group. | Table 1, Item 6.3 |
| **Costs and consequences should be adjusted for differential timing** | | |
| 22 | State and justify the time horizon over which costs and consequences were collected | Table 1, Item 7.1 |
| 23 | If costs were collected over a period of more than 1 year, use the recommended discount rate | Table 1, Item 7.2 |
| 24 | The effect of the intervention on the number of falls after completion of the trial should not be estimated or modelled as there are not adequate data available to estimate the future risk or cost of falls accurately | Table 1, Item 7.3 |
| 25 | If appropriate data permit, model the lifetime costs and consequences using a Markov model or discrete event simulation | Table 1, Item 7.4 |
| **Perform an incremental analysis of costs and consequences for all alternatives** | | |
| 26 | [Where natural unit of falls are used as health outcome under CEA,] report the ICER in three ways: (1) incremental cost per fall prevented; (2) incremental cost per unit decrease in falls per person-year (falls rate); and (3) incremental cost per unit decrease in mean number of falls per person | Table 1, Item 8.1 |
| 27 | Report all elements of incremental cost-effectiveness ratios (e.g., incremental costs, QALYs, total number of falls) separately for each group (preferably in a table). Avoid merely stating that one intervention “dominated” an alternative. | Table 1, Item 8.2 |
| **Identify key parameters and assumptions that may lead to different conclusions from the incremental analysis** | | |
| 28 | Estimate uncertainty for costs and consequences using comprehensive one-way sensitivity analyses and probabilistic sensitivity analyses | Table 1, Item 9.1 |
| **Present and discuss results from base case and sensitivity analyses** | | |
| 29 | Report key assumptions and values that substantially affected the estimates for costs and health outcomes | Table 1, Item 10.1 |
| 30 | Include a discussion of the assumptions and values of cost items and measures of effectiveness incorporated in the point estimates of cost-effectiveness or cost-utility outcomes | Table 1, Item 10.2 |
| 31 | Include a discussion of issues related to implementation of the intervention(s) – e.g., generalizability, feasibility, alternative settings, relevant ethical issues | Table 1, Item 10.3 |
| 32 | Discuss how the economic evaluation will inform health policy. | Table 1, Item 10.4 |
| **Abbreviation:** CEA: cost-effectiveness analysis; HRQoL: health-related quality of life; ICER: incremental cost-effectiveness ratio; ProFaNE: Prevention of Falls Network Europe; QALY: quality-adjusted life year.  1 Each study is given a score of 1 for each item if it is deemed to have followed the recommendation sufficiently, 0.5 if followed sub-optimally and 0 if not followed. The maximum potential score is 32.  2 The following items from the original checklist were excluded because they were deemed less relevant to the decision modelling context [17]: Item 3.3 concerning primary collection of falls data in trials; Item 3.8 concerning trial sample size calculation; Item 5.1 concerning primary collection of cost data in trials; Item 5.4 concerning methods for handling missing cost data; Item 7.5 concerning methods for costing resource items without decision modelling; Item 8.3 concerning methods for handling missing HRQoL and falls data; Item 8.4 concerning methods for identifying biases due to non-random missing data; Item 8.5 concerning adjusting the ICER for baseline HRQoL; Item 9.2 concerning estimation of intervention efficacy; and Item 9.3 concerning tests for statistical significance in between-group differences in outcomes.  3 The original checklist adds: “A societal perspective is regarded as most comprehensive; however, a funder or provider perspective may be more appropriate depending on the research question” [17]. Therefore, unless justifying reasons are given, models which did not employ the societal perspective are given the score of 0.5.  4 The original checklist recommends that the study describe the components, staff training, how and where it was delivered, frequency and dose, *the sample receiving the intervention, the method of recruitment and inclusion and exclusion criteria*. The latter italicized features are less relevant to decision models that infrequently conduct primary sampling and participant recruitment. They are hence adapted to address the issues of whether the external intervention study evidence suit the model’s population and intervention eligibility and access criteria. Out of 8 components, models that incorporated 6-8 are given a score of 1; those that incorporated 3-5 given 0.5; and those that incorporated 0-2 given 0.  5 Specifically, the guideline recommends the comparator represent the usual practice in the decision-making setting. Models should therefore justify how their choice of comparator reasonably represents usual practice.  6 The original checklist adds: “The number of radiographically confirmed peripheral fracture events per person-year is included in the dataset recommended by ProFaNE, classified using the ICD-10 classification system [88]. Fractures of the hip, wrist, and spine are the most common consequences of a fall. These should be reported individually. Other injuries as a result of a fall (e.g., traumatic brain injury) should be considered.” Models should incorporate granulated injury types. | | |

Ten items from the original Davis checklist were deemed primarily relevant to single-vehicle economic evaluations alongside randomized controlled trials rather than decision models and hence were excluded. Items 3.3 and 5.1 concerned methods for primary collection of falls and cost data in trial settings, respectively, while item 7.5 concerned methods for costing primary resource use data. Items 5.4, 8.3 and 8.4 concerned methods for handling missing data in trial settings, including the use of multiple imputation and identification of any biases resulting from non-random missing patterns. Item 3.8 concerned sample size calculation to detect statistically significant intervention effect, while Item 9.2 concerned estimation of the intervention effect and its 95% confidence interval. These issues regarding the quality of primary data collection and the calculation of effect in trial setting only indirectly affect decision models which can incorporate evidence from other (better designed and powered) trials and meta-analyses. Item 8.5 recommends that incremental cost per QALY ratios in cost-utility analyses are adjusted for baseline differences in HRQoL between intervention groups. Though this is feasible in decision models, the primary aim of the adjustment appears to be to control for covariates in identifying statistically significant differences in cost and health outcomes between the intervention groups in a trial. Indeed, Item 9.3 more explicitly recommends that statistical tests of significance be conducted on all cost and health outcomes. Such frequentist statistical tests that aim to reject or fail to reject a specific hypothesis are not relevant to decision models that are based on a Bayesian approach to statistics [15]. Items 8.5 and 9.3 were hence also excluded.

For Item 5, the original checklist recommends that the study describe the sample receiving the intervention, the method of recruitment and inclusion and exclusion criteria [17]. This recommendation appears to be primarily aimed at trial-based evaluations. Hence, the item modifies the original recommendation to better suit the modelling context. Specifically, the models should ensure that (or at least discuss whether) the inclusion and exclusion criteria, the methods of recruitment and the sample characteristics of external intervention studies that provide parameter estimates sufficiently match the models’ target population and intervention eligibility and access criteria. Out of the eight components considered in this item, models that incorporated six or more are given a score of 1; those that incorporated 3-5 given 0.5; and those that incorporated 0-2 given 0.

## Excluded studies

|  |  |  |
| --- | --- | --- |
| **Table D2** Studies excluded from systematic review at full text screening and exclusion reason. | | |
| **First author (year)** | **Title** | **Main exclusion reason** |
| Benzinger (2016) | The impact of preventive measures on the burden of femoral fractures – a modelling approach to estimating the impact of fall prevention exercises and oral bisphosphonate treatment for the years 2014 and 2025 | Not full economic evaluation |
| Bray Jenkyn (2010) | Fall-related health service utilization, costs, and cost-effectiveness of a multi-factorial falls prevention program delivered to community-dwelling older adults | Not decision model |
| Busbee (2003) | Cost-utility analysis of cataract surgery in the second eye | No falls outcome |
| Campbell (2005) | Randomised controlled trial of prevention of falls in people aged > or =75 with severe visual impairment: the VIP trial | Not decision model |
| Cockayne (2017) | Clinical effectiveness and cost-effectiveness of a multifaceted podiatry intervention for falls prevention in older people: a multicentre cohort randomised controlled trial (the REducing Falls with ORthoses and a Multifaceted podiatry intervention trial) | Not decision model |
| Cohen (2015) | Prevention Program Lowered The Risk Of Falls And Decreased Claims For Long-Term Services Among Elder Participants | Not decision model |
| Church (2015) | Cost Effectiveness of Falls and Injury Prevention Strategies for Older Adults Living in Residential Aged Care Facilities | Not community-dwelling older population |
| Davis (2011) | Economic evaluation of dose-response resistance training in older women: a cost-effectiveness and cost-utility analysis | Not decision model |
| Davis (2011b) | Sustained economic benefits of resistance training among community-dwelling senior women | Not decision model |
| Davis (2020) | Action Seniors! Cost-effectiveness analysis of a secondary falls prevention strategy among community-dwelling older fallers | Not decision model |
| Department of Health (2009) | Impact assessment of fracture prevention interventions | Not community-dwelling older population |
| Evers (2020) | Economic evaluation of a home-based programme to reduce concerns about falls in frail, independently-living older people | Not decision model |
| Farag (2015) | Cost-effectiveness of a Home-Exercise Program Among Older People After Hospitalization | Not decision model |
| Farag (2016) | Economic evaluation of a falls prevention exercise program among people With Parkinson's disease | Not decision model |
| Fletcher (2012) | An exercise intervention to prevent falls in Parkinson's: an economic evaluation | Not decision model |
| Ghimire (2015) | Effects of a Community-Based Fall Management Program on Medicare Cost Savings | Not decision model; Not full economic evaluation |
| Harper (2019) | Cost analysis of a brief intervention for the prevention of falls after discharge from an emergency department | Not decision model |
| Haumschild (2003) | Clinical and economic outcomes of a fall-focused pharmaceutical intervention program | Not community-dwelling older population |
| Hendriks (2008) | Cost-effectiveness of a multidisciplinary fall prevention program in community-dwelling elderly people: a randomized controlled trial (ISRCTN 64716113) | Not decision model |
| Hiligsmann (2009) | Development and validation of a Markov microsimulation model for the economic evaluation of treatments in osteoporosis | Not falls prevention |
| Hiligsmann (2010) | Cost–effectiveness of osteoporosis screening followed by treatment: the impact of medication adherence | Not falls prevention |
| Irvine (2010) | Cost-effectiveness of a day hospital falls prevention programme for screened community-dwelling older people at high risk of falls | Not decision model |
| Isaranuwatchai (2017) | Cost-effectiveness analysis of a multifactorial fall prevention intervention in older home care clients at risk for falling | Not decision model |
| Johnson (2015) | Yield and cost-effectiveness of laboratory testing to identify metabolic contributors to falls and fractures in older persons | Not decision model |
| Kingkaew (2012) | Evidence to inform decision makers in Thailand: a cost-effectiveness analysis of screening and treatment strategies for postmenopausal osteoporosis | Not falls prevention |
| Lamb (2020) | Screening and Intervention to Prevent Falls and Fractures in Older People | Not decision model |
| Li (2015) | Economic Evaluation of a Tai Ji Quan Intervention to Reduce Falls in People With Parkinson Disease, Oregon, 2008-2011 | Not decision model |
| Li (2016) | Implementing an Evidence-Based Fall Prevention Intervention in Community Senior Centers | Not decision model |
| Li (2019) | Cost-Effectiveness of a Therapeutic Tai Ji Quan Fall Prevention Intervention for Older Adults at High Risk of Falling | Not decision model |
| Markle-Reid (2010) | The effects and costs of a multifactorial and interdisciplinary team approach to falls prevention for older home care clients 'at risk' for falling: a randomized controlled trial | Not decision model |
| Matchar (2018) | A Cost-Effectiveness Analysis of a Randomized Control Trial of a Tailored, Multifactorial Program to Prevent Falls Among the Community-Dwelling Elderly | Not decision model |
| Mueller (2008) | Cost effectiveness of the German screen-and-treat strategy for postmenopausal osteoporosis | Not falls prevention |
| Nayak (2011) | Cost-effectiveness of different screening strategies for osteoporosis in postmenopausal women | Not falls prevention |
| Nayak (2016) | Cost‐Effectiveness of Osteoporosis Screening Strategies for Men | Not falls prevention |
| Patil (2016) | Cost-effectiveness of vitamin D supplementation and exercise in preventing injurious falls among older home-dwelling women: findings from an RCT | Not decision model |
| Peeters (2011) | Multifactorial evaluation and treatment of persons with a high risk of recurrent falling was not cost-effective | Not decision model |
| Polinder (2016) | Cost-utility of medication withdrawal in older fallers: results from the improving medication prescribing to reduce risk of FALLs (IMPROveFALL) trial | Not decision model |
| Qin (2016) | Economic impact of using fesoterodine for the treatment of overactive bladder with urge urinary incontinence in a vulnerable elderly population in the United States | Not falls prevention |
| Sach (2012) | Community falls prevention for people who call an emergency ambulance after a fall: an economic evaluation alongside a randomised controlled trial | Not decision model |
| Schousbee (2013) | Cost-effectiveness of bone densitometry among Caucasian women and men without a prior fracture according to age and body weight | Not falls prevention |
| Si (2015) | Screening for and treatment of osteoporosis: construction and validation of a state-transition microsimulation cost-effectiveness model | Not falls prevention |
| Stanmore (2019) | The effectiveness and cost-effectiveness of strength and balance Exergames to reduce falls risk for people aged 55 years and older in UK assisted living facilities: a multi-centre, cluster randomised controlled trial | Not decision model |
| Stevens (2018) | The Potential to Reduce Falls and Avert Costs by Clinically Managing Fall Risk | Not decision model; Not full economic evaluation |
| Strom (2007) | Cost-effectiveness of alendronate in the treatment of postmenopausal women in 9 European countries-an economic evaluation based on the fracture intervention trial | Not falls prevention |
| Van Haastregt (2013) | Cost-effectiveness of an intervention to reduce fear of falling | No falls outcome |
| Zethraeus (2007) | Cost-effectiveness of the treatment and prevention of osteoporosis—a review of the literature and a reference model | Not falls prevention |

## Methodological and reporting quality checklist scores

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table D3** Results of methodological and reporting quality checklist application to included models. See Table A2 for checklist item contents. | | | | | | | | | | | | | | | | |
| **Item #** | Agartioglu (2020) [89] | Albert (2016) [32] | Alhambra-Borras (2019) [90] | Beard (2006) [33] | Boyd (2020) [91] | Carande-Kulis (2015) [72] | CSP (2016) [92] | Church (2011) [73] | Church (2012) [74] | Comans (2009) [93] | Day (2009) [46] | Day (2010) [94] | Deverall (2018) [95] | Eldridge (2005) [96] | Farag (2015) [36] | Franklin (2019) [97] |
| 1 | 0 | 0.5 | 1 | 0.5 | 1 | 0.5 | 0.5 | 1 | 1 | 1 | 1 | 0 | 1 | 0.5 | 0.5 | 0.5 |
| 2 | 1 | 1 | 1 | 0.5 | 1 | 0 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 0 | 1 | 1 | 0.5 | 0 | 0 | 0 | 1 | 0 | 0 | 0.5 | 0 | 0.5 | 1 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 0 | 0.5 | 1 | 1 | 1 | 1 | 0 | 0.5 |
| 6 | 0 | 0 | 1 | 0.5 | 0 | 0 | 0.5 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 7 | 0.5 | 1 | 0.5 | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 1 |
| 8 | 1 | 0.5 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 1 |
| 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 10 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 |
| 11 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1 | 0 | 0 |
| 12 | 1 | 0 | 0 | 1 | 0 | 0 | 0.5 | 0 | 0.5 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 13 | 1 | 0.5 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 14 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 0.5 | 1 | 1 | 0.5 | 0.5 | 0.5 | 1 | 1 | 1 | 1 |
| 15 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 16 | 0.5 | 0 | 0 | 0.5 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0 | 0 | 0.5 | 0.5 | 0.5 |
| 17 | 0.5 | 1 | 1 | 1 | 1 | 0.5 | 1 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 1 | 1 | 0.5 | 1 |
| 18 | 1 | 0 | 0 | 1 | 0.5 | 1 | 0.5 | 0 | 0.5 | 1 | 0 | 0 | 0.5 | 0.5 | 1 | 1 |
| 19 | 1 | 0.5 | 0.5 | 1 | 1 | 1 | 0.5 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0.5 |
| 20 | 1 | 1 | 1 | 1 | 1 | 0.5 | 1 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 1 | 1 | 0.5 | 1 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 | 0 |
| 22 | 0.5 | 0 | 0 | 0.5 | 0 | 0.5 | 0 | 0.5 | 0.5 | 0 | 1 | 1 | 1 | 0.5 | 1 | 1 |
| 23 | 0.5 | 0.5 | 1 | 1 | 0.5 | 0.5 | 0 | 1 | 1 | 0.5 | 0.5 | 0.5 | 1 | 1 | 0 | 0 |
| 24 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 25 | 0 | 0 | 0.5 | 0 | 1 | 0.5 | 0 | 0 | 1 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0 |
| 26 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0 | 0.5 | 0 | 0 | 0.5 | 0.5 | 0.5 | 0.5 |
| 27 | 0 | 1 | 0 | 1 | 1 | 1 | 0.5 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 28 | 0.5 | 1 | 0 | 0 | 1 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 1 | 1 |
| 29 | 1 | 1 | 0.5 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30 | 1 | 1 | 0 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 31 | 1 | 1 | 0 | 0 | 1 | 1 | 0.5 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 32 | 1 | 1 | 0 | 1 | 1 | 1 | 0.5 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Total** | 22 | 20.5 | 16 | 21 | 23 | 18.5 | 17.5 | 15.5 | 17.5 | 20.5 | 20.5 | 18 | 24 | 17.5 | 17 | 22.5 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Table D3 (continued)** Results of checklist application to included studies | | | | | | | | | | | | | | | | |
| **Item #** | Frick (2010) [75] | Hektoen (2009) [76] | Hiligsmann (2014) [98] | Hirst (2016) [99] | Honkanen (2006) [100] | Howland (2015) [101] | Ippoliti (2018) [102] | Johansson (2008) [34] | Lee (2013) [77] | Ling (2008) [78] | McLean (2015) [38] | Miller (2011) [103] | Mori (2017) [79] | Moriarty (2019) [104] | Nshimyu-mukiza (2013) [105] | OMAS (2008) [80] |
| 1 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 0.5 | 1 | 0 | 0.5 | 1 | 0.5 | 0.5 | 1 | 1 | 1 |
| 2 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 0.5 | 1 | 0.5 | 0.5 | 0 | 0.5 | 1 | 1 | 0.5 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 0.5 | 1 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 0 | 1 | 0.5 |
| 6 | 1 | 1 | 0 | 0.5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0.5 | 0 | 1 |
| 7 | 1 | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 1 | 1 | 1 |
| 8 | 0 | 1 | 0 | 1 | 0.5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 |
| 9 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 10 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 11 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0.5 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 12 | 0 | 1 | 0 | 1 | 0.5 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 13 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0.5 |
| 14 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 1 | 1 | 0.5 |
| 15 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 17 | 0.5 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 18 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 19 | 1 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 20 | 0 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0.5 | 1 | 1 |
| 21 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0.5 | 0.5 |
| 22 | 0 | 0 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0 | 1 | 1 | 1 | 0.5 | 1 | 1 |
| 23 | 1 | 0.5 | 1 | 0.5 | 1 | 0.5 | 0 | 1 | 1 | 0.5 | 1 | 0 | 1 | 1 | 1 | 1 |
| 24 | 1 | 1 | 0.5 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 1 |
| 25 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 26 | 0.5 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.5 | 0.5 | 0.5 | 0 | 0 |
| 27 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 28 | 0.5 | 0.5 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0.5 | 1 | 0 |
| 29 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 30 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 31 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 32 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| **Total** | 21 | 23.5 | 24 | 26 | 23.5 | 20 | 18.5 | 26.5 | 20.5 | 13.5 | 26 | 16 | 25.5 | 23 | 27 | 22.5 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table D3 (continued)** Results of checklist application to included studies | | | | | | | | | | | | | | | | |
| **Item #** | Pega (2016) [81] | Poole (2014) [106] | Poole (2015) [82] | PHE (2018) [39] | RCN (2005) [14] | Sach (2007) [83] | Sach (2010) [107] | Smith (2016) [108] | Tannenbaum (2015) [109] | Turner (2020) [110] | van der Velde (2008) [35] | Wilson (2017) [111] | Wu (2010) [84] | Zarca (2014) [112] |  |  |
| 1 | 1 | 1 | 0.5 | 0.5 | 0 | 1 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 0.5 | 0.5 |  |  |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0 | 1 | 1 | 1 |  |  |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| 4 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 0 |  |  |
| 5 | 0.5 | 0 | 0 | 1 | 0 | 0.5 | 0.5 | 0 | 1 | 1 | 1 | 1 | 0.5 | 1 |  |  |
| 6 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0.5 | 0 | 0 | 1 | 0 |  |  |
| 7 | 1 | 1 | 1 | 1 | 0 | 0.5 | 0.5 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |  |  |
| 8 | 1 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 1 | 0.5 | 0.5 | 1 | 0 | 1 |  |  |
| 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| 10 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |  |  |
| 11 | 0.5 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0.5 | 0.5 | 0 | 1 |  |  |
| 12 | 0 | 1 | 1 | 1 | 0 | 0.5 | 0 | 0.5 | 0 | 0 | 1 | 0 | 1 | 0.5 |  |  |
| 13 | 1 | 0.5 | 0.5 | 1 | 1 | 0.5 | 0.5 | 0.5 | 1 | 0 | 1 | 1 | 1 | 1 |  |  |
| 14 | 1 | 0.5 | 1 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 1 |  |  |
| 15 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |  |  |
| 16 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.5 | 0.5 |  |  |
| 17 | 0 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 0.5 | 0.5 | 1 |  |  |
| 18 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 1 |  |  |
| 19 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| 20 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 1 |  |  |
| 21 | 0 | 0.5 | 0.5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.5 |  |  |
| 22 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0 | 1 | 1 | 0.5 |  |  |
| 23 | 1 | 0.5 | 0 | 1 | 1 | 1 | 1 | 0.5 | 0 | 0.5 | 0 | 1 | 0.5 | 1 |  |  |
| 24 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0.5 | 0 | 1 | 1 |  |  |
| 25 | 1 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 0 | 0.5 | 0.5 | 0 | 1 | 0.5 | 1 |  |  |
| 26 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.5 | 0 | 0.5 |  |  |
| 27 | 1 | 1 | 0.5 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |  |  |
| 28 | 1 | 0 | 0 | 0.5 | 0.5 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 0.5 |  |  |
| 29 | 1 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 1 | 1 | 1 |  |  |
| 30 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| 31 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| 32 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| **Total** | 23.5 | 23.5 | 20.5 | 26.5 | 18 | 20 | 20 | 18 | 23.5 | 22 | 18 | 23.5 | 22 | 25.5 |  |  |

## Health utilities data

|  |  |  |  |
| --- | --- | --- | --- |
| **Table D4** Summary of health utilities data and source used in decision models. | | | |
| **Study label1** | **Health state** | **Health utility** | **Source** |
| Albert (2016) | Health states defined by all-cause care utilisation frequencies, falls incidence and intervention receipt | EQ-5D range 0.263-0.942 | Internal data |
| Alhambra-Borras (2019) | Improved falls risk and/or frailty from baseline | EQ-5D 0.81 | Internal data |
| Same/worse falls risk and/or frailty | EQ-5D 0.75 | Internal data |
| BODE3 models | New Zealand population norm aged 65+ | Vary by age, sex and ethnicity; not reported. |  |
| MA fall | DW 0.100 for 1 year  (95% CI 0.060-0.150) | [113] |
| Vision improvement from cataract removal in Boyd (2020) | QALY gain of 0.057 (95% CI 0.041-0.075) | [113] |
| Church (2011); (2012) | Australian population aged 65+ | EQ-5D range 0.676-0.806; vary by age | [114] |
| Fall requiring ED visit | EQ-5D loss 0.014 (Range 0.010-0.016) for 1 year | [115] |
| Hospitalised fall | EQ-5D loss 0.144 (Range 0.000-0.255) for 1 year | [114, 115] |
| LTC admission (fall/other cause) | EQ-5D loss 0.060 (Range 0.030-0.338) for 1 year | [100] |
| Post-fracture state | EQ-5D loss 0.072 (Range 0.000-0.128) for 1 year | [114, 115] |
| Fear of falling after any fall | EQ-5D loss 0.045 (Range 0.033-0.058) for 1 year | [116] |
| Eldridge (2005) | No fall or fear | TTO value of 1.000 | Assumed |
| Fear of falling | TTO value of 0.670 | [117] |
| Hip fracture, no LTC admission | TTO value of 0.310 | [117] |
| Hip fracture, LTC admission | TTO value of 0.050 | [117] |
| Farag (2015) | Australian population aged 65 | EQ-5D 0.806 (Range 0.676-1); vary by age group | [114] |
| Fall not requiring ED visit | EQ-5D loss 0.018 (Range 0.013-0.070) for 1 year | [114] |
| Fall requiring ED visit | EQ-5D loss 0.040 (Range 0.014-0.150) for 1 year | [118] |
| Hospitalised fall, 1st year | EQ-5D loss 0.239 (Range 0.144-0.250) for 1 year | [118] |
| Hospitalised fall, 2nd year | EQ-5D loss 0.126 (Range 0.050-0.200) for 1 year (unclear whether permanent) | [118] |
| LTC admission (fall/other cause) | EQ-5D loss 0.100 (Range 0.030-0.940) for 1 year | [96, 114, 119] |
| Franklin (2019) | UK population norm aged 65+ | EQ-5D 0.780 (SE 0.11) for age 65; vary by age | [120, 121] |
| Fall requiring A&E, not hospital | EQ-5D loss 0.025 (SE 0.003) for 1 year | [122] |
| Hospitalised fall | EQ-5D loss 0.098 (SE 0.010) for 1 year | [122] |
| Fall requiring LTC admission | EQ-5D loss 0.194 (SE 0.019) for 1 year | [82] |
| Frick (2010) | US population aged 65+ | EQ-5D 0.823 (SD 0.025) | [123] |
| Hip fracture, 1st year | EQ-5D loss 0.200 (SD 0.010) for 1 year | [123] |
| Hip fracture, after 1st year | EQ-5D loss 0.060 (SD 0.010) each year | [123] |
| Hiligsmann (2014) | Hip fracture, 1st year | Multiplier 0.80 (Range 0.770-0.825) for 1 year | [124] |
| Hip fracture, after 1st years | Multiplier 0.90 (Range 0.885-0.910) each year | [124] |
| Vertebral fracture, 1st year | Multiplier 0.72 (Range 0.660-0.775) for 1 year | [124] |
| Vertebral fracture, after 1st year | Multiplier 0.93 (Range 0.916-0.946) each year | [124] |
| Wrist fracture, 1st year | Multiplier 0.94 (Range 0.910-0.960) for 1 year | [124] |
| Wrist fracture, after 1st year | Multiplier 1.00 each year | [124] |
| Other fracture, 1st year | Multiplier 0.91 for 1 year | [124] |
| Other fracture, after 1st year | Multiplier 1.00 each year | [124] |
| Hirst (2016) | UK women aged 75+ | EQ-5D 0.710 (SE 0.02) | [125] |
| Hip fracture | Multiplier 0.7 (SE 0.14) for 1 year | [126] |
| Humerus, wrist and other fracture | Multiplier 0.934 (SE 0.19) for 1 year | [126] |
| Honkanen (2006) | US population aged 60+ | TTO range 0.792-0.841; vary by age group, sex | [127] |
| Hip fracture | TTO loss 0.312 (Range 0.000-0.692) for 1 year | [114] |
| Post-hip fracture, non-disabling | HUI2 loss 0.112 (Range 0.000-0.482) each year | [128] |
| Functional dependence | HUI2 loss 0.170 (Range 0.140-0.230) each year | [129] |
| LTC admission | HUI2 loss 0.060 (Range 0.030-0.338) each year | [129] |
| Hip protector use | Utility loss 0.010 (Range -0.005-0.050) each year | [130] |
| Johansson (2008) | Swedish population aged 65+ | EQ-5D range 0.660-0.780; vary by age group, sex | [131] |
| Hip fracture | EQ-5D loss 0.170 for 1 year (unclear whether permanent) | [132] |
| Lee (2013) | US population aged 65+ | EQ-5D range 0.724-0.840; vary by age group, sex | [133] |
| Non-MA fall, no fear of falling | EQ-5D loss 0.044 (Range 0.000-0.075) for 1 year | [116, 118] |
| MA fall, fear of falling | EQ-5D loss 0.161 (Range 0.105-0.253) for 1 year | [116, 118] |
| McLean (2015) | No fall | EQ-5D 1.000 for 18 months | Assumed |
| Any fall [women only] | EQ-5D 0.993 [0.985] for 18 months | [116, 134, 135] |
| Hip fracture | EQ-5D 0.730 for 18 months | [118] |
| Shoulder fracture | EQ-5D 0.940 for 18 months | [136] |
| Wrist fracture [women only] | EQ-5D 0.969 [0.966] for 18 months | [118] |
| Other fracture [women only] | EQ-5D 0.958 [0.955] for 18 months | [136] |
| Mori (2017) | US population aged 65+ | EQ-5D range 0.677-0.801; vary by age group | [133] |
| Hip fracture, 1st year | Multiplier 0.776 (Range 0.720-0.844) for 1 year | [137, 138] |
| Hip fracture, after 1st year | Multiplier 0.855 (Range 0.800-0.909) each year | [137, 138] |
| Vertebral fracture, 1st year | Multiplier 0.724 (Range 0.667-0.779) for 1 year | [137, 138] |
| Vertebral fracture, after 1st year | Multiplier 0.868 (Range 0.827-0.922) each year | [137, 138] |
| Wrist fracture, 1st year | Multiplier 0.940 (Range 0.910-0.960) for 1 year | [124] |
| Other fracture, 1st year | Multiplier 0.910 (Range 0.880-0.940) for 1 year | [124] |
| Moriarty (2019) | UK population aged 65+ | EQ-5D VAS 0.770 (Beta 129, 39) for age 65-74; 0.740 (Beta 109, 38) for age 75+ | [120] |
| Hip fracture | Loss of 0.203 (Gamma 209, 1031) | [124] |
| Other MA falls | EQ-5D loss of 0.060 (Gamma 22, 369) | [132] |
| LTC admission (hip fracture/other cause) | HUI2 loss of 0.060 (Gamma 1, 10) (unclear whether permanent) | [73, 100] |
| Nshimyumukiza (2013) | Hip fracture hospitalisation | HUI3 0.300 (Range 0.510-0.600) for 1 year | [139] |
| Hip fracture rehabilitation | HUI3 0.560 (Range 0.630-0.700) for 1 year | [139] |
| Hip fracture post-rehabilitation | HUI3 0.850 (Range 0.730-0.900) each year | [139] |
| Vertebral fracture hospitalisation | HUI3 0.330 for 1 year | [140, 141] |
| Vertebral fracture rehabilitation | HUI3 0.680 for 1 year | [140, 141] |
| Vertebral fracture post-rehabilitation | HUI3 0.850 (Range 0.760-0.900) each year | [140, 141] |
| Wrist fracture hospitalisation | HUI3 0.610 for 1 year | [141] |
| Wrist fracture rehabilitation | HUI3 0.880 for 1 year | [141] |
| Wrist fracture post-rehabilitation | HUI3 1.000 (Range 0.820-1.000) each year | [141] |
| Poole (2015) | UK population aged 60+ | EQ-5D range 0.730-0.800; vary by age group | [120] |
| Fall requiring A&E, not hospital | EQ-5D range 0.713-0.783 by age group | [122] |
| Hospitalised fall | EQ-5D range 0.698-0.768 by age group | [122] |
| Fall requiring LTC admission | EQ-5D range 0.536-0.606 by age group | [142] |
| PHE (2018) | UK population aged 75+ | EQ-5D 0.730 | [82, 120] |
| Fall requiring GP or A&E | EQ-5D 0.730 | [82, 120] |
| Hip fracture, hospitalisation | EQ-5D 0.582 each year | [114] |
| Non-hip fracture or non-fracture, hospitalisation | EQ-5D 0.699 each year | [114] |
| Fall requiring LTC admission | EQ-5D loss 0.060 each year | [74] |
| Fear of falling after MA fall | EQ-5D loss 0.045 each year | [74, 116] |
| RCN (2005) | UK population aged 60+ | EQ-5D 0.800 for age 60-64 and 65-69; 0.750 for 70-74 and 75+ | [125] |
|  | Hip fracture | Multiplier unspecified; range 0.166 for 60-69 and 0.146 for 80+ | Assumed |
|  | Non-hip fracture | Multiplier unspecified; range 0.074 for 60-69 and 0.065 for 80+ | Assumed |
| Sach (2007); (2010) | Patient-level variation for women aged 70+ with bilateral cataracts | EQ-5D (range not reported) | Internal data |
| Tannanbaum (2015) | Insomnia patients, no treatment | SF-6D 0.630 | [143] |
| Insomnia patients, treatment | SF-6D 0.660 | [143] |
| Any fall | EQ-5D loss 0.030 for 6 months | [116] |
| Fear of falling after fall | EQ-5D loss 0.060 each 6-month cycle | [116] |
| Hip fracture | EQ-5D loss 0.170 for 6 months | [144] |
| Vertebral and write fractures | EQ-5D loss 0.140 for 6 months | [144] |
| Turner (2020) | Insomnia patients, sedative users | SF-6D 0.630 | [143] |
| Non-fracture fall | Loss of 0.005 (Gamma) | [104] |
| Non-hip fracture | EQ-5D loss of 0.025 (Gamma) | [132] |
| Hip fracture | EQ-5D loss of 0.019 (Gamma) | [132] |
| Zarca (2014) | French population aged 60+ | EQ-5D 0.780 for 60-69; 0.740 for 70-79 and 80-89 | [131] |
| Hip fracture, 1st year | Multiplier 0.79 to norm for 1 year | [145, 146] |
| Hip fracture, 2nd year | Multiplier 0.81 for 1 year | [145, 146] |
| Hip fracture, after 2nd year | Multiplier 0.90 each year | [145, 146] |
| **Abbreviation:** BODE3: Burden of Disease Epidemiology, Equity and Cost-Effectiveness Programme studies, including Boyd (2020), Deverall (2018), Pega (2016) and Wilson (2017); CI: confidence interval; DW: disability weight; ED: emergency department; LTC: long-term care; MA fall: fall requiring medical attention; PHE: Public Health England; QALY: quality-adjusted life year; RCN: Royal College of Nursing; SD: standard deviation; SE: standard error; TTO: time trade-off; VAS: visual analogue scale  1 See Table D3 for study references. | | | |

## Intervention characteristics summary

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| **Table D5** Summary of interventions evaluated in models. | | |
| **Study label1** | **Intervention type** | **Description** |
| Agartioglu (2020) | Community-based HAM | * Comparator: usual care * Component: older people in community visited at home monthly for 3 months; each visit lasted 40 minutes; home security checklist filled out. * Pathway: unclear * Resource/cost: implemented by GP nurse with 1-day training; salary; booklet. * Efficacy source: internal RCT; meta-analysis [47]; previous model which used meta-analysis [73] |
| Albert (2016) | Multifactorial intervention – Healthy Steps for Older Adults | * Comparator: community centre attendance only without intervention receipt * Component: FRA (TUG, one-legged stand, 60-second chair stand); referral to physician and HAM for participants scoring below age- and gender-based norms; education on home hazards and exercise. * Pathway: self-referred – voluntary take-up at community senior centres * Resource/cost: FRA by professional or trained volunteer; state department assured fidelity by training staff, monitoring data and interviewing participants; per-participant reimbursement from state department. * Efficacy source: internal quasi-experimental study |
| Alhambra-Borras (2019) | Exercise – nine-month group-based multi-component physical exercise | * Comparator: usual care * Component: 60 balance and strength exercise routines – 34 from Otago (adapted to group setting) and 26 designed *ad hoc* by PT leader; two 45-minute sessions per week; session supervised by PT; excluded walking component from Otago; aim to affect frailty as well as falls. * Pathway: proactive – assessed by home visit at baseline for study inclusion eligibility (i.e., at high falls risk and/or frail) * Resource/cost: PT labour; training and community venue but not costed * Efficacy source: internal quasi-experimental study |
| Beard (2006) | Intersectoral intervention, Stay on Your Feet, including multifactorial and environmental interventions | * Comparator: usual care in control regions * Component: education, HAM, exercise and public space safety improvements; FRA part of multifactorial intervention; targeting 8 falls risk factors (balance, gait, insufficient exercise, inappropriate footwear, poor vision, medication use, undertaking medical conditions, environmental hazards) * Pathway: self-referred – investment in marketing; environmental * Resource/cost: local clinicians and community staff labour; printing; marketing; overheads (administration); exercise cost borne by participants included in societal evaluation; travel and HAM costs borne by participants excluded from evaluation; time opportunity cost of local clinicians and community staff excluded; lobbying cost for public safety improvements included. * Efficacy source: internal quasi-experimental study |
| Boyd (2020) | Cataract surgery: (i) Expedited; (ii) Non-expedited first-eye surgery | * Comparator: no surgery receipt * Component: expedited surgery involves public sector purchase of private sector practice and reduces waiting time by 12 months; non-expedited surgery involves public sector delivery; surgery generates permanent vision improvement * Pathway: unclear – likely proactive; but no mention of how cataracts diagnosed * Resource/cost: specialist service; public sector reimbursement for private or public sector delivery * Efficacy source: external RCT [147] |
| Carande-Kulis (2015) | (i) Otago exercise; (ii) Tai Chi – Moving for Better Balance; (iii) ‘Stepping On’ – multiple-component intervention | * Comparator: unclear – control group in external RCTs * Component: (i) Otago – individually tailored muscle-strengthening and balance-retraining exercises of increasing difficulty combined with a walking programme; set of in-home exercises for appropriate and increasing levels of difficulty and walking plan; home visits by PT or trained nurse in first two months; (ii) Tai Chi – one-hour sessions of Tai Chi including warm-up and cool-down; 24 Tai Chi forms for weight shifting, postural alignment, and coordinated movements; three classes per week for 26 weeks; delivered by Tai Chi instructors; implemented in senior centres, adult activity centres and community centres; (iii) Stepping On – seven weekly three-hour group sessions in community setting with follow-up home visits; led by OT who introduced exercises and sessions on topics related to falls; most sessions attended by trained volunteer discussing medication management, home and community safety, sleep quality, and hip protector use. * Pathway: self-referred – cost of 10 hours of pre-intervention marketing; but also includes Otago strategy targeting persons aged 80+ – unclear how * Resource/cost: marketing; staff labour; training – lead trainer to train instructors who need retraining; materials; volunteer labour under Stepping On not costed * Efficacy source: external RCTs [148-150] |
| CSP (2016) | Falls risk screening and physiotherapy | * Comparator: no physiotherapy * Component: different physiotherapy forms – physiotherapy only, individual exercise, group exercise, modern exercise, all forms combined * Pathway: proactive – referral after TUG risk screening * Resource/cost: TUG screening not costed; two clients per PT; 20% of PTs implement group exercise, six per group; each PT provides 4.6 sessions per year. * Efficacy source: external meta-analysis [47] |
| Church (2011) | Multiple types | * Types: (A) For general older populations: (i) group exercise; (ii) home exercise; (iii) Tai Chi; (iv) Stepping On – multiple-component intervention; (v) multifactorial intervention; (vi) multifactorial risk assessment; (B) For specific older populations: (i) expedited cataract surgery; (ii) psychotropic medication withdrawal; (iii) cardiac pacing. * Comparator: no intervention received * Component: (A) General: (i) group exercise – two group classes and one home exercise session per week for 26 weeks; (ii) home exercise – five district nurse home visits in the first week, followed by home visits at week 2, 4 and 8 weeks with a booster at 6 months; (iii) Tai Chi – 6-month instructed classes twice a week for 12 participants; (iv) Stepping On – two-hour weekly group information sessions on falls prevention run by OT for 7 weeks, follow-up home visit, 2-hour nurse interview; (v) multifactorial intervention – FRA plus weekly exercise, HAM by OT, vision assessment, medication review and counselling; (vi) multifactorial risk assessment – FRA plus physician follow-up, 1-hour OT home visit and 2-hour nurse interview; (B) Specific: (i) expedited cataract surgery – surgery within 4 weeks vs. usual 12-month and two specialist visits; (ii) medication reduction over 14 weeks with six GP visits and nurse time; (iii) cardiac pacing – screening by carotid sinus massage, cardiovascular assessment, insertion of a pacemaker and post-pacemaker visit. * Pathway: unclear – screening required to identify specific patient groups but not mentioned or costed. * Resource/cost: see components. * Efficacy source: external meta-analysis [47] |
| Church (2012) | Multiple types | * Types: (A) For general-risk older populations: (i) group exercise; (ii) home exercise; (iii) Tai Chi; (iv) multiple-component intervention; (v) multifactorial intervention; (vi) multifactorial risk assessment; (B) For high-risk older populations: (i) group exercise; (ii) HAM; (iii) multifactorial intervention; (C) For specific older populations: (i) expedited cataract surgery; (ii) psychotropic medication withdrawal; (iii) cardiac pacing. * Comparator: no intervention received; cross-comparison between alternatives * Component: general- and high-risk group exercise – two classes per week for 26 weeks and home exercise; Tai Chi – two classes per week for six months with 12 participants per group; cataract surgery – not stated; multiple-component intervention – see Carande-Kulis (2015); other interventions – see Day (2009) * Pathway: unclear – no mention of how high-risk populations were identified * Resource/cost: 30% administration fee for group exercise (general- and high-risk) and Tai Chi but other resource/cost not stated; diagnostic-related group reimbursement rate for cataract surgery; multiple-component intervention – see Carande-Kulis (2015); other interventions – see Day (2009) * Efficacy source: external meta-analysis [47] |
| Comans (2009) | Multifactorial intervention: (i) centred-based; (ii) home-based | * Comparator: no intervention receipt * Component: for both multifactorial forms – FRA; Tai Chi; HAM; education; dietary advice * Pathway: unclear – likely proactive since targets persons with recent falls history, self- or GP-identified functional decline or self-reported gait instability; but no mention of routine care screening * Resource/cost: fixed – office space, equipment, storage, motor vehicle lease; variable – motor vehicle running, PT/OT labour, consumables * Efficacy source: external RCT [150] |
| Day (2009) | Multiple types | * Types: (i) Tai Chi for mobile 70+; (ii) home exercise for mobile 80+; (iii) HAM for all-cause hospital inpatients 65+ (including cognitively impaired) with falls history; (iv) multifactorial intervention for fall patients 65+ admitted to ED; (v) psychotropic medication withdrawal for medication users 65+; (vi) cardiac pacing for fall patients 50+ admitted to ED and have cardioinhibitory carotid sinus hypersensitivity. * Comparator: no intervention receipt * Component: (i) Tai Chi – group class twice per week (45 minutes, 12 participants per group) for 15 weeks and twice-daily home practice; progressive difficulty (gradual reduction of standing support until single limb stance achieved, increased body and rotation, increased reciprocal arm movements); (ii) home exercise – muscle-strengthening and balance retraining individually prescribed by PT-trained district or GP nurse and twice-weekly walks; five home visits over first six months and monthly telephone call to boost motivation over one year; (iii) HAM – home assessment around one hour conducted by OT using standardised home assessment form; list of specific recommendations on modifications made; telephone follow-up two weeks later to check modifications and encourage compliance; (iv) multifactorial intervention – falls risk screening at ED admission for fall; 36% referred to hospital outpatient department; 21% referred to multidisciplinary falls clinic – FRA by geriatrician, PT and nurse followed by tailored treatments (home/group exercise, gait aid change, footwear change, footcare, hip protectors, day hospital service, further medical tests); 18% referred to GP; 15% referred to optometrist; 100% received HAM by OT; (v) psychotropic medication withdrawal – doses of benzodiazepine, other hypnotic, antidepressant or major tranquiliser gradually reduced over 14 weeks: 80% of original dose after two weeks, 60% after five, 40% after eight, 20% after 11, placebo by 14; (vi) cardiac pacing – carotid screening, specialist consultation and cardiovascular assessment, pacemaker insertion, post-insertion specialist visit * Pathway: (i) Tai Chi – self-referred with marketing; (ii) home exercise – proactive because GPs’ time included in recruitment; (iii) HAM – reactive, though for all-cause hospital inpatients; (iv) multifactorial intervention – reactive; (v) psychotropic medication withdrawal – proactive, users referred by GPs; (vi) cardiac pacing – reactive. * Resource/cost: (i) Tai Chi – instructor labour, venue, music license, community marketing, administration; (ii) home exercise – staff training, recruitment, material, staff labour; (iii) HAM – staff labour and travel, equipment; (iv) multifactorial intervention – falls risk identification, staff labour, equipment, overhead; (v) psychotropic medication withdrawal – falls risk screening, medication cost, staff labour; (vi) cardiac pacing – staff labour, equipment. * Efficacy source: external RCTs [31, 148, 151-155] |
| Day (2010) | Group-based Tai Chi | * Comparator: no intervention receipt * Component: group-based Tai Chi for persons 70+ without profound limits in communication, mobility and self-care; twice weekly classes for 26 weeks * Pathway: self-referred – participants recruited through newspaper advertisement * Resource/cost: recruitment; coordination; staff labour; venue; music license fee * Efficacy source: external meta-analysis (2009 version) [47] |
| Deverall (2018) | Exercise: (i) Peer-led group exercise; (ii) Home exercise; (iii) Commercial group exercise | * Comparator: no intervention receipt * Component: (i) peer-led group exercise “Steady As You Go” – based on Otago exercise programme (OEP); weekly sessions, first 10 weeks supervised by trained staff, after which a group member trained as peer leader; individuals can participate until age 90 or death; (ii) home exercise – physiotherapy-based exercise individually tailored by nurse specialist; based on OEP; home visits at week 1, 2, 4 and 8 and at 6 months; (iii) commercial group exercise – group exercise classes in commercial gym, not specifically designed for older adults; focus on balance and strength (e.g., Tai Chi, Pilates, Yoga) * Pathway: self-referred – discusses mass media campaigns to promote uptake * Resource/cost: (i) group exercise – private transport costs for 50% of group exercise participants; venue hire using donations; maintained for 25 years with same cost; (ii) home exercise – recruitment, equipment, consumables, staff labour, overheads; (iii) commercial exercise – cost of gym class enrolment * Efficacy source: external meta-analysis [47] |
| Eldridge (2005) | Falls risk screening and multifactorial intervention at falls clinic or bi-disciplinary gait and balance exercise | * Comparator: usual care in primary care trust (PCT) area * Component: facilitator at PCT to introduce programme; enhancement of existing falls risk screening and referral system; screening using Falls Risk Assessment Tool (FRAT) – high falls risk if three or more risk factors out of falls history, 4+ prescribed medication per day, stroke or Parkinson’s disease, balance problems, and inability to rise from chair without using arms; screening conducted in community by primary healthcare and social care staff and in hospital and A&E by healthcare staff; establishment of a falls clinic if none existed multidisciplinary FRA and treatment by geriatrician, nurse, OT and PT (multifactorial intervention); reactive patients always referred to falls clinic; proactive patients referred to falls clinic or OT/PT (bi-disciplinary) gait and balance treatment * Pathway: (i) proactive – screening by FRAT conducted by primary healthcare and social care services plus additional screening by GP before referral to falls clinic or OT/PT gait and balance treatment; (ii) reactive – screening by FRAT conducted by healthcare staff at A&E and hospital before referral to falls clinic; (iii) self-referred – individuals screened but not referred can still self-refer to (presumably) gait and balance exercise (50% of false and 10% of true negative individuals self-refer). * Resource/cost: fixed cost – programme set-up; staff labour (facilitator, OT/PT); falls clinic running; printing and miscellaneous; per-participant cost – staff labour cost (GP, primary and community nurses, A&E staff) administering FRAT. * Efficacy source: external meta-analysis (2001 version) [47]; same efficacy applied to falls clinic and OT/PT treatment. |
| Farag (2015) | Non-specific intervention | * Comparator: no programme condition * Component: non-specific intervention representative of “intervention strategies suited to application to the broader population” such as individual/group exercise and multifactorial intervention. * Pathway: self-referred – intervention targets individuals without falls history; mentions information provision to community groups and GPs to increase uptake. * Resource/cost: not stated; per-participant cost of AUS$700 * Efficacy source: assumption |
| Franklin (2019) | Falls risk screening and: (i) Otago home exercise; (ii) FaME group exercise; (iii) Group Tai Chi; (iv) HAM | * Comparator: no falls risk screening and no treatment; strategy cross comparison * Component: TUG or QTUG for falls risk screening – in QTUG individuals wear inertial sensor on each leg whilst performing TUG; both performed by GP nurse; (i) Otago – multiple-component exercise conducted at home; trained instructor teaches participants and monitors progress; initial assessment performed by PT or postural stability instructor to determine initial difficulty; 10 contact hours over year; (ii) FaME – multiple-component group exercise programme delivered by postural stability instructor; weekly group sessions for 45-75 minutes plus home exercises for six months; (iii) Tai Chi – performed at home or in group; exercises combining deep breathing and relaxation with flowing movements; (iv) HAM – professional assesses person’s usual residence to identify environmental hazards (e.g., poor lighting, no handrails) and carries out actions to reduce these * Pathway: proactive – only screened high-risk individuals referred * Resource/cost: TUG/QTUG – set-up cost (training for QTUG); staff labour; equipment; treatments – costs from PHE (2018) including 5% evaluation cost * Efficacy source: external meta-analysis for TUG efficacy [156]; external study for QTUG efficacy [157]; external meta-analyses for treatments [47, 49]. |
| Frick (2010) | Multiple types | * Types: (i) multifactorial intervention for general-risk population; (ii) multifactorial intervention for high-risk population (fallen in past year); (iii) HAM for high-risk population; (iv) vitamin D supplementation; (v) medication modification; (vi) exercise; (vii) Tai Chi. * Comparator: standard care – standard medical evaluation on health status and routine examinations and treatments where needed; cross comparisons * Component: (i/ii) multifactorial intervention – not stated; (iii) HAM – delivered by OT, PT, nurses; (iv) vitamin D – 800 IU per day; (v) medication modification – management of central nervous system drugs, particularly withdrawal of psychotropics such as benzodiazepines, anti-depressants and antipsychotics; (vi) exercise – muscle and balance training; (vii) Tai Chi – not stated * Pathway: unclear – screening required for (ii), (iii) and (v) but not mentioned and not costed, though possibly included in overheads * Resource/cost: staff labour (adjusted upwards by 30% to cover benefits); overheads (adjusted upwards by 50% for office and administrative costs) * Efficacy source: external meta-analysis (2003 version) [47] |
| Hektoen (2009) | Otago home exercise | * Comparator: RCT control group * Component: strength and balance re-training for people at high risk of falling; for first two months, four one-hour home visits by PT who gave instructions for home-based training; for next 10 months, PT made telephone calls every second month; exercise lasted 30 minutes per session and performed three times weekly; walking plan * Pathway: self-referred – RCT invested resources for participant recruitment but no mention of professional referrals. * Resource/cost: recruitment; staff labour (exercise instruction, follow-up telephone calls); equipment * Efficacy source: external RCT [68] |
| Hiligsmann (2014) | Vitamin D and calcium supplementation for osteoporotic patients | * Comparator: no supplementation * Component: one BMD measurement at first and third years of three-year supplementation programme; one physician visit per year during programme; vitamin D – 800 IU daily; calcium – ‘magistral formula’, 1000mg daily. * Pathway: proactive – BMD screening to diagnose osteoporosis * Resource/cost: BMD screening; physician labour; vitamin D and calcium tablets * Efficacy source: external meta-analyses – efficacy on hip fracture reduction [158]; on vertebral fracture [159]; on non-vertebral fractures [160] |
| Hirst (2016) | Transdermal buprenorphine vs. Tramadol for pain management | * Comparator: Tramadol * Component: (i) Transdermal buprenorphine – BuTrans 1.68 mg; 0.24 mg daily dose (1/7 of single patch); average of 107.18 days dosed per year; (ii) Tramadol – modified release non-propriety 100 mg; 240 mg daily dose; 107.18 days/year; BNF conversion ratio used to equate dosage of two medications. * Pathway: unclear – likely proactive because population is women 75+ using tramadol to treat moderate-to-severe pain; but screening not mentioned or costed * Resource/cost: see component. * Efficacy source: external case-control study for fracture odds ratio [161]; retrospective cohort study for medication average annual adherence rate [162]. |
| Honkanen (2006) | Hip protector | * Comparator: no hip protector or non-adherence to hip protector use * Component: hip protector efficacy gained only during hours it is worn during day; soft-shell version; functionally independent persons use less expensive pull-up model, dependent persons use more expensive wrap-around model; 3 or 5 pairs of protectors required per year in community (according to functional status), 4 or 7 in nursing home; protector use incurs health utility loss. * Pathway: unclear – likely proactive because study providing the adherence data [163] mentioned that women were referred from GPs to hospital outpatient clinic to discuss hip protector use; but referral process not modelled or costed. * Resource/cost: see component; depends on functional status and residence. * Efficacy source: efficacy – external RCT [164]; adherence (% of daily hours protector is worn) – external observational studies [163, 165]; utility loss [130]. |
| Howland (2015) | Multiple-component intervention – Matter of Balance lay-led version | * Comparator: usual care received by persons admitted to ED for fall * Component: ED fall patients advised by healthcare professional to participate in intervention; Matter of Balance lay-led version (MoB/VLL) – eight-session cognitive behavioural programme developed to reduce fear of falling and associated activity restriction; change perception of falls as something controllable; set goals to increase activity; reduce fall risk at home; exercise to increase strength and balance * Pathway: reactive – targets adults admitted to ED for fall * Resource/cost: cost of healthcare professionals promoting participation not included; per-participant cost estimate of MoB/VLL from previous cost analysis; deliberately excluded start-up cost included in Miller (2011). * Efficacy source: external RCT [166] |
| Ippoliti (2018) | Multifactorial intervention delivered by community nurses in mountainous areas | * Comparator: no intervention * Component: proactive engagement of community nurses with older persons living in mountainous areas of Italy; lifestyle changes (walking groups and low impact exercise); HAM (e.g., adequate lighting, bathroom handrails); active collaboration with family doctors to coordinate health and social care services (e.g., outpatient clinic visits, prescriptions, specialist services); community organisations and stakeholders to help identify needy older persons. * Pathway: proactive – relies on community organisations and stakeholders to identify needy older persons and promote uptake * Resource/cost: unclear whether community organisations are reimbursed by local health authority; staff labour; transport cost * Efficacy source: policy variable for break-even analysis |
| Johansson (2008) | Intersectoral intervention, Safe Seniors in Sundbyberg, including multifactorial and environmental interventions | * Comparator: usual care in community * Component: programme implemented in Sweden municipality with around 5,500 persons aged 65+; principle of community and intersectoral collaboration; components based on safety promotion and injury prevention methods; project team included full-time project coordinator, steering group (executives from regional healthcare management and older care organisations and representatives of public and voluntary organisations and businesses); (i) multifactorial intervention – safety education, group balance exercises delivered by PT; Tai Chi and other physical activities; HAM delivered by nurse and PT; (ii) environmental – safety surveillance in neighbourhoods; new routines in housing reconstruction (representatives from council, housing firm and tenants’ voluntary organisation inspected buildings and recommended new norms) * Pathway: (i) multifactorial intervention – likely self-referred, no mention of screening to refer eligible persons; (ii) environmental * Resource/cost: total cost of 2.5 million Swedish Krona over five years; primary collection of resource use data; coordinator labour cost for access; overheads costed based on hours of project work, assuming value of 20% of hourly labour costs for providing overheads; standardised cost of venues; labour wage cost according to profession; time costs for unpaid volunteers and participants valued at 35% of average wage; equipment (e.g., reconstruction costs, devices); only a portion of local stakeholder costs borne by the public sector * Efficacy source: internal quasi-experimental study |
| Lee (2013) | Vitamin D level screening and universal or targeted supplementation | * Comparator: no vitamin D level screening and no supplementation * Component: (i) universal supplementation – cholecalciferol 1,000 IU daily regardless of underlying 25-hydroxyvitamin D status; persons with vitamin D insufficiency gain benefit of falls risk reduction; persons with vitamin D deficiency gain no benefit due to insufficient dose; (ii) targeted supplementation – all persons screened for 25-hydroxyvitamin D levels; vitamin D dose varied according to level; no supplement for sufficient level; 1,000 IU daily for vitamin D insufficiency; 2,000-4,000 IU daily for vitamin D deficiency. * Pathway: proactive – even for universal supplementation because it is initiated by healthcare professional * Resource/cost: vitamin D screening reimbursement rate; supplements cost; physician time not costed. * Efficacy source: external meta-analyses (unclear referencing) [47, 167, 168] |
| Ling (2008) | HAM | * Comparator: no intervention * Component: Hana Program – installation of access ramps, minor floor repairs and grab-bars plus education on falls and follow-up by community volunteers; goal to promote independent living at home; targeted individuals with falls history and other falls risk factors * Pathway: unclear – targets those with falls history and other falls risk factors but unclear how they were identified and no cost of screening included. * Resource/cost: material; labour; community volunteer labour (not costed) * Efficacy source: external RCT (evaluated intervention includes not only HAM but also multidisciplinary multifactorial intervention) [153] |
| McLean (2015) | Group exercise | * Comparator: routine care and activity considered standard care * Component: NoFalls exercise programme – weekly one-hour group exercise (graded exercises for flexibility, leg strength, balance) for 15 weeks, supplemented by daily home exercises * Pathway: self-referred – investment in advertising (printed flyers, local newspapers in alternative scenario) * Resource/cost: staff labour; administration support; venue; music license fee; exercise equipment; consumables * Efficacy source: internal RCT [169] |
| Miller (2011) | Multiple-component intervention – Matter of Balance lay-led version | * Comparator: no intervention * Component: Matter of Balance lay-led version (MoB/VLL) – change perception of falls as something controllable; set goals to increase activity; reduce fall risk at home; exercise to increase strength and balance; eight two-hour sessions over 4-8 week period; start with training video and talk by qualified instructor on falls risk factors; later sessions involve exercise; training of lay leaders to lead sessions * Pathway: unclear – targets high-risk group but screening not mentioned or costed * Resource/cost: start-up and development cost (amortised over three years); coordinator fixed salary; labour; venues (donated by local organisations); supplies; training (master trainers and volunteers; fixed cost); total capacity of 10 classes with 140 participants (100 adherents). * Efficacy source: policy variable for break-even analysis |
| Mori (2017) | Exercise and oral bisphosphonate combined | * Comparator: cross-comparison – exercise alone, oral bisphosphonate alone or no intervention; exercise alone and no intervention strategies are dominated, hence comparison between oral bisphosphonate alone and combined strategy. * Component: combined strategy of falls prevention exercise for one year and oral bisphosphonate therapy for five years; (i) exercise – Otago programme; (ii) bisphosphonate therapy – initial dual-energy X-ray absorptiometry (DXA) measurement of femoral neck and lumbar spine; generic alendronate 70 mg once weekly for five years for those with osteoporosis (T-score -2.5 or less) * Pathway: unclear – likely proactive for oral bisphosphonate prescribing by healthcare professional; considers targeting osteoporotic patients only in alternative scenario but screening not mentioned or costed. * Resource/cost: (i) exercise – cost taken from Carande-Kulis (2015) plus time opportunity cost for exercise participants; (ii) bisphosphonate therapy – reimbursement rates for DXA and physician visits; medication * Efficacy source: exercise – external meta-analysis [170]; multiplicative efficacies for combined strategy. |
| Moriarty (2019) | Modification of inappropriately prescribed benzodiazepine and proton pump inhibitors | * Comparator: continued inappropriate prescription of benzodiazepine – use for four or more weeks – and proton pump inhibitors (PPIs) – use at maximal dose for longer than eight weeks. * Component: appropriate prescribing of benzodiazepine (complete withdrawal) and PPIs (use at maintenance dose); patients not shifted to appropriate prescribing after fall due to withdrawal symptoms for benzodiazepine and unlikely attribution of adverse events for PPIs – i.e., no reactive intervention pathway. * Pathway: unclear – likely proactive to identify inappropriately prescribed medication users, but screening not mentioned or costed; no reactive pathway. * Resource/cost: medication ingredient costs from reimbursement rates – annual cost at daily dose estimated; labour – pharmacist dispensing fee * Efficacy source: external RCTs for rates of discontinuation of inappropriately prescribed drugs – benzodiazepine [171]; PPI [172]. |
| Nshimyumu-kiza (2013) | BMD screening and physical activity and/or vitamin D and calcium supplementation as primary prevention of osteoporosis in women | * Comparator: cross-comparisons between primary and secondary osteoporosis prevention strategies and no prevention (absence of any specific national programme to initiate prevention) * Component: (i) primary prevention of osteoporosis for women not already engaged in the options recommended by the 2010 Canadian guidelines: (a) vitamin D and calcium supplementation; (b) physical activity (as simple was daily walking) promotion; (ii) secondary prevention of osteoporosis – universal screening programme using: (a) risk questionnaires (Simple Calculated Osteoporosis Risk Estimation (SCORE), Osteoporosis Risk Assessment Instrument (ORAI), Osteoporosis Self-Assessment Tool (OST)); (b) the Canadian Association of Radiologists and Osteoporosis Canada (CAROC) assessment tool, based on age, gender, BMD, prior fracture and prior use of glucocorticoids; (c) women categorised into low risk (<10% ten-year risk of fracture), moderate risk (10-20% risk) and high risk (>20% risk) based on CAROC thresholds; primary prevention for low-risk persons and osteoporosis treatment for high-risk. Following fracture, reactive intervention is initiated involving risedronate pharmacotherapy and vitamin D and calcium supplement. * Pathway: (i) primary prevention – proactive, because initiated only for those not currently engaged in adequate physical activity or vitamin D/calcium supplementation; under universal screening scenario, this assessment is made at screening; under primary prevention only scenario, this assessment process is not costed; but model includes cost of national physical activity promotion campaign, suggesting that there is a self-referred element; (ii) secondary prevention – proactive, always initiated after screening; (iii) reactive intervention – reactive, initiated after fracture incidence. * Resource/cost: (i) primary prevention – promotion campaign for physical activity access; vitamin D and calcium unit costs; cost of BMD screening; (ii) secondary prevention – cost of BMD screening; labour and pharmaceuticals. * Efficacy source: physical activity – external meta-analysis of prospective cohort studies [173]; vitamin D and calcium – external meta-analysis [159]; take the highest of the two efficacies. |
| OMAS (2008) | Multiple types | * Types: (i) exercise longer than six months; (ii) HAM; (iii) vitamin D and calcium supplementation; (iv) psychotropic medication withdrawal; (v) gait stabiliser * Comparator: no intervention * Component: (i) exercise – 26 group classes with PT for year, nine people per group; for mobile seniors without disability; (ii) HAM – one OT home visit (two hours) plus modifications; for frail seniors with disability; (iii) vitamin D and calcium – 1,000 IU vitamin D and 1,000 mg calcium daily; for older women with fracture risk factor(s); (iv) psychotropic medication withdrawal – one pharmacy consultation in year; for older psychotropic medication users; (v) gait stabiliser – single device replaced every year; for mobile seniors without disability. * Pathway: unclear – screening required for HAM, vitamin D and calcium, and psychotropic medication withdrawal; but not mentioned or costed. * Resource/cost: (i) exercise – labour (PT fee); (ii) HAM – labour; equipment; (iii) vitamin D and calcium – equipment; (iv) psychotropic medication withdrawal – labour; (v) gait stabiliser – equipment. * Efficacy source: internal meta-analysis |
| Pega (2016) | HAM | * Comparator: no intervention * Component: personalised assessment of injury hazards in the home (generally by OT) and systematic removal of these hazards (e.g., reducing tripping hazards, adding grab-bars, adding stairway handrails, improving home lighting); for older persons living in still unmodified private dwellings; evaluates alternative scenario of targeting subgroup with MA falls history. * Pathway: unclear – likely self-referred in base case but does not include cost of citywide invitation programme as in Wilson (2017); likely proactive in alternative scenario where HAM targeted at those who experience MA fall, but screening not mentioned or costed; mentions a further scenario in Appendix of prospective HAM provision for MA fallers at point of the fall, i.e., a reactive pathway. * Resource/cost: labour; equipment * Efficacy source: external meta-analysis [47] |
| Poole (2014) | Vitamin D supplementation | * Comparator: no supplementation * Component: licensed oral colecalciferol 800 IU daily (Desunim or Fultium-D3) * Pathway: unclear * Resource/cost: vitamin D daily dose cost * Efficacy source: external meta-analysis [174] |
| Poole (2015) | Vitamin D supplementation | * Comparator: no supplementation * Component: licensed oral colecalciferol 800 IU daily * Pathway: unclear * Resource/cost: vitamin D daily dose cost * Efficacy source: external meta-analysis [175] |
| PHE (2018) | (i) Otago home exercise; (ii) FaME group exercise; (iii) Group Tai Chi; (iv) HAM | * Comparator: control group in RCTs * Component: (i) Otago home exercise – initial assessment by PT or postural stability instructor to set starting level; supervised by trained instructor, with assumed mix of 50% PT, 40% technical assistant and 10% leisure service employees; 50% of staff require training; 10 contact hours for year (one initial visit, four follow-up visits, nine catch-up calls) (ii) FaME group exercise – initial assessment of ability; weekly one-hour sessions for 24 weeks; group of 10 participants; delivery staff mix of 20% PT, 45% technical assistant, 25% leisure service exercise instructors; 50% of staff require training; (iii) Tai Chi – 49 one-hour sessions twice per week; staff mix of 20% PT, 20% technical assistant and 60% self-employed instructors; 10 participants per group; 50% of staff require training; (iv) HAM – delivered only by OT; initial safety assessment at home and recommendations on required modifications plus follow-up visits; modifications and equipment – non-slip bathmat, stair rail, grab-rail, raised toilet seat, shower seat, rollator, wet rom conversion, move electrical cord * Pathway: unclear for Otago, FaME and Tai Chi – targeted high-risk group (34% of those aged 65+) but no screening mentioned or costed; reactive for HAM – targeted at hospitalised fallers (2% of those aged 65+) * Resource/cost: (i) Otago – labour, training, travel, equipment, evaluation; (ii) FaME – labour, training, travel, equipment, venue, evaluation; (iii) Tai Chi – labour, training, travel, equipment, venue, evaluation; (iv) HAM – labour, equipment, evaluation. * Efficacy source: (i) Otago home exercise – external meta-analysis [170]; (ii) FaME group exercise – external RCT [176]; (iii) Tai Chi – external meta-analysis [47]; (iv) HAM – external meta-analysis [47] |
| RCN (2005) | (i) Exercise; (ii) Multifactorial intervention | * Comparator: no intervention receipt * Component: falls risk screening for both interventions targeted at ‘high risk’ * Pathway: proactive – falls risk screening costed * Resource/cost: not stated * Efficacy source: internal meta-analysis |
| Sach (2007) | Expedited first-eye cataract surgery | * Comparator: ‘waiting list’ controls – surgery after 9-13 months * Component: first-eye cataract surgery (median time to surgery 27 days) for women aged 70+ with bilateral unoperated cataract, suitable for phacoemulsification * Pathway: proactive – involves referral to secondary care; resource item includes GP consultation (though not explicitly for screening) * Resource/cost: staff labour for screening; specialist cataract operation * Efficacy source: internal RCT |
| Sach (2010) | Expedited second-eye cataract surgery | * Comparator: ‘waiting list’ controls – surgery after median 316 days * Component: immediate second-eye cataract surgery (median time to surgery 30 days) for women aged 70+ who previously had successful first-eye cataract surgery and have a second operable cataract (baseline acuity of 6/12 or better, i.e., good vision in the operated eye) * Pathway: likely proactive as in Sach (2007), though referral not mentioned * Resource/cost: staff labour for screening; specialist cataract operation * Efficacy source: internal RCT |
| Smith (2016) | Falls risk screening and multifactorial intervention | * Comparator: cross comparison between falls risk cut-off levels for referral * Component: (i) falls risk prediction model generated from variables identified from multilevel logistic regressions (patients nested within GP) using Bayesian information criterion; variables – age group, sex, recent inpatient episodes, recent outpatient visits and frequency, recent A&E investigation, recent non-elective admission, fracture history recorded in GP, osteoporosis, falls history recorded in GP and hospital; COPD, stroke history, depression, mental health condition, asthma, urinary tract infection history, polypharmacy and drug number; (ii) components of multifactorial intervention not stated. * Pathway: proactive – falls risk screening followed by multifactorial intervention * Resource/cost: not stated; resource use/cost of using the falls risk prediction model not included. * Efficacy source: external meta-analysis [47] |
| Tannenbaum (2015) | Cognitive behavioural therapy (CBT) or sedative-hypnotic therapy for insomnia | * Comparator: no insomnia intervention; cross comparison * Component: (i) CBT – six-week course group therapy (private therapy in alternative scenario; (ii) sedative-hypnotic therapy – generic zolpidem tartrate 5 mg one tablet nightly (branded version in alternative scenario) * Pathway: proactive – both treatments initiated after GP diagnosis of insomnia which is costed. * Resource/cost: one-time GP consultation fee to diagnose insomnia; (i) CBT – reimbursement rate from the 2013 US National Government Services fee schedule; (ii) sedative-hypnotic therapy – reimbursement rate for monthly dispensing of generic zolpidem. * Efficacy source: external meta-analyses of prospective cohort studies – increased odds of falling under sedative-hypnotics relative to CBT [177]; increased odds under no insomnia intervention relative to CBT [178]. |
| Turner (2020) | Deprescribing of sedatives for insomnia by community pharmacists | * Comparator: usual care from pharmacists and GPs (no deprescribing) * Component: chronic users (>3 months of prescription claims) of sedatives for insomnia received an evidence-based educational brochure on sedative risks and alternative insomnia management strategies by community pharmacists; pharmacists provided evidence-based pharmaceutical opinion to patients’ GPs; GPs supervised deprescribing of sedatives * Pathway: proactive – initiated by community pharmacists * Resource/cost: pharmacist labour (including chronic sedative use identification); sedative medication cost. * Efficacy source: external RCT [179] |
| Velde (2008) | Withdrawal of fall-risk-increasing drugs (FRIDs) | * Comparator: no withdrawal after receiving geriatric assessment * Component: full geriatric assessment by geriatrician at geriatric outpatient clinic; medication list checked for FRID use (anxiolytics/hypnotics, antipsychotics, antidepressants, antihypertensives, anti-arrhythmics, nitrates and other vasodilators, digoxin, beta-andrenoceptor antagonist eye drops, analgesics, anticholinergics, antihistamines, anti-vertigo drugs, antihyperglycaemics); if fallen in past year, redundant FRID use stopped or reduced over one-month; prescribing physician consulted before change; patients consulted by telephone calls every two weeks during one-month withdrawal period; all other interventions postponed during one-month period * Pathway: proactive – patients referred to geriatric outpatient clinic; but this referral process not described or costed. * Resource/cost: staff labour – geriatric assessment and telephone calls; 72% added to labour cost to account for overheads and venue; pharmaceutical costs. * Efficacy source: internal observational study |
| Wilson (2017) | HAM | * Comparator: no intervention which is usual care * Component: personalised assessment of injury hazards in the home (generally by OT) and systematic removal of these hazards (e.g., reducing tripping hazards, adding grab-bars, adding stairway handrails, improving home lighting); for older persons living in still unmodified private dwellings; evaluates alternative scenario of targeting subgroup with MA falls history. * Pathway: self-referred in base case – includes cost of citywide invitation programme; proactive in alternative scenario – HAM targeted at those who experience MA fall, cost of invitation programme may account for screening cost. * Resource/cost: citywide invitation programme – fixed annual cost converted to per-participant cost; HAM – labour; material. * Efficacy source: external meta-analysis [47] |
| Wu (2010) | Multifactorial intervention | * Comparator: no intervention * Component: Falls Rehabilitation Program (FRP) is a proposed Medicare service modelled after a typical multifactorial intervention – FRA (medications, vision, gait, mobility, balance, lifestyle, blood pressure, function, home hazards) by physician at usual office visit followed by group exercise (eight sessions);2 targeted at Medicare beneficiaries who have fallen within the previous 12 months; Medicare physician receive additional reimbursement in addition to usual office visit rate plus single follow-up visit to assess compliance. * Pathway: proactive – FRP initiated (i.e., patient screened) by physician at usual office visit; but screening not costed. * Resource/cost: reimbursement rates for FRP (in addition to the physician’s usual office visit fees), group exercise sessions and follow-up visit * Efficacy source: external meta-analysis [180] |
| Zarca (2014) | Vitamin D supplementation – universal or one of two targeting strategies | * Comparator: no supplementation; cross-comparison between strategies * Component: (i) ‘Treat without check’ – universal vitamin D supplementation; (ii) ‘Treat, then check’ – immediate universal supplementation, then screen for 25(OH) vitamin D serum level three months later for subsequent treatment adaptation; (iii) ‘Screen and treat’ – screen for vitamin D insufficiency then treat. Maximum number of check and adaptation cycles for strategies (ii) and (iii) set at two (adaptation followed French guidelines); thereafter, individuals received vitamin D quarterly until death. For vitamin D deficiency: four 100,000 UI doses at two-week intervals followed by one 100,000 UI dose every quarter. For vitamin D insufficiency: two to three 100,000 UI doses at two-week intervals followed by one 100,000 UI dose every quarter. * Pathway: proactive – even universal supplementation initiated by professional * Resource/cost: cost per screening – one GP visit and one 25(OH) vitamin D test; cost per 100,000 UI vitamin D dose. * Efficacy source: effect of vitamin D supplementation on vitamin D level – external RCT [181]; relationship between vitamin D level and hip fracture risk – external meta-analysis [160] |
| **Abbreviation:** BMD: bone mass density; BNF: British National Formulary; CSP: Chartered Society of Physiotherapy; ED: emergency department; FaME: Falls Management Exercise; FRA: falls risk assessment; FRAT: falls risk assessment tool; HAM: home assessment and modification; MA fall: fall requiring medical attention; OMAS: Ontario Medical Advisory Secretariat; OT: occupational therapist; PHE: Public Health England; PT: physiotherapist; QTUG: quantitative timed-up-and-go; RCN: Royal College of Nursing; RCT: randomised controlled trial; TUG: timed-up-and-go  1 See Table D3 for study references.  2 Text mentions more treatments including medication modification, behavioural recommendations, HAM and rehabilitation therapy; but intervention costing only includes group exercise. | | |

## Dynamic entry and exit patterns

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| **Table D6** Dynamic entry and exit patterns for non-binary models with horizons longer than five years. | | | | | | |
| **Study label1** | **Population** | | **Mortality** | | **LTC admission** | |
| Entry | Migration | Fatal fall / Excess mortality | Non-fall-related | Fall-related | Non-fall-related |
| Boyd (2020) |  |  | ˟ | ˟ |  | ˟ |
| Church (2011); (2012) |  |  | ˟ | ˟ | ˟ | ˟ |
| Deverall (2018) |  |  | ˟ | ˟ |  | ˟ |
| Eldridge (2005) |  |  | ˟ | ˟ | ˟ | ˟ |
| Farag (2015) |  |  | ˟ | ˟ | ˟ | ˟ |
| Hiligsmann (2014) |  |  | ˟ | ˟ |  |  |
| Honkanen (2006) |  |  | ˟ | ˟ | ˟ | ˟ |
| Johansson (2008) |  |  | ˟ | ˟ |  |  |
| Mori (2017) |  |  | ˟ | ˟ | ˟ |  |
| Moriarty (2019) |  |  | ˟ | ˟ | ˟ | ˟ |
| Nshimyumukiza (2013) | ˟ |  | ˟ |  | ˟ |  |
| OMAS (2008) |  |  | ˟ | ˟ | ˟ | ˟ |
| Pega (2016) |  | ˟ | ˟ | ˟ |  | ˟ |
| RCN (2005) |  |  |  | ˟ |  |  |
| Wilson (2017) |  | ˟ | ˟ | ˟ |  | ˟ |
| Zarca (2014) |  |  | ˟ | ˟ |  |  |
| **Abbreviation:** LTC: long-term care; OMAS: Ontario Medical Advisory Secretariat; RCN: Royal College of Nursing  1 See Table D3 for study references. | | | | | | |

The two columns under ‘Population’ record whether the model incorporated migration and entry processes that affect the target population size over time. The two columns under ‘Mortality’ report whether the models incorporated mortality attributable to falls (via immediate fatality or as excess mortality risk) and/or non-fall-related mortality. The two columns under ‘LTC admission’ report whether the models incorporated LTC admission attributable to falls and/or non-fall-related admission. Only those that directly incorporated LTC admission as a separate model state (rather than just include the cost of LTC admission) were marked.

## Assessing parameter uncertainty

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| **Table D7** Parameters explored in deterministic sensitivity analysis and probabilistic sensitivity analysis presentation methods. | | | |
| **Study label2** | **DSA parameters1** | | **PSA presentation methods** |
| **Falls epidemiology** | **Falls prevention intervention** |
| Agartioglu (2020) | (1) Fracture HC cost; (2) Head injury HC cost |  | (1) CEAC; (2) CEAF; (3) Scatter |
| Albert (2016) | (1) Utility; (2) HC cost |  | (1) CEAC; (2) VoI |
| Alhambra-Borras (2019) | *None* | | |
| Beard (2006) | *None* | | |
| Boyd (2020) | (1) Falls risk; (2) Initial falls history; (3) Hospital fall risk; (4) Fatal fall risk; (5) Utility; (6) HC cost; (7) LTC BG risk | (1) Int. cost; (2) Efficacy | (1) 95% UI |
| Carande-Kulis (2015) | *None* | | |
| CSP (2016) | *None* | | |
| Church (2011) | (1) Falls risk; (2) Utility | (1) Int. cost; (2) Efficacy; (3) Falls rate multiplier |  |
| Church (2012) | (1) Falls risk; (2) Utility | (1) Int. cost; (2) Efficacy; (3) Falls rate multiplier | (1) CEAC |
| Comans (2009) | (1) Falls rate per faller; (2) HC cost | (1) Int. cost |  |
| Day (2009); (2010) | (1) Hospital fall risk | (1) Int. cost; (2) Uptake; (3) Efficacy |  |
| Deverall (2018) | (1) Falls risk; (2) Initial falls history; (3) Hospital fall risk; (4) Fatal fall risk; (5) Utility; (6) HC cost; (7) LTC BG risk | (1) Int. cost; (2) Persistence; (3) Efficacy | (1) CEAC; (2) 95% UI |
| Eldridge (2005) |  |  | (1) CEAC |
| Farag (2015) | (1) Falls risk; (2) Hospital fall risk; (3) LTC fall risk; (4) Utility; (5) HC cost; (6) LTC cost |  | (1) CEAC |
| Franklin (2019) |  |  | (1) CEAC; (2) CE prob. |
| Frick (2010) |  |  | (1) CEAC |
| Hektoen (2009) | *None* | | |
| Hiligsmann (2014) | (1) Falls risk; (2) Utility; (3) HC cost | (1) Int. cost | (1) CEAC |
| Hirst (2016) | (1) Utility; (2) HC cost | (1) Int. cost; (2) Efficacy | (1) CEAC |
| Honkanen (2006) | (1) Falls risk; (2) LTC fall risk; (3) Fatal fall risk; (4) HC cost; (5) BG health transition risk; (6) BG mortality risk; (7) LTC BG risk; (8) Com. care cost | (1) Int. cost; (2) Adherence; (3) Persistence; (4) Efficacy | (1) CE prob. |
| Howland (2015) | *None* | | |
| Ippoliti (2018) | *None* | | |
| Johansson (2008) |  |  | (1) Scatter |
| Lee (2013) | (1) Falls risk; (2) MA falls risk; (3) Utility; (4) HC cost; (5) BG mortality risk | (1) Int. cost; (2) Efficacy | (1) CE prob. |
| Ling (2008) | *None* | | |
| McLean (2015) |  |  | (1) CEAC; (2) CE prob. |
| Miller (2011) | *None* | | |
| Mori (2017) | (1) Fracture risk; (2) Recurrent fracture risk; (3) Osteoporosis risk; (4) Fracture risk with osteoporosis; (5) Excess mortality risk; (6) Utility; (7) BG mortality risk | (1) Int. cost; (2) Exercise time opportunity cost; (3) Efficacy | (1) CE prob. |
| Moriarty (2019) | (1) HC cost | (1) Int. cost | (1) Scatter |
| Nshimyumukiza (2013) |  |  | (1) CEAC; (2) CE prob. |
| OMAS (2008) | *None* | | |
| Pega (2016) | (1) Falls risk; (2) Initial falls history; (3) Hospital fall risk; (4) Fatal fall risk; (5) Utility; (6) HC cost; (7) LTC BG risk; (8) Rate of moving house | (1) Int. cost | (1) 95% UI |
| Poole (2014); (2015) | *None* | | |
| PHE (2018) | (1) Discharge destination after hospital fall; (2) Utility; (3) HC cost |  |  |
| RCN (2005) |  |  | (1) Scatter |
| Sach (2007); (2010) |  |  | (1) CEAC |
| Smith (2016) |  |  | (1) 95% UI |
| Tannenbaum (2015) | (1) Falls risk; (2) Recurrent fall risk; (3) Utility; (4) HC cost | (1) Int. cost | (1) CEAC |
| Turner (2020) |  |  | (1) CEAC; (2) CE prob. |
| Velde (2008) |  |  | (1) 95% UI |
| Wilson (2017) | (1) Falls risk; (2) Initial falls history; (3) Hospital fall risk; (4) Fatal fall risk; (5) Utility; (6) HC cost; (7) LTC BG risk; (8) Rate of moving house | (1) Int. cost; (2) Uptake; (3) Efficacy | (1) 95% UI |
| Wu (2010) | (1) Falls risk; (2) Recurrent fall risk | (1) Efficacy |  |
| Zarca (2014) | (1) Mean baseline Vit. D level; (2) Risk of recurrent fracture; (3) Excess mortality; (4) HC cost | (1) Int. cost; (2) Adherence; (3) Efficacy | (1) CEAC; (2) Scatter; (3) CE prob. |
| **Abbreviation:** BG: background; CE: cost-effectiveness; CEAC: cost-effectiveness acceptability curve; CEAF: cost-effectiveness acceptability frontier; Com.: comorbidity; CSP: Chartered Society of Physiotherapy; DSA: deterministic sensitivity analysis; HC: healthcare; Int.: intervention; LTC: long-term care; MA falls: falls requiring medical attention; OMAS: Ontario Medical Advisory Secretariat; PHE: Public Health England; prob.: probability; PSA: probabilistic sensitivity analysis; RCN: Royal College of Nursing; UI: uncertainty interval; VoI: value of information.  1 To distinguish between assessment of parameter uncertainty in DSA and evaluation of alternative scenarios (see Table D8), attention was paid to studies’ descriptions of the purpose of their sensitivity analyses, though these varied in clarity. For example, if the parameter range assessed in DSA denoted the 95% confidence interval then the analysis concerned parameter uncertainty.  2 See Table D3 for study references. | | | |

## Scenario analyses

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| **Table D8** Scenarios evaluated by models in sensitivity analysis | | | |
| **Study label1** | **Falls epidemiology** | **Falls prevention intervention** | **Evaluation framework** |
| Agartioglu (2020) | (1) Falls risk | (1) Efficacy: pessimistic, optimal, optimistic |  |
| Albert (2016) | *None* | | |
| Alhambra-Borras (2019) |  |  | (1) Discount rate |
| Beard (2006) | (1) Costs included: narrow HC vs. wide HC vs. societal | (1) Control for secular falls trend in effectiveness estimation | (1) Perspective: HC vs. Societal |
| Boyd (2020) |  | (1) Efficacy: vision benefit only from cataract surgery | (1) Time horizon; (2) Discount rate |
| Carande-Kulis (2015) | (1) Higher HC cost per fall for 80+ | (1) Lower int. training cost; (2) Efficacy break-even analysis |  |
| CSP (2016) |  | (1) Access rate |  |
| Church (2011); (2012) | (1) Baseline age; (2) No fear of falling |  |  |
| Comans (2009) |  | (1) Uptake break-even analysis |  |
| Day (2009) |  | (1) Private co-payment for int. | (1) Time horizon |
| Day (2010) |  | (1) Private co-payment for int. |  |
| Deverall (2018) |  |  | (1) Equity analysis; (2) Discount rate |
| Eldridge (2005) |  | (1) Int. cost; (2) Uptake rate |  |
| Farag (2015) |  | (1) Int. cost; (2) Uptake rate; (3) Efficacy |  |
| Franklin (2019) | (1) Utility | (1) TUG/QTUG efficacy; (2) Uptake | (1) Perspective: HC vs. H&SC |
| Frick (2010) | *None* | | |
| Hektoen (2009) | (1) Risk of injury break-even analysis | (1) Efficacy break-even analysis |  |
| Hiligsmann (2014) |  | (1) Sustain rate; (2) Efficacy on mortality risk | (1) Discount rate |
| Hirst (2016) | (1) Fracture risk; (2) Fracture cost | (1) Int. process cost; (2) Adherence rate |  |
| Honkanen (2006) | (1) Fracture risk | (1) Int. process disbenefit; (2) Int. cost; (3) Int. effectiveness |  |
| Howland (2015) |  | (1) Uptake rate; (2) State level scale-up |  |
| Ippoliti (2018) |  | (1) Efficacy break-even point |  |
| Johansson (2008) | (1) Fracture risk; (2) Mortality risk; (3) HC cost; (4) No health/economic effects after 1st yr.; (5) Utility; (6) Loss of unpaid productivity; (7) Consumption cost of added years | (1) Int. cost; (2) Efficacy – break-even analysis, alternate estimate | (1) Discount rate |
| Lee (2013) | *None* | | |
| Ling (2008) | *None* | | |
| McLean (2015) | (1) HC cost | (1) Int. cost – different professional; (2) Int. cost – no venue or equipment cost; (3) Int. cost – advertising cost; (4) Efficacy threshold analysis | (1) Discount rate; (2) Handling missing data |
| Miller (2011) |  | (1) Efficacy break-even analysis | (1) Perspective: HC vs. Societal |
| Mori (2017) | (1) Excess mortality for vertebral fracture | (1) Longer exercise maintenance; (2) Exercise only for osteoporosis patients | (1) Discount rate |
| Moriarty (2019) |  | (1) Int. cost threshold analysis; (2) Adherence rate | (1) Discount rate |
| Nshimyumukiza (2013) | (1) Fracture hospital cost; (2) Fracture LTC admission risk; (3) Excess mortality risk; (4) Utility | (1) Uptake rates; (2) Reactive access to osteoporosis pathway; (3) Compliance and sustainability of osteoporosis pathway; (4) Efficacy of primary prevention; (5) Efficacy of osteoporosis pathway | (1) Discount rate |
| OMAS (2008) | *None* | | |
| Pega (2016) |  | (1) Int. cost reduced from economies of scale; (2) Efficacy heterogeneity; (3) Perfect efficacy; (4) Shorter efficacy duration | (1) Equity analysis; (2) Discount rate |
| Poole (2014); (2015) | *None* | | |
| PHE (2018) | (1) Falls rate threshold analysis; (2) MA falls risk threshold analysis | (1) Efficacy threshold analysis |  |
| RCN (2005) | *None* | | |
| Sach (2007); (2010) | (1) High cost outliers removed | (1) Int. cost threshold analysis; (2) Different efficacy path (immediate vs. gradual gain over 6 months) | (1) Perspective: HC vs. Societal; (2) Time horizon; (3) Discount rate |
| Smith (2016) |  | (1) Different falls risk cut-off levels for referral to treatment |  |
| Tannenbaum (2015) |  |  | (1) Time horizon |
| Turner (2020) |  | (1) Int. implemented at primary care, not community pharmacy; (2) Int. cost increase; (3) Lower efficacy on deprescribing |  |
| Velde (2008) | (1) Injurious falls risk | (1) National level scale-up |  |
| Wilson (2017) |  | (1) Int. cost reduced from economies of scale; (2) Shorter efficacy duration | (1) Equity analysis; (2) Time horizon; (3) Discount rate |
| Wu (2010) | (1) Magnitude of additional HC cost for recurrent faller; (2) Proportion of fall HC cost averted | (1) Uptake rate; (2) Greater reach of exercise; (3) Int. cost; (4) Efficacy threshold analysis | (1) Perspective – proportion of HC cost accruing to Medicare; (2) Perspective – HC vs. Societal |
| Zarca (2014) |  |  | (1) Discount rate |
| **Abbreviation:** CSP: Chartered Society of Physiotherapy; HC: healthcare; H&SC: health and social care; Int.: intervention; LTC: long-term care; MA fall: fall requiring medical attention; OMAS: Ontario Medical Advisory Secretariat; PHE: Public Health England; RCN: Royal College of Nursing; TUG/QTUG: (quantified) timed-up-and-go  1 See Table D3 for study references. | | | |

## Evaluation outcomes for non-general population and/or non-lifetime models

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| **Table D9** Evaluation outcomes for non-lifetime and/or non-general population models. | | | | |
| **Study label1** | **Target population** | **Analysis; Perspective; Time horizon** | **Intervention [comparator]** | **Evaluation outcomes2** |
| Agartioglu (2020) | CD adults aged 65+ | CEA; Public sector; 1 year | HAM [UC] | ***Ratio***: Unclear – appears to report per-participant intervention cost rather than ICERs.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – results robust to cost variations; PSA – CEAC, CEAF, scatter.  ***Scenarios***: Results robust to change in baseline risk; results reported by efficacy scenarios (pessimistic, optimal, optimistic). |
| Albert (2016) | CD adults aged 50+ (mean age 75.5) | CUA; Public sector; 1 year | MF int. [UC] | ***Ratio***: Intervention had higher health gain and lower cost (dominated) comparator; net saving of £606 per participant; average EQ-5D gain of 0.008 per participant.  ***Aggregate***: Per-participant results can be scaled up to quasi-experimental study sample size.  ***Parameter uncertainty***: DSA – results robust to treatment cost and utility variations, utility had the greatest impact; PSA – CEAC, no uncertainty for utility parameter favoured intervention.  ***Scenarios***: No analysis |
| Alhambra-Borras (2019) | CD adults aged 65+ at high falls risk or frail with no severe physical or cognitive limitation | CUA; Public sector; Lifetime | Exercise [UC] | ***Ratio*:** Intervention had higher health gain and lower cost (dominated) comparator.  ***Aggregate***: Total cost saving of £52,672 and QALY gain of 0.513 for intervention group relative to control group – no extrapolation to larger population.  ***Parameter uncertainty***: No analysis  ***Scenarios***: No discounting had little impact on decision. |
| Beard (2006) | CD adults aged 60+ | CBA, ROI; Public sector, Societal; 5 years | MC (intersectoral) int.3 [UC] | ***Ratio***: ROI of 8.5:1 from state government perspective (hospitalisation cost only); 13.7:1 from national government perspective (direct healthcare costs); 20.6:1 from societal perspective (direct healthcare costs + intangible cost of falls + participant costs for exercise)  ***Aggregate***: Reports total net economic saving  ***Parameter uncertainty***: No analysis  ***Scenarios***: Range of costs included in public healthcare perspective; Public vs. societal perspective; Minimising the proportion of the secular decline in fall-related healthcare cost in intervention region (relative to comparator regions) that can be attributed to intervention lowered ROI to 6.3:1 (hospitalisation cost only). |
| Boyd (2020) | Adults aged 65+ | CUA; Public sector; Lifetime | Cataract surgery (expedited, routine) [NR] | ***Ratio***: Expedited vs. routine surgery produced ICER of £6,034 per QALY; Routine vs. no surgery produced ICER of £2,493 per QALY; Routine vs. no surgery (vision improvement benefit only) produced ICER of £5,619 per QALY.  ***Aggregate***: Reports aggregate health gain and incremental cost.  ***Parameter uncertainty***: DSA – ICER most sensitive to variations in efficacy, utility loss from cataract, and expedited surgery cost; PSA – reports 95% uncertainty interval for all outcomes.  ***Scenarios***: Expedited surgery cost-effective relative to routine surgery under 10-year and 20-year time horizons, 0% and 6% discount rates and private sector surgery costs. |
| Carande-Kulis (2015) | CD adults aged 65+ | ROI; US health insurance payer; 1 year | Exercise (2 forms); MC int. (Stepping On) [NR] | ***Ratio***: ROI of 1.36:1 for Otago exercise; 2.27:1 for Otago exercise high-risk subgroup; 6.09:1 for Tai Chi; 1.64:1 for Stepping On.  ***Aggregate***: Not reported  ***Parameter uncertainty***: No analysis  ***Scenarios***: All interventions can break-even with lower efficacy; 50% increase in falls economic cost for Otago exercise high-risk subgroup increased ROI from 2.27:1 to 3.40:1; No difference in results under cheaper intervention cost of online training. |
| CSP (2016) | CD adults aged 65+ | ROI; Public sector; 1 year | FRS + Exercise (physiotherapy) [NR] | ***Ratio***: ROI of 1.69:1 for combined physiotherapy form (20% group physiotherapy; 87% TUG test efficacy; 11% referral rate) in England.  ***Aggregate***: Reports total intervention cost and total fall-related healthcare savings.  ***Parameter uncertainty***: No analysis  ***Scenarios***: Same ROI when access level increased from 11% to 100%; Interactive Excel platform allows users to change parameters. |
| Church (2011) | CD adults aged 65+ (separate model for residential care) | CEA, CUA; Public sector; 10 years | Exercise (3 forms); MC int.; MF int.; MRA; Exp. cataract surgery; Med. modification; Cardiac pacing [NR] | ***Ratio***: (CUA results) ICER per QALY vs. no intervention: Tai Chi £28,159; Group exercise £45,656; Home exercise £60,364; MC int. £46,548; MF int. £81,656; MRA £107,927; Expedited cataract surgery £1,387; Psychotropic medication withdrawal £10,406; Cardiac pacing £50,357.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – (For group exercise only) Intervention cost, efficacy and baseline age were the most important determinants of ICER for group exercise. No PSA.  ***Scenarios***: No fear of falling had the largest impact on group exercise ICER among parameter changes (for DSA and scenarios). |
| Comans (2009) | CD adults aged 65+, falls history in past 6 months or gait/functional decline and cognitively intact | ROI; Societal; 1 year | MF int. (2 forms) [NR] | ***Ratio***: Centre-based MF int. needs 57 clients per year to break even; Home-based MF int. 78. Both services have annual capacity of 300, hence likely to return positive ROI.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – Both MF int. forms were not able to break even if HC cost of falls was reduced by 25% or if baseline falls rate was reduced from 6 to 1 per year. No PSA.  ***Scenarios***: Uptake (number of clients) required for break-even (see *Ratio*) |
| Day (2009) | CD adults aged 50+ (age and characteristics differ by intervention type) | CEA; Public sector, Societal; 1 year | Exercise (2 forms); HAM; MF int.; Med. modification; Cardiac pacing [NR] | ***Ratio***: ICER per fall prevented relative to no intervention – Home exercise £2,750; Tai Chi £708; HAM £274; MF int. £543; Psychotropic med. withdrawal £329; Cardiac pacing £1,707  ***Aggregate***: Reports total number of falls prevented and total cost per intervention.  ***Parameter uncertainty***: DSA – Explored impacts of variations in risk of hospitalised fall, intervention uptake, intervention cost and efficacy. No PSA.  ***Scenarios***: Two-year horizon for home exercise produced ICER of £1,917 per fall prevented; Five-year horizon for cardiac pacing produced ICER of £341 per fall prevented. Explored scenarios of private co-payments for Tai Chi which improved the ICER for public sector. |
| Day (2010) | CD adults aged 70+ | CEA; Public sector, Societal; 1 year | Exercise (Tai Chi) [NR] | ***Ratio***: Tai Chi produced ICER of £2,896 per fall prevented relative to no intervention.  ***Aggregate***: Reports total number of falls prevented and total cost per intervention.  ***Parameter uncertainty***: DSA – Explored impacts of variations in risk of hospitalised fall, intervention uptake, intervention cost and efficacy. No PSA.  ***Scenarios***: Private co-payments for Tai Chi improved the ICER for public sector. |
| Franklin (2019) | CD adults aged 65+ | CUA; Public sector (2 types); 2 years | FRS + Exercise (3 forms) or HAM [NR; Cross-comparison] | ***Ratio***: (Results for QTUG pathway vs. no intervention for age 65-89 – see Franklin (2019) for results for TUG pathway and age subgroups) QTUG and Otago exercise produced ICER of £2,094 per QALY; QTUG and FaME dominated no intervention; QTUG and Tai Chi produced ICER of £14,642 per QALY; QTUG and HAM dominated no intervention.  ***Aggregate***: Reported incremental HC costs and QALY at GP practice cohort level.  ***Parameter uncertainty***: PSA – CEAC; see Table 2 in Franklin (2019) for CE probabilities.  ***Scenarios***: See Appendix Tables S9 to S11 on impacts of variations in intervention uptake rate, screening efficacy and utility decrements on ICERs. |
| Frick (2010) | CD adults aged 65+ | CUA; US healthcare payer;4 1 year5 | Exercise (2 forms); HAM; MF int. (2 forms); Vit. D; Med. modification [Cross-comparison] | ***Ratio***: HAM and vitamin D were the only non-dominated intervention; HAM had ICER of £13,692 per QALY relative to vitamin D  ***Aggregate***: Not reported  ***Parameter uncertainty***: At threshold of £46,370 per QALY, HAM had the highest INMB in 54.1% of replications, and vitamin D in 29.7%.  ***Scenarios***: No analysis |
| Hektoen (2009) | CD women aged 80+ | CEA; Societal; 1 year | Exercise [NR] | ***Ratio***: Home-based Otago exercise dominated no intervention.  ***Aggregate***: Not reported  ***Parameter uncertainty***: No analysis  ***Scenarios***: Intervention would break even if risk of injurious fall is reduced from 0.5 to 0.34 and if efficacy reduced to 22% from 40%. |
| Hiligsmann (2014) | Adults aged 60+ with osteoporosis | CUA; Societal; Lifetime | Vit. D and calcium [NR] | ***Ratio***: ICER per QALY for intervention vs. no intervention – £44,452 and £25,719 for women and men aged 60; £8,667 and £11,229 for women and men aged 70; intervention dominated no intervention for men and women aged 80.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – fracture risk and intervention cost had the largest impact on ICERs. PSA – CEAC; at threshold of £49,296 per QALY, 49%, 87% and 99% probability of intervention being cost-effective for women aged 60, 70 and 80; 80%, 94% and 99% for men.  ***Scenarios***: Mortality risk reduction due to intervention, varying sustainability duration and varying discount rate had modest impact on ICER. |
| Hirst (2016) | Women aged 75+ on chronic pain medication | CUA; Public sector; 1 year | Med. modification (Transdermal Buprenorphine) [Tramadol] | ***Ratio***: transdermal buprenorphine had ICER of £7,969 per QALY vs. tramadol  ***Aggregate***: Total cost and health gain per 100,000 women reported.  ***Parameter uncertainty***: DSA – Efficacy had the largest impact on ICER. PSA – CEAC; transdermal buprenorphine had 52% probability of being cost-effective vs. tramadol at threshold of £22,837 per QALY  ***Scenarios***: Alternative efficacy source, lower adherence rate and targeting at age 85+ made transdermal buprenorphine dominate tramadol. |
| Howland (2015) | CD adults aged 65+ admitted to A&E due to fall | ROI; US healthcare payer;4 1 year | MC int. (MoB/VLL) [NR] | ***Ratio***: ROI for intervention was 1.44:1.  ***Aggregate***: Total HC savings was £4.52 million for state population at 50% uptake rate; £2.26 million at 25% uptake and £6.78 million at 75% uptake.  ***Parameter uncertainty***: No analysis  ***Scenarios***: See *Aggregate* for state-level scale up and impacts of varying uptake rate. |
| Ippoliti (2018) | CD adults aged 65+ living in mountainous areas | ROI; Public sector; 3 years | MF int. [NR] | ***Ratio***: For population of 191,977 over 3-year horizon, 1,657 hip fractures must be prevented for intervention to break even; this requires efficacy of 36% reduction in hip fracture.  ***Aggregate***: Reports number of hip fractures prevented.  ***Parameter uncertainty***: No analysis  ***Scenarios***: See *Ratio* for efficacy break-even analysis. |
| Lee (2013) | CD adults aged 65-80 without falls history | CBA; Public sector; 3 years | Vit. D (targeted, universal) [NR] | ***Ratio***: Targeted supplementation had average INMB of £191 vs. no intervention for women and £255 for men; universal supplementation had £162 and £222 respectively.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – efficacy and screening cost had the largest impact on INMBs. PSA – at threshold of £42,634 per QALY, targeted supplementation was the most cost-effective option in 52.8% of the simulations for women and 54.3% for men, compared to 36.3% and 38.2% for universal supplementation.  ***Scenarios***: No analysis |
| Ling (2008) | CD adults aged 65+ with falls history or other risk factors | ROI; US healthcare payer;4 1 year | HAM [NR] | ***Ratio***: HAM had ROI of 3.2:1 vs. no intervention.  ***Aggregate***: Not reported  ***Parameter uncertainty***: No analysis  ***Scenarios***: No analysis |
| McLean (2015) | CD adults aged 70+ | CEA, CUA; Public sector; 18 months | Exercise [UC] | ***Ratio***: (CUA results) Exercise had ICER of £64,449 per QALY vs. usual care for whole sample and £28,775 for women subgroup.  ***Aggregate***: Incremental cost and health gains reported.  ***Parameter uncertainty***: PSA – CEAC; 8.08% probability of exercise being cost-effective at £37,564 per QALY threshold (76.77% for women subgroup)  ***Scenarios***: ICER reduced to £32,123 per QALY if venue cost excluded and cheaper fitness instructors used (£13,493 for women subgroup). |
| Miller (2011) | CD adults aged 50+ at high falls risk | ROI; US healthcare,4 Societal; 2 years | MC int. (MoB/VLL) [NR] | ***Ratio***: For high-risk subgroup, ROI above one is achieved if intervention averts 7.1 falls among 140 participants within the first year from societal perspective and 4.4 falls from healthcare perspective. For whole group, the numbers are 10.7 and 6.6 falls.  ***Aggregate***: Not reported  ***Parameter uncertainty***: No analysis  ***Scenarios***: Efficacy break-even analysis (see *Ratio*) |
| Mori (2017) | CD women aged 65+ at osteoporosis risk without previous fracture | CUA; Societal; Lifetime | Exercise and bisphosphonate combined [Cross-comparison: single or no intervention] | ***Ratio***: Combined therapy vs. bisphosphonate alone produced ICER per QALY of £161,256 for age 65, £94,557 for age 70, £37,412 for age 75 and £14,081 for age 80.  ***Aggregate***: Reports incremental cost and QALY which can be scaled up by age group.  ***Parameter uncertainty***: DSA – Efficacy and intervention cost significantly affected outcomes. PSA – At £79,819 per QALY threshold, probabilities of combined therapy being cost-effective relative to next best alternative were 35% for baseline age 65, 40% for age 70, 42% for age 75 and 48% for age 80.  ***Scenarios***: Targeting exercise at osteoporosis patient subgroups can significantly improve the cost-effectiveness of combined therapy vs. bisphosphonate alone for all ages. |
| Moriarty (2019) | CD adults aged 65, no current/previous adverse events for benzodiazepine/PPI | CUA; Public sector; 35 years | Med. modification (Benzodiazepine, PPI) [Inappropriate prescribing] | ***Ratio***: No sedative use dominated inappropriate benzodiazepine use; Maintenance dose of PPI use dominated maximal dose use.  ***Aggregate***: Reports prevalence rates for each inappropriate medication use – 4.3% for benzodiazepine and 23.6% for PPI.  ***Parameter uncertainty***: DSA – see Table 3 in Moriarty (2019) for impacts of variations in inpatient cost of c. difficile infection (for PPI) and in costs of medications. PSA – scatter plot.  ***Scenarios***: See Table 3 in Moriarty (3) for impacts of variations in discount rate and adherence rate, and Table 4 for results of threshold analysis using medication costs. |
| Poole (2014) | Adults aged 65+ | ROI; Public sector; 1 year | Vit. D [NR] | ***Ratio***: Intervention generated net savings relative to no intervention.  ***Aggregate***: Total national net savings of £26.3 million and 1,692 hip fractures prevented.  ***Parameter uncertainty***: No analysis  ***Scenarios***: No analysis (except age-based targeting) |
| Poole (2015) | CD adults aged 60+ | CUA, ROI; Public sector; 5 years | Vit. D [NR] | ***Ratio***: (CUA results) Intervention produced ICER of £22,035 per QALY relative to no intervention for age 60+ (excluding LTC cost).  ***Aggregate***: Including LTC cost savings, intervention produced net cost savings of £468.4 million for age 60+.  ***Parameter uncertainty***: No analysis  ***Scenarios***: No analysis (except age-based targeting) |
| PHE (2018) | CD adults aged 65+ | CUA, ROI; Public sector; 2 years | Exercise (3 forms); HAM [NR] | ***Ratio***: (CUA results) ICER per QALY were £2,661 for Otago exercise, £525 for FaME and £8,707 for Tai Chi; HAM dominated no intervention. (ROI results) ROI of 0.95:1 for Otago, 0.99:1 for FaME, 0.85:1 for Tai Chi and 3.17:1 for HAM.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – discharge destination after hospitalised fall, utility decrement and HC cost of fall had little impact on results. No PSA.  ***Scenarios***: Tables 31-33 in PHE (2018) report changes to falls rate, MA falls risk and efficacy required to change decision for each intervention. |
| Sach (2007) | Women aged 70+ with bilateral cataracts | CEA, CUA; Public sector, Societal; Lifetime extrapol.6 | Exp. cataract surgery (first eye) [UC: Routine surgery] | ***Ratio***: ICER of £18,911 per QALY under public sector perspective and £14,905 under societal.  ***Aggregate***: Not reported  ***Parameter uncertainty***: PSA – CEAC; intervention had 90.4% probability of being cost-effective relative to routine surgery at £30,000 per QALY threshold.  ***Scenarios***: ICER of £2,499 per QALY if 5% high-cost outliers removed from sample; Significant impacts from changes to perspective and time horizon (e.g., ICER of £51,277 per QALY under public sector perspective and 1-year horizon). |
| Sach (2010) | Women aged 70+ with second operable cataract | CUA; Public sector, Societal; Lifetime extrapol.6 | Exp. cataract surgery (second eye) [UC: No surgery] | ***Ratio***: ICER of £24,836 per QALY under public sector perspective and £60,259 under societal.  ***Aggregate***: Not reported  ***Parameter uncertainty***: PSA – CEAC  ***Scenarios***: Significant impacts from changes to perspective and time horizon (e.g., ICER of £63,570 per QALY under public sector perspective and 1-year horizon). |
| Smith (2016) | Adults aged 65+ covered by GP practice and hospital | ROI; Public sector; 1 year | FRS + MF int. [Cross-comparison] | ***Ratio***: The falls risk cut-off where savings outweigh costs was P=0.27 which would result in 1.8% of the population being referred to intervention.  ***Aggregate***: Reports proportion of the population accessing intervention. The cut-off level which maximised total savings was P=0.53 (0.45% of population referred); the cut-off with maximum sensitivity (81%) and specificity (78%) was P=0.07.  ***Parameter uncertainty***: Reports 95% uncertainty intervals around estimates of net economic saving by cut-off level.  ***Scenarios***: Variation in falls risk cut-off levels (see *Ratio* and *Aggregate*) |
| Tannenbaum (2015) | CD adults aged 65+ with insomnia | CUA; Public sector; 1 year | Med. modification; CBT [NR; Cross-comparison] | ***Ratio***: CBT dominated pharmacologic therapy and no intervention.  ***Aggregate***: Not reported  ***Parameter uncertainty***: DSA – falls risk significantly affected results: at low risk, pharmacologic therapy dominated CBT and no intervention. PSA – CEAC.  ***Scenarios***: CBT remained dominant under 5-year horizon |
| Turner (2020) | CD adults aged 65+ who are chronic users of sedatives for insomnia | CUA; Public sector; 1 year | Med. modification [NR] | ***Ratio***: Intervention dominated no intervention; average INMB of £3,253 at £31,060 per QALY threshold and £5,642 at £62,119 threshold.  ***Aggregate***: Not reported  ***Parameter uncertainty***: PSA – CEAC, 100% probability of intervention being cost-effective relative to no intervention at £31,060 and £62,119 per QALY thresholds.  ***Scenarios***: Intervention dominance did not change for any scenarios. |
| Velde (2008) | CD geriatric outpatient population with falls history (mean age 78) | CEA; Public sector; 1 year5 | Med. modification [NR] | ***Ratio***: Intervention dominated no intervention; average net cost saving of £1,695 per recipient.  ***Aggregate***: Scaling up intervention to national level for older persons with MA falls history (7% of population aged 65+) would generate total cost saving of £60.2 million.  ***Parameter uncertainty***: PSA – 95% uncertainty interval reported.  ***Scenarios***: Intervention dominance did not change when falls risk reduced by 50%. |
| Wu (2010) | CD Medicare beneficiaries aged 65+ with falls history | CEA, ROI; Public sector, Societal; 1 year | MF int. [NR] | ***Ratio***: (CEA results) Intervention produced ICER of £764 per MA fall prevented relative to no intervention under Medicare perspective and dominated no intervention under Medicare and private insurance perspective.  ***Aggregate***: Total net cost to Medicare was £391 million for all age groups, £252 million for age 65-74 and £139 million for age 75+; Total net cost to all payers was £714 million for all age groups, £198 million for age 65-74 and £516 million for age 75+.  ***Parameter uncertainty***: DSA – efficacy had the largest impact on ICER for CEA. No PSA.  ***Scenarios***: Proportion of HC cost of those with falls history that can be averted had the second largest impact on ICER for CEA. |
| **Abbreviation:** CBA: cost-benefit analysis; CBT: cognitive behavioural therapy; CD: community-dwelling; CEA: cost-effectiveness analysis; CEAC: cost-effectiveness acceptability curve; CEAF: cost-effectiveness acceptability frontier; CSP: Chartered Society of Physiotherapy; CUA: cost-utility analysis; DSA: deterministic sensitivity analysis; FaME: falls management exercise; HAM: home assessment and modification; HC: healthcare; ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; NR: non-receipt of modelled intervention(s); PHE: Public Health England; PPI: proton pump inhibitor; PSA: probabilistic sensitivity analysis; QALY: quality-adjusted life year; QTUG: quantified timed-up-and-go; ROI: return on investment; TUG: timed-up-and-go; UC: usual care  1 See Table D3 for study references.  2 All monetary units are converted to £ in year 2021 using the average consumer price index (CPI) between the original year of reported currency to 2019 (most recent year for CPI data) [182] in the country of study and purchasing power parity (PPP) rate between the original currency and £ in year 2020 (most recent PPP data) [183].  3 Intervention included individually tailored education, HAM and exercise and public space safety improvement.  4 This would include Medicare/aid, private health insurance and patients.  5 One-year horizon with lifetime costs and health effects of falls.  6 One-year trial outcomes are extrapolated over lifetime horizon. | | | | |

# Appendix E: Model parameterisation

## Simul8 features for base case analysis

**Initial setting**

* Set travel time to zero
* No warm-up period (default)
* Set time horizon: 40 years (14600 days); 5 years (1825 days)
* Clock properties: day unit; simple unit count from zero

### Labels

|  |  |
| --- | --- |
| **Label** | **Description** |
| Cohort\_L | 1 = Initial cohort aged 60 and over (n=125,244)  2…40 = Subsequent new cohorts aged 60 (n=259,950 in total across 39 cohorts)  Routing Out from ‘Entry’ to [1] ‘Initial Cohort’ and [2] ‘New Cohorts’ |
| Cycle\_L | Initially set as Cohort\_L-1 at ‘Initial Cohort’ and ‘New Cohorts’ objects; used for discounting hence should be uniform across all cohorts  Updated +1 at ‘Start Cycle’ object: Cohort 1 will have Cycle\_L=1 at their first cycle; Cohort 5 will have Cycle\_L=5 at their first cycle |
| CycleIn\_L | Cycle number at model entry; set as Cohort\_L at ‘Initial Cohort’ and ‘New Cohorts’ |
| CycleN\_L | Total number of cycles/years spent by individual in model; set to 0 at ‘Initial Cohort’ and ‘New Cohorts’  Updated +1 at ‘Start Cycle’ object: in 5th model cycle, Cohort 1 will have CycleN\_L=5 and Cohort 2 will have CycleN\_L=4 etc. |
| IntHistRe\_L | Lifetime reactive intervention history (set to 0 at outset; accumulated)  0= No intervention; 1+ = History of reactive intervention |
| IntHistPro\_L | Lifetime proactive intervention history (set to 0 at outset; accumulated)  0= No intervention; 1+ = History of proactive intervention |
| IntHistSelf\_L | Lifetime self-referred intervention history (set to 0 at outset; accumulated)  0= No intervention; 1+ = History of self-referred intervention |
| IntCurRe\_L | Current reactive intervention status (set to 0 at outset; 1 at receipt; returned to 0 at dynamic update)  0= No intervention receipt; 1= Intervention receipt |
| IntCurPro\_L | Current proactive intervention status (set to 0 at outset; 1 at receipt; returned to 0 at dynamic update)  0= No intervention receipt; 1= Intervention receipt |
| IntCurSelf\_L | Current self-referred intervention status (set to 0 at outset; 1 at receipt; returned to 0 at dynamic update)  0= No intervention receipt; 1= Intervention receipt |
| IntCostRePS\_L | Public sector cost of reactive intervention for individual (accumulated) |
| IntCostRePri\_L | Private cost (travel, copayment) of reactive intervention for individual (accumulated) |
| IntCostReToc\_L | Time opportunity cost of reactive intervention for individual (accumulated) |
| IntCostReInf\_L | Informal caregiver burden of reactive intervention for individual (accumulated) |
| IntCostProPS\_L | Public sector cost of proactive intervention for individual (accumulated) |
| IntCostProPri\_L | Private cost (travel, copayment) of proactive intervention for individual (accumulated) |
| IntCostProToc\_L | Time opportunity cost of proactive intervention for individual (accumulated) |
| IntCostProInf\_L | Informal caregiver burden of proactive intervention for individual (accumulated) |
| IntCostSelfPS\_L | Public sector cost of self-referred intervention for individual (accumulated) |
| IntCostSelfPri\_L | Private cost (travel, copayment) of self-referred intervention for individual (accumulated) |
| IntCostSelfToc\_L | Time opportunity cost of self-referred intervention for individual (accumulated) |
| IntCostSelfInf\_L | Informal caregiver burden of self-referred intervention for individual (accumulated) |
| IntCostFRS\_L | Cost of falls risk screening under proactive pathway (accumulated) |
| IntEffAny\_L | Intervention efficacy for reducing risk of any fall |
| IntEffRec\_L | Intervention efficacy for reducing risk of recurrent falls given any fall |
| IntEffMA\_L | Intervention efficacy for reducing risk of MA fall given single or recurrent fall |
| IntEffPA\_L | Intervention efficacy for increasing probability of high physical activity |
| Sex\_L | Set at ‘Initial Cohort’ and ‘New Cohorts’  1=Male; 2=Female |
| AgeIn\_L | Initial integer age at model entry [60-90] |
| Age\_L | Dynamic integer age [60-90] |
| Age2\_L | Integer age squared |
| AgeGrIn\_L | Initial age group: 1=age 60-64; 2=age 65-69; 3=age 70-74; 4=age 75-79; 5=age80-84; 6=age 85-89; 7=age 90+ |
| AgeGr\_L | Dynamic age group |
| SES\_L | 1=Least deprived; 2=2nd quartile; 3=3rd quartile; 4=Most deprived |
| FallHistIn\_L | Initial falls history at model entry: 0=No falls history; 1=Single non-MA fall history; 2=Recurrent non-MA fall history; 3=Single MA fall history; 4=Recurrent MA fall history |
| FallHist\_L | Dynamic falls history |
| Subgroup\_L | Baseline subgroups defined by sex, age group, SES and falls history [1-280] |
| SubgroupC2\_L | Baseline subgroups defined by sex, SES and falls history [1-40] |
| FrailtyIn\_L | Initial frailty score at model entry [0-100] |
| FrailtyCatIn\_L | Initial frailty category at model entry: 1=Robust, FI<=10.902 (50th percentile); 2=Mild, FI<=23.42 (85th percentile); 3=Moderate, FI<=39.25 (97th percentile); 4=Severe, FI>39.25; Percentiles calculated from Excel output |
| Frailty\_L | Dynamic frailty score |
| FrailtyCat\_L | Dynamic frailty score category |
| Frailty2\_L | Frailty score squared updated |
| Logitrisk\_L | Temporary label to store risk/probability estimated from logistic equations to generate binary outcomes |
| PAhighrisk\_L | Probability of having high physical activity |
| PAhigh\_L | Incidence of having high physical activity  0=Not high physical activity  1=High physical activity |
| PAhighIn\_L | Initial physical activity status |
| Cogimrisk\_L | Risk of having cognitive impairment |
| Cogim\_L | Incidence of cognitive impairment  0=Not cognitively impaired  1=Cognitively impaired |
| CogimIn\_L | Initial cognitive impairment status |
| Fearrisk\_L | Risk of having fear of falling |
| Fear\_L | Incidence of fear of falling  0=No fear of falling  1=Fear of falling |
| FearIn\_L | Initial fear of falling status |
| Abngaitbalrisk\_L | Risk of having abnormal gait or balance |
| Abngaitbal\_L | Incidence of abnormal gait or balance  0=No abnormal gait or balance  1=Abnormal gait or balance |
| AbngaitbalIn\_L | Initial abnormal gait/balance status |
| Utility\_L | Dynamic EQ-5D value |
| UtilityIn\_L | Initial EQ-5D value |
| UtilityMin\_L | EQ-5D below the age- and sex-specific decent minimum level  0=Not below the decent minimum  1=Below the decent minimum |
| UtilityMinN\_L | Number of years spent with EQ-5D below decent minimum (accumulated) |
| Utility2\_L | EQ-5D squared value for dynamic progression regression |
| QALY\_L | QALY outcome (accumulated) |
| Paidworkrisk\_L | Probability of being in paid employment |
| Paidwork\_L | Incidence of being in paid employment  0=Not in paid employment  1=In paid employment |
| PaidworkIn\_L | Initial paid employment status |
| PaidworkVal\_L | Total value of paid employment (accumulated) |
| Unpaidworkrisk\_L | Probability of doing unpaid work |
| Unpaidwork\_L | Incidence of doing unpaid work  0=Not doing unpaid work  1=Doing unpaid work |
| UnpaidworkIn\_L | Initial unpaid work status |
| UnpaidworkHist\_L | Unpaid work history (accumulated) to measure social mobilisation |
| UnpaidworkVal\_L | Total value of unpaid work (accumulated) |
| Product\_L | Whether person is engaged in paid or unpaid work  0=Not engaged in paid or unpaid work  1=Engaged in either paid or unpaid work |
| ProductHist\_L | Accumulated number of years of engaging in paid or unpaid work |
| CASP\_L | Dynamic CASP-19 value |
| CALY\_L | CASP-adjusted life year outcome (accumulated) |
| HCareCost\_L | Comorbidity primary and secondary healthcare cost (accumulated) |
| HCareCostAC\_L | All-cause primary and secondary healthcare cost (accumulated) |
| ComCare\_L | Incidence of community healthcare receipt (set to ComCare distributions)  1=Receiving community healthcare  2=Not receiving community healthcare >>> changed to 0 for regression |
| ComCareCost\_L | All-cause community healthcare cost (accumulated) |
| SocCare\_L | Incidence of social care receipt (set to SocCare distributions)  1=Receiving social care  2=Not receiving social care >>> changed to 0 for regression |
| SocCareCost\_L | All-cause social care cost (accumulated) |
| OOPCarerisk\_L | Risk of receiving OOP care |
| OOPCare\_L | Incidence of OOP care receipt  0=Not receiving OOP care  1=Receiving OOP care |
| OOPCareCost\_L | All-cause OOP care cost (accumulated) |
| InfCarerisk\_L | Risk of receiving any informal care |
| InfCare\_L | Incidence of any informal care receipt  0=Not receiving informal care  1=Receiving any informal care |
| InfCare2risk\_L | Risk of having multiple care needs given any informal care receipt |
| InfCare2\_L | Incidence of having multiple care needs given any informal care receipt  0=Not having multiple care needs  1=Having multiple care needs |
| InfCareCost\_L | All-cause informal care cost (accumulated) |
| ReactAccess\_L | Whether person with MA falls history accesses the reactive intervention; set to ReactAccess\_D which is set to ProbFrailty spreadsheet under UC and to IntDemand spreadsheet under RC  0=Not relevant because no MA falls history; 1=Access; 2=No access |
| Close\_L | Whether reactive intervention patient requires bi-disciplinary intervention or multidisciplinary falls clinic under Close et al (1999) formulation  1=Bi-disciplinary; 2=Multidisciplinary |
| Rout\_L | Routing label for all purposes |
| GPcontrisk\_L | Probability of receiving routine GP contact |
| GPcont\_L | Incidence of routine GP contact  0=No routine GP contact  1=Routine GP contact |
| FRS\_L | Whether a person who receives routine GP contact receives falls risk screening; set to FRS\_D under usual care  1=Access; 0/2=No access |
| HighRisk\_L | At high risk of falling and eligible for proactive intervention under RC (recurrent non-MA/MA falls history and/or abnormal gait/balance)  1=At high risk; 0=Not at high risk |
| ProTreat\_L | Whether a person who receives falls risk screening accesses falls prevention treatment; set to ProTreat\_D which is set to ProbFrailty spreadsheet under usual care and to IntDemand spreadsheet under RC  1=Access; 0/2=No access |
| SelfTreat\_L | Whether a person not receiving other interventions accesses self-referred intervention; set to SelfTreat\_D under usual care and estimated from SelfTreatrisk\_L under RC  1=Access; 0/2=No access |
| SelfTreatrisk\_L | Probability of accessing self-referred intervention; used only under RC to estimate SelfTreat\_L |
| FatalFallRisk\_L | Risk of experiencing fatal falls (set to FatalFallRisk spreadsheet) |
| FatalFall\_L | Incidence of fatal fall  0= No fatal fall  1= Fatal fall |
| CostDying\_L | Cost of dying due to fatal fall or other causes |
| OtherMortRisk\_L | Risk of experiencing other-cause mortality (set to OtherMortRisk spreadsheet) |
| OtherMort\_L | Incidence of other-cause mortality  0= No other-cause mortality  1= Other-cause mortality |
| FallAnyrisk\_L | Biannual risk of any fall from ELSA risk equation |
| FallAny\_L | Incidence of any fall  1=Any fall; 0=No fall |
| FallAnyTot\_L | Total number of fall episodes per individual (accumulated) |
| FallRecrisk\_L | Biannual risk of recurrent fall given any fall |
| FallRec\_L | Incidence of recurrent fall given any fall  1=Recurrent fall; 0=Single fall |
| FallRecTot\_L | Total number of recurrent fall episodes per individual (accumulated) |
| FallMArisk\_L | Risk of MA fall given single or recurrent falls |
| FallMA\_L | Incidence of MA fall given single or recurrent falls  1=MA fall; 0=Non-MA fall |
| FallMATot\_L | Total number of MA fall (single or recurrent) episodes per individual (accumulated) |
| FallInc\_L | Fall incidence type  0=No fall; 1=Single non-MA fall; 2=Recurrent non-MA falls; 3=Single MA fall; 4=Recurrent falls with 1+ MA fall |
| FallMAHos\_L | Incidence of hospitalized MA fall among those who experience a single MA fall (FallInc\_L=3 or FallInc\_L=4 & FallMARec\_L=2); follows a frailty gradient and set to ProbFrailty spreadsheet column 6 |
| FallMARec\_L | Incidence of recurrent MA falls given FallInc\_L=4; set to FallMARec\_D  1=Incidence of recurrent MA falls; 0/2=No incidence of recurrent MA falls |
| FallMAHos2\_L | Distribution of types of MA falls for those with recurrent falls with 1+ MA fall who experience recurrent MA falls (FallInc\_L=4 & FallMARec\_L=1); follows a frailty gradient and set to FallMAHos2 spreadsheet  1=Two non-hospitalized MA falls; 2=One hospitalized and one non-hospitalized MA falls; 3=Two hospitalized MA falls; (0=For individuals who are not relevant) |
| FallInc2\_L | More granulated fall incidence type for health and cost consequence assignment  0=No fall; 1=Single non-MA fall; 2=Recurrent non-MA falls; 3=Single non-hospitalized MA fall; 4=Single hospitalized MA fall; 5=Recurrent falls with single non-hospitalized MA fall; 6=Recurrent falls with single hospitalized MA fall; 7=Recurrent falls with two non-hospitalized MA falls; 8=Recurrent falls with one hospitalized and one non-hospitalized MA falls; 9=Recurrent falls with two hospitalized MA falls |
| FallHos\_L | Incidence of hospitalized MA fall (FallInc2\_L=4/6/8/9)  1=Incidence; 0=No incidence |
| FallHosTot\_L | Total number of hospitalized fall (single or recurrent) episodes per individual (accumulated) |
| FallQALY\_L | Acute QALY loss (discounted) due to falls (using values in ValueCost spreadsheet) |
| FallCost\_L | Direct fall-related primary & secondary healthcare cost (discounted) (using values in ValueCost spreadsheet); added to all-cause healthcare cost HCareCostAC\_L |
| FallCostTot\_L | Accumulated direct fall-related primary & secondary healthcare cost (discounted) |
| DFrailty\_L | Annual change in frailty score according to ELSA linear regression: biannual change between ELSA Waves 4 and 5 divided by two |
| LTCrisk\_L | Annual risk of LTC admission |
| LTC\_L | Incidence of LTC admission |
| LTCCostPS\_L | Public sector cost of LTC admission (using values in ValueCost spreadsheet) |
| LTCCostPri\_L | Private cost of LTC admission (using values in ValueCost spreadsheet) |
| AllCauseCostPS\_L | All-cause public sector care costs: all-cause healthcare costs + community healthcare costs + short-term social care costs + LTC costs + cost of dying |
| IntCostPS\_L | Total public sector intervention variable costs |
| PAhigh2\_L | Predicted high physical activity for next cycle (to include PAhigh\_L as covariate in other longitudinal equations) |
| Cogim2\_L | Predicted cognitive status for next cycle (to include Cogim\_L as covariate in other longitudinal equations) |
| Abngaitbal2\_L | Predicted abnormal gait/balance for next cycle (to include Abngaitbal\_L as covariate in other longitudinal equations) |
| GPcont2\_L | Predicted GP routine contact for next cycle (to include GPcont\_L as covariate in other longitudinal equations) |
| DUtility\_L | Annual change in EQ-5D |
| DCASP\_L | Annual change in CASP-19 |
| OOPCare2\_L | Predicted OOP care receipt for next cycle (to include OOPCare\_L as covariate in other longitudinal equations) |
| FrailtyM\_L | Frailty score calibrated for mortality risk |
| FrailtyCatM\_L | Frailty score category calibrated for mortality risk |
| SocialMob\_L | Total person-years of social mobilisation including unpaid work and self-referred intervention participation |
| SocialMob34\_L | Above for 3rd or 4th SES quartile |
| FairInn\_L | Whether the person achieves a ‘fair health-related innings’ of 60% of median lifetime QALY  1= Achieves fair innings; 0= Does not achieve fair innings |
| FairInn65\_L | Whether person aged 65 at baseline achieves a ‘fair health-related innings’ |
| FairCInn\_L | Whether the person achieves a ‘fair wellbeing-related innings’ of 60% of median lifetime CALY  1= Achieves fair innings; 0= Does not achieve fair innings |
| FairCInn65\_L | Whether person aged 65 at baseline achieves a ‘fair wellbeing-related innings’ |
| ProductAge\_L | Whether the person achieves productive ageing of five years of paid/unpaid work  1= Achieves productive ageing; 0= Does not achieve productive ageing |
| ProductAge65\_L | Whether person aged 65 at baseline achieves productive ageing |
| PriExp\_L | Cumulative private expenditure, including OOP care expenditure, LTC private cost and intervention private co-payment. |
| PriExp2\_L | Excluding intervention private co-payment from PriExp\_L |
| CatExp\_L | Whether person in 3rd or 4th SES quartile experiences catastrophic private expenditure.  1= Experiences catastrophic expenditure; 0= Does not experience |
| CatExp65\_L | Whether person aged 65 at baseline in 3rd or 4th SES quartile experiences catastrophic private expenditure. |
| CatExp2\_L | Excluding intervention private co-payment from CatExp\_L |
| CatExp265\_L | Above for person aged 65 at baseline |
| InfBurden\_L | Cumulative informal caregiver burden, including informal caregiving cost and intervention time opportunity cost for caregiver. |
| InfBurden2\_L | Excluding intervention caregiver TOC from InfBurden\_L |
| InfExcess\_L | Whether person’s caregiver experiences excessive caregiving burden  1= Experiences excessive burden; 0= Does not experience |
| InfExcess65\_L | Above for person aged 65 at baseline |
| InfExcess2\_L | Excluding intervention caregiver TOC from InfExcess\_L |
| InfExcess265\_L | Above for person aged 65 at baseline |
| AnyFaller\_L | Whether person experienced any fall during model simulation |
| RecFaller\_L | Whether person experienced recurrent falls during model simulation |
| MAFaller\_L | Whether person experienced MA fall during model simulation |
| HosFaller\_L | Whether person experienced hospitalised fall during model simulation |

### Distributions

|  |  |
| --- | --- |
| **Distribution** | **Description** |
| C1Sex\_D | Sex prevalence for initial cohort: 1=46.5% male; 2=53.5% female |
| C2Sex\_D | Sex prevalence for new cohorts: 1=48.4% male; 2=51.6% female |
| C1MaleAge\_D | Age prevalence for male in initial cohort [60-90] |
| C1FemaleAge\_D | Age prevalence for female in initial cohort [60-90] |
| MAge1SES\_D | SES prevalence for male aged 60-64 in initial cohort [1=Least deprived…4=Most deprived] |
| MAge2SES\_D | SES prevalence for male aged 65-69 in initial cohort |
| MAge3SES\_D | SES prevalence for male aged 70-74 in initial cohort |
| MAge4SES\_D | SES prevalence for male aged 75-79 in initial cohort |
| MAge5SES\_D | SES prevalence for male aged 80-84 in initial cohort |
| MAge6SES\_D | SES prevalence for male aged 85-89 in initial cohort |
| MAge7SES\_D | SES prevalence for male aged 90+ in initial cohort |
| FAge1SES\_D | SES prevalence for female aged 60-64 in initial cohort |
| FAge2SES\_D | SES prevalence for female aged 65-69 in initial cohort |
| FAge3SES\_D | SES prevalence for female aged 70-74 in initial cohort |
| FAge4SES\_D | SES prevalence for female aged 75-79 in initial cohort |
| FAge5SES\_D | SES prevalence for female aged 80-84 in initial cohort |
| FAge6SES\_D | SES prevalence for female aged 85-89 in initial cohort |
| FAge7SES\_D | SES prevalence for female aged 90+ in initial cohort |
| C2MSES\_D | SES prevalence for male aged 60 in new cohorts |
| C2FSES\_D | SES prevalence for female aged 60 in new cohorts |
| MS1Age1FH\_D | Fall history prevalence for male SES1 aged 60-64 [0=No falls history; 1=Single non-MA fall history; 2=Recurrent non-MA falls history; 3=Single MA fall history; 4=Recurrent falls with 1+ MA fall] |
| MS1Age2FH\_D | Fall history prevalence for male SES1 aged 65-69 |
| MS1Age3FH\_D | Fall history prevalence for male SES1 aged 70-74 |
| MS1Age4FH\_D | Fall history prevalence for male SES1 aged 75-79 |
| MS1Age5FH\_D | Fall history prevalence for male SES1 aged 80-84 |
| MS1Age6FH\_D | Fall history prevalence for male SES1 aged 85-89 |
| MS1Age7FH\_D | Fall history prevalence for male SES1 aged 90+ |
| MS2Age1FH\_D | Fall history prevalence for male SES2 aged 60-64 |
| MS2Age2FH\_D | Fall history prevalence for male SES2 aged 65-69 |
| MS2Age3FH\_D | Fall history prevalence for male SES2 aged 70-74 |
| MS2Age4FH\_D | Fall history prevalence for male SES2 aged 75-79 |
| MS2Age5FH\_D | Fall history prevalence for male SES2 aged 80-84 |
| MS2Age6FH\_D | Fall history prevalence for male SES2 aged 85-89 |
| MS2Age7FH\_D | Fall history prevalence for male SES2 aged 90+ |
| MS3Age1FH\_D | Fall history prevalence for male SES3 aged 60-64 |
| MS3Age2FH\_D | Fall history prevalence for male SES3 aged 65-69 |
| MS3Age3FH\_D | Fall history prevalence for male SES3 aged 70-74 |
| MS3Age4FH\_D | Fall history prevalence for male SES3 aged 75-79 |
| MS3Age5FH\_D | Fall history prevalence for male SES3 aged 80-84 |
| MS3Age6FH\_D | Fall history prevalence for male SES3 aged 85-89 |
| MS3Age7FH\_D | Fall history prevalence for male SES3 aged 90+ |
| MS4Age1FH\_D | Fall history prevalence for male SES4 aged 60-64 |
| MS4Age2FH\_D | Fall history prevalence for male SES4 aged 65-69 |
| MS4Age3FH\_D | Fall history prevalence for male SES4 aged 70-74 |
| MS4Age4FH\_D | Fall history prevalence for male SES4 aged 75-79 |
| MS4Age5FH\_D | Fall history prevalence for male SES4 aged 80-84 |
| MS4Age6FH\_D | Fall history prevalence for male SES4 aged 85-89 |
| MS4Age7FH\_D | Fall history prevalence for male SES4 aged 90+ |
| FS1Age1FH\_D | Fall history prevalence for female SES1 aged 60-64 |
| FS1Age2FH\_D | Fall history prevalence for female SES1 aged 65-69 |
| FS1Age3FH\_D | Fall history prevalence for female SES1 aged 70-74 |
| FS1Age4FH\_D | Fall history prevalence for female SES1 aged 75-79 |
| FS1Age5FH\_D | Fall history prevalence for female SES1 aged 80-84 |
| FS1Age6FH\_D | Fall history prevalence for female SES1 aged 85-89 |
| FS1Age7FH\_D | Fall history prevalence for female SES1 aged 90+ |
| FS2Age1FH\_D | Fall history prevalence for female SES2 aged 60-64 |
| FS2Age2FH\_D | Fall history prevalence for female SES2 aged 65-69 |
| FS2Age3FH\_D | Fall history prevalence for female SES2 aged 70-74 |
| FS2Age4FH\_D | Fall history prevalence for female SES2 aged 75-79 |
| FS2Age5FH\_D | Fall history prevalence for female SES2 aged 80-84 |
| FS2Age6FH\_D | Fall history prevalence for female SES2 aged 85-89 |
| FS2Age7FH\_D | Fall history prevalence for female SES2 aged 90+ |
| FS3Age1FH\_D | Fall history prevalence for female SES3 aged 60-64 |
| FS3Age2FH\_D | Fall history prevalence for female SES3 aged 65-69 |
| FS3Age3FH\_D | Fall history prevalence for female SES3 aged 70-74 |
| FS3Age4FH\_D | Fall history prevalence for female SES3 aged 75-79 |
| FS3Age5FH\_D | Fall history prevalence for female SES3 aged 80-84 |
| FS3Age6FH\_D | Fall history prevalence for female SES3 aged 85-89 |
| FS3Age7FH\_D | Fall history prevalence for female SES3 aged 90+ |
| FS4Age1FH\_D | Fall history prevalence for female SES4 aged 60-64 |
| FS4Age2FH\_D | Fall history prevalence for female SES4 aged 65-69 |
| FS4Age3FH\_D | Fall history prevalence for female SES4 aged 70-74 |
| FS4Age4FH\_D | Fall history prevalence for female SES4 aged 75-79 |
| FS4Age5FH\_D | Fall history prevalence for female SES4 aged 80-84 |
| FS4Age6FH\_D | Fall history prevalence for female SES4 aged 85-89 |
| FS4Age7FH\_D | Fall history prevalence for female SES4 aged 90+ |
| FrailtyIn\_D | Frailty distribution (lognormal bounded at 0-100) for Initial Cohort. Subgroup-specific means and SDs drawn from FrailtyPar spreadsheet. For mean values: FrailtyPar[1,Subgroup\_L]. For SD values: FrailtyPar[2,Subgroup\_L] |
| FrailtyC2In\_D | Frailty distribution (lognormal bounded at 0-100) for New Cohorts. Subgroup-specific means and SDs drawn from FrailtyParC2 spreadsheet. For mean values: FrailtyParC2[1,SubgroupC2\_L]. For SD values: FrailtyParC2[2,SubgroupC2\_L] |
| ComCare\_D | Community healthcare receipt: 1=Receipt; 2=No receipt  Probability varying by frailty category (Moderate and Severe) and cognitive status: see ProbFrailty spreadsheet column 1 |
| SocCare\_D | Social care receipt: 1=Receipt; 2=No receipt  Probability varying by frailty category (Moderate and Severe) and cognitive status: see ProbFrailty spreadsheet column 2 |
| ReactAccess\_D | Individuals with MA falls history who access reactive intervention **under UC**  1=Access; 2=No access  Probability varying by frailty category: see ProbFrailty spreadsheet column 3 |
| FRS\_D | Individuals with no history of proactive intervention who access falls risk screening **under UC**  1=Access; 2=No access  Probability varying by frailty category: see ProbFrailty spreadsheet column 4 |
| ProTreat\_D | Cognitively intact persons who access proactive treatment after falls risk screening **under UC**  1=Access; 2=No access  Probability varying by frailty category: see ProbFrailty spreadsheet column 5 |
| SelfTreat\_D | Persons in most privileged social quartile not receiving reactive or proactive intervention who access self-referred intervention **under UC**  1=Access; 2=No access |
| FallMARec\_D | Risk of persons with FallInc\_L=4 experiencing recurrent MA falls  1=Incidence of recurrent falls; 2=No incidence  According to Howland et al (2015), 42.6% of those with Fallinc\_L=4 experience multiple MA falls within one year of first MA fall |

### Spreadsheets

|  |  |
| --- | --- |
| **Spreadsheet** | **Description** |
| Start Point 1 Arrival Schedule | Cohort sizes by time of entry Arrival.Schedule spreadsheet  Time 0: Batch Size 125244 etc.  Information copied from Excel |
| FrailtyPar | Frailty score mean and SD for initial cohort |
| FrailtyParC2 | Frailty score mean and SD for new cohorts |
| CoeffBook | Spreadsheet of coefficients for multivariate equations under base case analysis:   1. Probability of baseline high physical activity [PAhighrisk\_L] 2. Risk of baseline cognitive impairment [Cogimrisk\_L] 3. Risk of baseline fear of falling [Fearrisk\_L] 4. Risk of baseline abnormal gait and balance [Abngaitbalrisk\_L] 5. Baseline EQ-5D values [Utility\_L] 6. Probability of baseline paid employment [Paidworkrisk\_L] 7. Probability of baseline unpaid work [Unpaidworkrisk\_L] 8. Risk of baseline OOP care receipt [OOPCarerisk\_L] 9. Risk of baseline any informal care receipt [InfCarerisk\_L] 10. Risk of multiple care needs given informal care receipt [InfCare2risk\_L] 11. Probability of routine GP contact [GPContrisk\_L] 12. Probability of self-referred exercise demand [Frtselfrisk\_L] 13. Risk of any fall [Anyfallrisk\_L] 14. Risk of recurrent fall given any fall [Recfallrisk\_L] 15. Risk of MA fall given single fall [MAsinfallrisk\_L] 16. Risk of MA fall given recurrent fall [MArecfallrisk\_L] 17. Change in frailty score [DFrailty\_L] 18. Risk of LTC admission [LTCrisk\_L] 19. Updated probability of high physical activity [PAhighrisk\_L] 20. Updated risk of cognitive impairment [Cogimrisk\_L] 21. Updated risk of abnormal gait/balance [Abngaitbalrisk\_L] 22. Updated probability of routine GP contact [GPContrisk\_L] 23. Updated probability of self-referred exercise demand [Frtselfrisk\_L] 24. Change in EQ-5D score [DUtility\_L] 25. Updated probability of paid employment [Paidworkrisk\_L] 26. Updated probability of unpaid work [Unpaidworkrisk\_L] 27. Updated risk of OOP care receipt [OOPCarerisk\_L] 28. Updated risk of any informal care receipt [InfCarerisk\_L] 29. Updated risk of multiple care needs given informal care receipt [InfCare2risk\_L] |
| CoBPAHigh | Coefficients for probability of baseline high physical activity under PSA |
| CoBCogim | Coefficients for baseline risk of cognitive impairment under PSA |
| CoBFear | Coefficients for baseline risk of fear of falling under PSA |
| CoBAbngaitbal | Coefficients for baseline risk of abnormal gait/balance under PSA |
| CoBEQ5D | Coefficients for baseline EQ-5D under PSA |
| CoBPaidwork | Coefficients for baseline probability of paid employment under PSA |
| CoBUnpaidwork | Coefficients for baseline probability of unpaid work under PSA |
| CoBOopcare | Coefficients for baseline risk of OOP care receipt under PSA |
| CoBInfcare | Coefficients for baseline risk of informal care receipt under PSA |
| CoBInfcare2 | Coefficients for baseline risk of multiple informal care receipt under PSA |
| CoBGPcont | Coefficients for baseline probability of GP routine contact under PSA |
| CoBFrtself | Coefficients for baseline probability of self-referred exercise demand [recommended scenario only] under PSA |
| CoAnyfall | Coefficients for any fall risk under PSA |
| CoRecfall | Coefficients for recurrent fall risk given any fall under PSA |
| CoMASinfall | Coefficients for MA fall risk given single fall under PSA |
| CoMARecfall | Coefficients for MA fall risk given recurrent fall under PSA |
| CoDFrailty | Coefficients for dynamic change in frailty under PSA |
| CoLTCrisk | Coefficients for LTC admission risk under PSA |
| CoDyPAHigh | Coefficients for probability of dynamic high physical activity under PSA |
| CoDyCogim | Coefficients for dynamic risk of cognitive impairment under PSA |
| CoDyAbngaitbal | Coefficients for dynamic risk of abnormal gait/balance under PSA |
| CoDyGPcont | Coefficients for dynamic probability of GP routine contact under PSA |
| CoDyFrtself | Coefficients for dynamic probability of self-referred exercise demand [recommended scenario only] under PSA |
| CoDyEQ5D | Coefficients for dynamic change EQ-5D under PSA |
| CoDyPaidwork | Coefficients for dynamic probability of paid employment under PSA |
| CoDyUnpaidwork | Coefficients for dynamic probability of unpaid work under PSA |
| CoDyOopcare | Coefficients for dynamic risk of OOP care receipt under PSA |
| CoDyInfcare | Coefficients for dynamic risk of informal care receipt under PSA |
| CoDyInfcare2 | Coefficients for dynamic risk of multiple informal care receipt under PSA |
| UtilityMin | Decent minimum EQ-5D thresholds by age group |
| ValueCost | Annual value and cost of (for base case analysis):   1. Paid employment (row 1) 2. Unpaid work (row 2) 3. Primary and secondary healthcare cost by frailty category (rows 3-6) 4. Community healthcare cost (row 7) 5. Social care cost by frailty category and cognitive status (rows 8-11) 6. OOP care cost by frailty category and SES (rows 12-27) 7. Informal care cost single care need (row 28) 8. Informal care cost multiple care needs (row 29) 9. Cost of dying due to fall and other causes (rows 30-31) 10. Acute QALY loss according to fall incidence type (rows 32-40) 11. Economic consequences according to fall incidence type (rows 41-45) 12. Cost of LTC admission by sector and SES (rows 46-51) 13. QALY remaining for new LTC residents (row 52) |
| ValueCostPSA | Parameter values drawn for variables under ValueCost for PSA. Note that the variables transposed such that they are arranged by columns rather than rows. |
| ProbFrailty | Probabilities stratified by frailty category for:   1. Community healthcare receipt (col 1) 2. Social care receipt (col 2) 3. Reactive intervention access under usual care (col 3) 4. Falls risk screening receipt given routine GP contact under usual care (col 4) 5. Falls prevention treatment given falls risk screening under usual care (col 5) 6. Hospitalization risk given single MA fall (col 6) |
| ProbFrailtyPSA | Parameter values drawn for variables under ProbFrailty for PSA. Note that the variables transposed such that they are arranged by columns rather than rows. |
| IntDemand | Demand for interventions under recommended scenario   1. Demand for reactive intervention for cognitively intact (row 1) 2. Demand for reactive intervention for cognitively impaired (row 2) 3. Demand for proactive intervention for cognitively intact (row 3) 4. Demand for proactive intervention for cognitively impaired (row 4) |
| IntCostUC | Intervention variable cost by intervention type and sector under usual care scenario |
| IntCostUCPSA | Parameter values drawn for variables under IntCostUC for PSA. Note that the variables transposed such that they are arranged by columns rather than rows. |
| IntCostRC | Intervention variable cost by intervention type and sector under recommended scenario |
| IntCostRCPSA | Parameter values drawn for variables under IntCostUC for PSA. Note that the variables transposed such that they are arranged by columns rather than rows. |
| IntEffUC | Intervention efficacy by intervention type and participant characteristics under usual care scenario |
| IntEffUCPSA | Parameter values drawn for variables under IntEffUC for PSA. Note that the variables transposed such that they are arranged by columns rather than rows. |
| IntEffRC | Intervention efficacy by intervention type and participant characteristics under recommended scenario |
| IntEffRCPSA | Parameter values drawn for variables under IntEffRC for PSA. Note that the variables transposed such that they are arranged by columns rather than rows. |
| FatalFallRisk | Annual risk of fatal fall by age group, sex and frailty category |
| OtherMortRisk | Annual risk of other-cause mortality by age, sex and frailty category |
| OtherMortRisk20 | Above with 20% reduction in hazard ratios for scenario analysis |
| FallMAHos2 | Distribution of types of MA falls by frailty for those with recurrent falls with 1+ MA fall who experience recurrent MA falls (FallInc\_L=4 & FallMARec\_L=1)  1=Two non-hospitalized MA falls; 2=One hospitalized and one non-hospitalized MA falls; 3=Two hospitalized MA falls |
| PSA Answers | For storing PSA outputs |
| Answers | For storing societal CUA outcomes |
| Answers2 | For storing wider outcomes |
| Answers3 | For storing outcomes by SES quartiles |
| CoDFrailtySc | Coefficients for dynamic frailty progression without falls incidence as explanatory variable in Scenario A2 versions. |

### Numbers

|  |  |
| --- | --- |
| **Numbers** | **Description** |
| Random | [0, 0] |
| SimTime | Simulation time [0, 0]  Stamped at ‘Start Cycle’ object; Used in ‘Update Lag’ object to create cycles |
| IntHistRe | Total number of people receiving the reactive intervention |
| IntHistPro | Total number of people receiving the proactive intervention |
| IntHistSelf | Total number of people receiving the self-referred intervention |
| IntHistFRS | Total number of people receiving falls risk screening under proactive pathway |
| Dis\_Cost | Discount rate for costs (0.035 default) |
| Dis\_Health | Discount rate for health (0.035 default) |
| IntCostFixed | Falls Clinic fixed intervention cost (public sector) – calculated manually from Excel |
| IntCostPS | Variable intervention cost for public sector |
| IntCostPSs1-4 | Above for SES quartiles 1-4 |
| QALY | Total QALY |
| QALYs1-4 | Total QALY for SES quartiles 1-4 |
| FallCost | Total fall-related healthcare costs |
| FallCosts1-4 | Total fall-related healthcare costs for SES quartiles 1-4 |
| AllCauseCostPS | Total all-cause public sector care costs: fall-related healthcare costs + comorbidity healthcare costs + community healthcare costs + short-term social care costs + LTC public sector costs + cost of dying (health and social care) |
| AllCauseCostPSs1-4 | Above for SES quartiles 1-4 |
| CALY | Total CALY |
| PSAR | PSA run number (content =1; reset blank) |
| PaidWorkVal | Total value of paid employment productivity |
| UnpaidWorkVal | Total value of unpaid work productivity |
| IntCostToc | Total intervention time opportunity cost |
| OOPCareCost | Total OOP care expenditure |
| IntCostPri | Total intervention private co-payment |
| InfCareCost | Total informal caregiver burden |
| IntCostInf | Total intervention informal caregiver time opportunity cost |
| LTC | Total number of persons admitted to LTC |
| AnyFaller | Total number of persons experience any fall in model simulation |
| AnyFall | Total number of person-years experiencing 1+ any fall |
| RecFaller | Total number of persons experience recurrent falls in model simulation |
| RecFall | Total number of person-years experiencing recurrent falls of any type |
| MAFaller | Total number of persons experience MA fall in model simulation |
| MAFall | Total number of person-years experiencing 1+ MA fall |
| HosFaller | Total number of persons experience hospitalised fall in model simulation |
| HosFall | Total number of person-years experiencing 1+ hospitalised fall |
| FatalFall | Total number of persons experiencing fatal fall |
| OtherMort | Total number of persons experiencing other-cause mortality |
| SocialMob | Total number of person-years of social mobilisation |
| SocialMob34 | Above for 3rd or 4th SES quartile |
| FairInn | Total number of persons achieving ‘fair health-related innings’ |
| FairInn65 | Above for persons aged 65 at baseline |
| FairCInn | Total number of persons achieving ‘fair wellbeing-related innings’ computed with CALY |
| FairCInn65 | Above for persons aged 65 at baseline |
| ProductAge | Total number of persons achieving productive ageing |
| ProductAge65 | Above for persons aged 65 at baseline |
| CatExp | Total number of persons experiencing catastrophic private expenditure |
| CatExp65 | Above for persons aged 65 at baseline |
| CatExp2 | Total number of persons experiencing catastrophic private expenditure (excluding intervention private co-payment) |
| CatExp265 | Above for persons aged 65 at baseline |
| InfExcess | Total number of persons whose caregiver(s) experience excessive burden |
| InfExcess65 | Above for persons aged 65 at baseline |
| InfExcess2 | Total number of persons whose caregiver(s) experience excessive burden (excluding intervention caregiver TOC) |
| InfExcess265 | Above for persons aged 65 at baseline |

### Visual logic

**(1) ‘Entry’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Set Arrival Schedule | See ‘Start Point 1 Arrival Schedule’  Time 0: Batch Size 125244; Cohort\_L=1  Time 395: Batch Size 6527; Cohort\_L=2  Etc.  Time 14265: Batch Size 6895; Cohort\_L=40 |
| Routing Out | By Cohort\_L: [1] ‘Initial Cohort’; [2] ‘New Cohorts’ |

**(2) ‘Initial Cohort’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Set Average [0]: no activity time |
| Action | Set Sex\_L to C1Sex\_D |
| Action VL – Set cycle label | 1. Set dynamic cycle label: SET Cycle\_L=Cohort\_L-1 2. Set initial cycle label: SET CycleIn\_L=Cohort\_L 3. Set cumulative cycle label (number of cycles/years spent in model): SET CycleN\_L=0 |
| Action VL – intervention labels for later use | 1. Set lifetime intervention history labels to zero 2. Set current intervention status labels to zero 3. Set intervention variable cost labels to zero |
| Action VL – assign baseline characteristics | 1. Set initial integer age given sex: SET AgeIn\_L=C1MaleAge\_D if male; SET AgeIn\_L=C1FemaleAge\_D if female 2. Set dynamic integer age and age squared: SET Age\_L=AgeIn\_L and SET Age2\_L=Age\_L^2 3. Set initial and dynamic age group (60-64; 65-69 … 90+): AgeGrIn\_L and AgeGr\_L 4. Set SES (SES\_L) by sex and age group: use sex- and age group-specific SES distributions (e.g., MAge1SES\_D for male aged 60-64) 5. Set initial falls history (FallHistIn\_L) given sex, age group and SES: use sex-, age group- and SES-specific falls history distributions (e.g., MS1Age1FH\_D for male aged 60-64 in SES1) 6. Set unique subgroup number for sex, age group, SES and falls history: Subgroup\_L 7. Set dynamic falls history: SET FallHist\_L=FallHistIn\_L 8. Set initial frailty score from FrailtyIn\_D that has subgroup-specific mean and SD for lognormal distribution (from ELSA data) 9. Calculate percentiles for initial cohort from Excel output (50th =10.902; 85th =23.420; 97th =39.245) 10. Set initial frailty category FrailtyCatIn\_L 11. Set dynamic frailty score: SET Frailty\_L=FrailtyIn\_L and Frailty2\_L=Frailty\_L^2 12. Set dynamic frailty category: SET FrailtyCat\_L=FrailtyCatIn\_L |

**(3) ‘New Cohorts’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action | Set Sex\_L to C2Sex\_D |
| Action VL – Set cycle label | 1. Set dynamic cycle label: SET Cycle\_L=Cohort\_L-1 2. Set initial cycle label: SET CycleIn\_L=Cohort\_L 3. Set cumulative cycle label (number of cycles/years spent in model): SET CycleN\_L=0 |
| Action VL – intervention labels for later use | 1. Set lifetime intervention history labels to zero 2. Set current intervention status labels to zero 3. Set intervention variable cost labels to zero |
| Action VL – Assign baseline characteristics | 1. SET AgeIn\_L=60 2. SET AgeGrIn\_L=1 3. SET Age\_L=AgeIn\_L and Age2\_L=Age\_L^2 4. SET AgeGr\_L=AgeGrIn\_L 5. Set SES given sex 6. Set initial falls history given sex and SES: use corresponding falls history distribution for age group 60-64 in initial cohort 7. Set unique subgroup number for sex, SES and falls history: SubgroupC2\_L: use corresponding frailty parameters for age group 60-64 in initial cohort 8. Set dynamic falls history: SET FallHist\_L=FallHistIn\_L 9. Set initial frailty score from FrailtyC2In\_D by unique subgroup 10. Set initial frailty category FrailtyCatIn\_L 11. Set dynamic frailty score: SET Frailty\_L=FrailtyIn\_L and Frailty2\_L=Frailty\_L^2 12. Set dynamic frailty category: SET FrailtyCat\_L=FrailtyCatIn\_L |

**(4) ‘Baseline Variables’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL – Estimate baseline covariates | 1. Estimate probability of high physical activity PAhighrisk\_L using STATA risk equation and CoBPAHigh spreadsheet 2. Predict incidence of high physical activity: PAhigh\_L; use Random 3. Set initial high physical activity label: PAhighIn\_L 4. Estimate risk of cognitive impairment Cogimrisk\_L using STATA risk equation and CoBCogim spreadsheet 5. Predict incidence of cognitive impairment: Cogim\_L; use Random 6. Set initial cognitive impairment label: CogimIn\_L 7. Estimate risk of fear of falling Fearrisk\_L using STATA risk equation and CoBFear spreadsheet 8. Predict incidence of fear of falling: Fear\_L; use Random 9. Set initial fear of falling label: FearIn\_L 10. Estimate risk of abnormal gait & balance Abngaitbalrisk\_L using STATA risk equation and CoBAbngaitbal spreadsheet 11. Predict incidence of abnormal gait & balance: Abngaitbal\_L; use Random 12. Set initial abnormal gait & balance label: AbngaitbalIn\_L |
| Action VL – Estimate baseline EQ-5D and productivity value | 1. Estimate dynamic EQ-5D label Utility\_L using STATA linear equation and CoBEQ5D spreadsheet 2. Account for ceiling effect: set Utility\_L=1 if it is >1 (n=945) 3. Set initial EQ-5D value: IF Cycle\_L=1; SET UilityIn\_L=Utility\_L 4. (NOT ESSENTIAL) Set label for EQ-5D below decent minimum UtilityMin\_L: use EQ5Dmin spreadsheet 5. (NOT ESSENTIAL) Set label for accumulative number of years spent below decent minimum EQ-5D: UtilityMinN\_L 6. Set label QALY\_L for outcome 7. Estimate probability of paid employment Paidworkrisk\_L using STATA risk equation and CoBPaidwork spreadsheet 8. Predict incidence of paid employment: Paidwork\_L; use random 9. Set initial paid employment label: PaidworkIn\_L 10. Assign discounted value of paid employment: PaidworkVal\_L using ValueCostPSA spreadsheet 11. Estimate probability of unpaid work Unpaidworkrisk\_L using STATA risk equation and CoBUnpaidwork spreadsheet 12. Predict incidence of unpaid work: Unpaidwork\_L; use random 13. Set initial unpaid work label: UnpaidworkIn\_L 14. Set unpaid work history label: UnpaidworkHist\_L 15. Assign discounted value of unpaid work: UnpaidworkVal\_L using ValueCostPSA spreadsheet 16. Set productivity label Product\_L and productivity history label ProductHist\_L for calculating productive ageing. 17. Estimate CASP-19 label CASP\_L using STATA linear equation and CoBCASP spreadsheet 18. Set label CALY\_L for CASP-adjusted life year outcome. |
| Action VL – Estimate baseline comorbidity care costs | 1. Assign discounted comorbidity primary and secondary healthcare costs HCareCost\_L (accumulated) by frailty category 2. Set all-cause primary and secondary healthcare cost label HCareCostAC\_L (accumulated) 3. Predict community healthcare recipients ComCare\_L by frailty and cognitive impairment 4. Assign discounted community healthcare cost ComCareCost\_L 5. Set ComCare\_L=0 for those not receiving community care (ComCare\_L=2) so that the label can be used as regression covariate 6. Predict social care recipients SocCare\_L by frailty and cognitive impairment 7. Assign social care cost SocCareCost\_L by frailty and cognitive impairment 8. Discount social care cost SocCareCost\_L 9. Set SocCare\_L=0 for those not receiving community care (SocCare\_L=2) so that the label can be used as regression covariate 10. Estimate risk of OOP care receipt OOPCarerisk\_L using STATA risk equation and CoeffBook spreadsheet 11. Predict OOP care receipt OOPCare\_L; use Random 12. Assign OOP care cost OOPCareCost\_L by frailty and SES 13. Discount OOP care cost 14. Estimate risk of informal care receipt InfCarerisk\_L using STATA risk equation and CoeffBook spreadsheet 15. Predict informal care receipt InfCare\_L; use Random 16. Estimate risk of multiple informal care need given informal care receipt InfCare2risk\_L using STATA risk equation and Coeffbook spreadsheet 17. Predict multiple informal care need given informal care receipt InfCare2\_L; use Random 18. Assign informal care cost InfCareCost\_L by no. of care needs 19. Discount informal caregiver burden |
| Routing out | Rout out to ‘Start Cycle’ |

**(5) ‘Start Cycle’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL – Update cycle label and simulation time | 1. Update dynamic cycle label: SET Cycle\_L=Cycle\_L+1 2. Update cumulative cycle label: SET CycleN\_L=CycleN\_L+1 3. Mark time of cycle start: SET SimTime=Simulation Time |
| Action VL – Set intervention routes by scenarios | 1. Set access to reactive intervention:    1. Under UC, eligibility/access rate for those with MA falls history varies by frailty category (ProbFrailty spreadsheet column 3)    2. Under RC, all MA fallers are eligible and access intervention pending demand rate which varies by cognitive status (IntDemand spreadsheet) 2. For individuals entering the for first cycle (CycleN\_L=1), estimate probability of GP routine contact GPcontrisk\_L for those not accessing reactive intervention using STATA risk equation and CoeffBook spreadsheet – same for both UC and RC. For those in intermediate cycles, use GPcont2\_L estimated in ‘Covariate Dynamics’ in previous cycle 3. Predict incidence of GP routine contact: GPcont\_L; use Random 4. Set Routing out label: Rout\_L=1 Reactive intervention; =2 Routine GP contact; =3 No routine GP contact |
| Routing out | Rout out by label Rout\_L:   * IF ReactAccess\_L=1; SET Rout\_L=1 for ‘Reactive Pathway’ * IF GPcont\_L=1; SET Rout\_L=2 for ‘Routine GP Contact’ * IF Rout\_L=0; SET Rout\_L=3 for ‘No Routine GP Contact’ |

**(6) ‘Reactive Intervention’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set current intervention status label (IntCurRe\_L) 2. Set intervention variable cost labels according to IntCost spreadsheet with 3.5% annual discounting 3. Set intervention efficacy labels according to IntEfficacy spreadsheet 4. Set lifetime intervention history label IntHistRe\_L and global number IntHistRe for total number of intervention recipients |
| Routing out | Rout out to ‘Fatal Fall Risk’ |

**(7) ‘Routine GP Contact’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL – Accessing falls risk screening | 1. Set probability of accessing falls risk screening FRS\_D    1. Under usual care, only those without proactive intervention history (IntHistPro\_L=0) and with recurrent non-MA or MA falls history receive falls risk screening; access rate follows a frailty gradient (ProbFrailty spreadsheet column 4)    2. Under recommended care, rout to FRS only if proactive intervention history three or less; otherwise, everyone receives falls risk screening 2. Set incidence of accessing falls risk screening: FRS\_L=1 access; =2 or =0 no access; no coding required for RC 3. Set routing label: Rout\_L=1 if FRS\_L=1; =2 if FRS\_L=0 or 2; no routing label for RC |
| Routing out | UC – Rout out by Rout\_L: 1= to ‘Falls Risk Screening’; 2= to ‘No Proactive Int’  RC – Rout out by Rout\_L: 1= to ‘Falls Risk Screening’; 2= to ‘No Proactive Int’ |

**(8) ‘Falls Risk Screening’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set cost of falls risk screening: IntCostFRS\_L 2. Set global number IntHistFRS for total number of screening recipients 3. Set treatment eligibility and access parameters    1. Under UC, only cognitively intact persons receive treatment and access rate ProTreat\_L is set to ProTreat\_D which follows the frailty gradient (ProbFrailty spreadsheet column 5)    2. Under RC, persons with high falls risk HighRisk\_L=1 (FallHist\_L>=2 or Abngaitbal\_L=1) are eligible. Among eligible persons, access rate ProTreat\_L depends on demand rates from IntDemand spreadsheet |
| Routing out | Rout out by Rout\_L: 1= to ‘Proactive Int’ in UC or ‘High Falls Risk’ in RC; 2= to ‘No Proactive Int’ |

**(9) ‘Proactive Intervention’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set current intervention status label (IntCurPro\_L) 2. Set intervention variable cost labels according to IntCost spreadsheet with 3.5% annual discounting 3. Set intervention efficacy labels according to IntEfficacy spreadsheet 4. Set lifetime intervention history label IntHistPro\_L and global number IntHistPro for total number of intervention recipients |
| Routing out | Rout out to ‘Fatal Fall Risk’ |

**(10) ‘No Routine GP Contact’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | Under RC, set high falls risk label HighRisk\_L according to FallHist\_L>=2 or Abngaitbal\_L=1 which will later determine self-referred intervention cost and efficacy |
| Routing out | Rout out to ‘No Proactive Int’ |

**(11) ‘No Proactive Intervention’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set probability of accessing self-referred intervention    1. Under usual care, this is 0.1% of SES1 individuals    2. Under recommended, for the first cycle, the probability SelfTreatrisk\_L is estimated from ELSA risk equation in CoeffBook spreadsheet and SelfTreat\_L is estimated using Random. For later cycles, SelfTreat2\_L estimated in ‘Covariate Dynamics’ in previous cycle is used. 2. Set routing label by self-referred intervention access: Rout\_L=1 if SelfTreat\_L=1; =2 if 0 or 2 |
| Routing out | Rout out by Rout\_L: 1= to ‘Self Referred Int’; 2= to ‘No Int’ |

**(12) ‘Self Referred Intervention’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set current intervention status label (IntCurSelf\_L) 2. Set intervention variable cost labels according to IntCost spreadsheet with 3.5% annual discounting 3. Set intervention efficacy labels according to IntEfficacy spreadsheet: efficacy varies by falls risk (no falls history or single non-MA fall history vs. recurrent non-MA falls or MA falls history) and cognitive status 4. Set lifetime intervention history label IntHistSelf\_L and global number IntHistSelf for total number of intervention recipients |
| Routing out | Rout out to ‘Fatal Fall Risk’ |

**(13) ‘No Intervention’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Routing out | Rout out to ‘Fatal Fall Risk’ |

**(14) ‘Fatal Fall Risk’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set risk of fatal fall by age group, sex and frailty category: FatalFallRisk\_L set to FatalFallRisk spreadsheet. Use normal frailty category for first cycle and calibrated category for subsequent cycles 2. Set incidence of fatal falls: FatalFall\_L; use Random 3. Set cost of dying from fall CostDying\_L; public sector cost from ValueCost spreadsheet discounted by 3.5% annual rate 4. Set final QALY\_L for deceased persons exiting the model 5. Set final CALY\_L for deceased persons existing the model 6. Set routing label by fatal fall incidence |
| Routing out | Rout out by Rout\_L: =1 to ‘Death Exit’; =2 to ‘Other Mortality Risk’ |

**(15) ‘Other Mortality Risk’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Set other-cause mortality risk by age, sex and frailty category: OtherMortRisk\_L set to OtherMortRisk spreadsheet. Use normal frailty category for first cycle and calibrated category for subsequent cycles 2. Set incidence of other-cause mortality: OtherMort\_L; use Random 3. Set cost of dying from other causes CostDying\_L; public sector cost from ValueCost spreadsheet discounted by 3.5% annual rate 4. Set final QALY\_L for deceased persons exiting the model 5. Set final CALY\_L for deceased persons exiting the model 6. Set routing label by other-cause mortality incidence |
| Routing out | Rout out by Rout\_L: =1 to ‘Death Exit’; =2 to ‘Fall Risk’ |

**(16) ‘Fall Risk’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL – falls risk and incidence | 1. Estimate risk of any fall FallAnyrisk\_L using STATA risk equation and CoeffBook spreadsheet 2. Apply efficacy IntEffAny\_L to FallAnyrisk\_L 3. Estimate incidence of any fall FallAny\_L using Random 4. Set total number of falls per individual FallAnyTot\_L 5. Estimate risk of recurrent falls given any fall FallRecrisk\_L using STATA risk equation and CoeffBook spreadsheet 6. Apply efficacy IntEffRec\_L to FallRecrisk\_L 7. Estimate incidence of recurrent falls given any fall FallRec\_L using Random 8. Set total number of recurrent falls per individual FallRecTot\_L 9. Estimate risk of MA fall FallMArisk\_L for subgroups of single and recurrent fallers using STATA risk equations and CoeffBook spreadsheet 10. Apply efficacy IntEffMA\_L to FallMArisk\_L 11. Estimate incidence of MA fall FallMA\_L using Random 12. Set total number of MA falls per individual FallMATot\_L 13. Set main categorical label for falls incidence type FallInc\_L 14. For those with FallInc\_L=4, set incidence of recurrent MA falls FallMARec\_L using FallMARec\_D (42.6% risk) 15. For those with FallMARec\_L=1, set incidence of 3 types of MA fall combination FallMAHos2\_L using FallMAHos2\_D (3 categories following frailty gradient according to FallMAHos2 spreadsheet) 16. For those with FallMARec\_L=2 (i.e., single MA fall), set incidence of hospitalised MA fall FallMAHos\_L (frailty stratified) using FallMAHos\_D (set using ProbFrailtyPSA spreadsheet) 17. For those with FalInc\_L=3, set incidence of hospitalized MA fall FallMAHos\_L (frailty stratified) using FallMAHos\_D (set using ProbFrailtyPSA spreadsheet) 18. Set 10-category FallInc2\_L label for assigning health and economic consequences by more granulated fall incidence type 19. Set label for any hospitalized fall (FallHos\_L) and total number of hospitalized falls per individual FallHosTot\_L |
| Action VL – falls health & economic consequences | 1. Set acute/direct QALY loss FallQALY\_L and economic cost of falls FallCost\_L by FallInc2\_L label with discounting factor using values in ValueCost spreadsheet 2. Update lifetime QALY variable QALY\_L and all-cause healthcare cost label HCareCostAC\_L |
| Routing out | Rout out to ‘Frailty Dynamics’ |

**(17) ‘Frailty Dynamics’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Estimate change in frailty DFrailty\_L using STATA risk equation and CoeffBook spreadsheet 2. Annualize DFrailty\_L |
| Routing out | Rout out to ‘Dynamics’ |

**(18) ‘LTC Risk’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Estimate LTC admission risk LTCrisk\_L using STATA risk equation and CoeffBook spreadsheet 2. Set incidence of LTC admission LTC\_L using Random 3. Set cost of LTC admission by sector and SES using values in ValueCost spreadsheet discounted by 3.5% annual rate 4. Update QALY\_L and CALY\_L with discounting: for new LTC residents this is the final QALY and CALY outcomes; for survivors this is the QALY\_L and CALY\_L updates before next cycle (unless it is the last cycle) 5. Add remaining lifetime QALYs and CALYs for new LTC residents 6. Set routing label by LTC admission LTC\_L: for non-final cycles, Rout\_L=1 for new LTC residents only; for final cycle, Rout\_L=1 for all individuals |
| Routing out | Rout out by Rout\_L: =1 to ‘Covariates Dynamics’; =2 to ‘Model Exit’ |

**(19) ‘Covariate Dynamics’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL – Longitudinal estimations | 1. Estimate PAHighrisk\_L adjusted by IntEffPA\_L and PAhigh2\_L 2. Estimate Cogimrisk\_L and Cogim2\_L 3. Estimate Abngaitbalrisk\_L and Abngaitbal2\_L 4. Estimate GPcontrisk\_L and GPcont2\_L 5. (Under RC) Estimate SelfTreatrisk2\_L and SelfTreat2\_L 6. Estimate DUtility\_L using DFrailty\_L\*2 and annualize 7. Update Utility\_L; UtilityMin\_L; UtilityMinN\_L; Utility2\_L 8. Estimate DCASP\_L using DFrailty\_L\*2 and annualize 9. Update CASP\_L 10. Estimate Paidworkrisk\_L and Paidwork\_L (no need for Paidwork2\_L because Paidwork\_L is not used again as covariate) 11. Estimate Unpaidworkrisk\_L and Unpaidwork\_L (no need for Unpaidwork2\_L) 12. Update UnpaidworkHist\_L for measuring social mobilisation. 13. Update productivity and productivity history labels for calculating productive ageing. 14. Estimate OOPCarerisk\_L and OOPCare2\_L 15. Estimate InfCarerisk\_L and InfCare\_L (InfCare\_L not used again) 16. Estimate InfCare2risk\_L and InfCare2\_L |
| Action VL – Cross-sectional updates | 1. Update age: Age\_L; AgeGr\_L; Age2\_L 2. Update falls history: FallInc\_L to FallHist\_L 3. Update frailty: Frailty\_L; Frailty2\_L; FrailtyCat\_L; FrailtyM\_L; FrailtyCatM\_L 4. Update PAhigh\_L; Cogim\_L; Abngaitbal\_L 5. Update Fear\_L cross-sectionally 6. Update utility: Utility\_L; Utility2\_L; UtilityMin\_L; UtilityMinN\_L 7. Update productivity values: PaidworkVal\_L; UnpaidworkVal\_L 8. Update comorbidity care costs: HCareCost\_L; HCareCostAC\_L; ComCare\_L; ComCareCost\_L; SocCare\_L; SocCareCost\_L; OOPCareCost\_L (set OOPCare\_L=OOPCare2\_L); InfCareCost\_L 9. Reset intervention labels: IntCurPro\_L; IntCurRe\_L; IntCurSelf\_L; IntEffAny\_L; IntEffRec\_L; IntEffMA\_L; IntEffPA\_L |
| Routing out | Rout out to ‘Update Lag’ |

**(20) ‘Update Lag’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Route In Before VL | 1. Delay simulation time until end of first annual cycle 2. Use SimTime number stamped in ‘Start Cycle’ to create annual stop-go cyclical pattern; at the final cycle, further progress is stopped |
| Routing out | Rout out to ‘Time Lag’ |

**(21) ‘Time Lag’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0.00001] |
| Routing out | Rout out to ‘Start Cycle’ |

**(22) ‘Results’**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| Setting | Average [0] |
| Action VL | 1. Update label for all-cause public sector care costs AllCauseCostPS\_L: all-cause healthcare cost + community healthcare cost + short-term social care cost + LTC cost + cost of dying 2. Update label for variable intervention costs: IntCostPS\_L; IntCostPri\_L; IntCostToc\_L; IntCostInf\_L 3. Set global outcome numbers in Information Store at model exit 4. QALY: QALY = QALY + QALY\_L 5. CALY: CALY = CALY + CALY\_L 6. Direct fall-related cost: FallCost = FallCost + Fallcost\_L 7. Intervention public sector variable costs: IntCostPS = IntCostPS + IntCostPS\_L 8. All-cause care public sector costs: AllCauseCostPS = AllCauseCostPS + AllCauseCostPS\_L 9. Intervention societal variable costs: IntCostPri; IntCostToc; IntCostInf 10. Societal outcomes – productivity values: PaidworkVal; UnpaidworkVal 11. Societal outcomes – societal costs: OOPCareCost (including LTC societal costs); InfCareCost 12. Store societal CUA outcomes in Answers spreadsheet 13. Set wider outcomes in Information Store at model exit:     1. Person-years of different fall types: AnyFall; RecFall; MAFall; HosFall     2. Number of LTC admissions: LTC = LTC + LTC\_L     3. Number of fatal falls: FatalFall = FatalFall + FatalFall\_L     4. Number of other-cause mortality: OtherMort = OtherMort + OtherMort\_L     5. If fair health-related innings achieved, set FairInn\_L to 1. Set total number of persons achieving fair innings FairInn = FairInn + FairInn\_L     6. If fair CALY-related innings achieved, set FairCALYInn\_L to 1. Set total number of persons achieving fair CALY-related innings FairCALYInn = FairCALYInn + FairCALYInn\_L     7. Set label and global number for social mobilisation: SocialMob\_L; SocialMob     8. If productive ageing is achieved, set ProductAge\_L to 1. Set total number of persons achieving productive ageing ProductAge = ProductAge + ProductAge\_L     9. Build label for cumulative private expenditure PriExp\_L. If catastrophic private expenditure is incurred, set CatExp\_L to 1. Set total number of persons experiencing catastrophic private expenditure CatExp = CatExp + CatExp\_L.     10. Repeat above without including intervention private co-payment, using PriExp2\_L and CatExp2\_L     11. Build label for cumulative informal caregiver burden InfBurden\_L. If excessive informal caregiver burden is incurred, set InfExcess\_L to 1. Set total number of persons experiencing excessive informal caregiver burden InfExcess = InfExcess + InfExcess\_L     12. Repeat above without including intervention caregiver TOC, using InfBurden2\_L and InfExcess2\_L     13. Store wider outcomes in Answers2 spreadsheet |
| Routing out | Rout out to ‘Exit’ |

**(23) End Run Logic and Reset Logic**

|  |  |
| --- | --- |
| **Activity** | **Description** |
| End Run Logic | 1. Store outcomes (global numbers) in ‘PSA Answers’ spreadsheet. Outcome columns:    1. IntCostFixed    2. QALY    3. AllCauseCostPS    4. FallCost    5. IntCostPS    6. PaidWorkVal    7. UnpaidWorkVal    8. IntCostToc    9. OOPCareCost    10. IntCostPri    11. InfCareCost    12. IntCostInf 2. Reset number PSAR [Note: must manually reset PSAR to 1 before starting a new round of PSA] 3. Reset clock to 0 |
| Reset Logic | 1. Reset input data 2. Command simulation run until end time [Note: must be disabled to stop PSA running automatically] |

## English Longitudinal Study of Ageing variables

Table E1 describes the variables in ELSA Waves 4 and 5 which were used for model parameterisation. The original labels in ELSA and the methods used to treat missing responses are presented.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table E1** Original labels and formats for English Longitudinal Study of Ageing variables. | | | |
| **ELSA variable** | **Original label** | **ELSA wave** | **Description and missing data treatment** |
| **Sociodemographic factors** | | | |
| Age | indager | 4/5 | Grouped into 5-year categories; no missing |
| Sex | dhsex | 4/5 | Binary; no missing |
| Residence – institutionalised; LTC admission outcome | askinst | 4/5 | Binary; no missing |
| Education | w4edqual; w5edqual | 4/5 | Highest educational qualification at ELSA W4 [Degree or equivalent; Higher education below degree; A-level equivalent; O-level equivalent; Other grade equivalent; Foreign/other; No qualification; Incomplete/no information]  Combined to form three levels: [(1) Degree or equivalent; (2) Higher education below degree + A-level + O-level; (3) Other grade + Foreign + No qualification + Incomplete/no information] |
| Self-reported financial difficulty | exrela | 4/5 | How often respondent find he/she too little money to spend on his/her needs [Never; Rarely; Sometimes; Often; Most of the time]  ‘Refusal’, ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘Never’ |
| Household wealth | iasava; hopay; iafbps | 4/5 | Amount held in current and savings accounts by respondent (and spouse) [iasava; ‘Refusal’, ‘Don’t know’ and ‘Item not applicable’ assumed to be have median value] + Value of property [hopay; ‘Refusal’, ‘Don’t know’ and ‘Item not applicable’ assumed to be 0] + Value of farm/business after debt [iafbps; ‘Refusal’, ‘Don’t know’ and ‘Item not applicable’ assumed to be 0]  Three variable values combined into a single variable and then divided into quartiles [(1) Richest quartile, (2), (3), (4) Poorest quartile] |
| Composite SES in Wave 4 baseline | w4edqual; exrela; iasava; hopay; iafbps | 4/5 | Composite score of education, self-reported financial difficulty and household wealth [Min value of 3 (least deprived); Max value of 12 (most deprived)]  Score divided into quartiles [(1) Least deprived, (2), (3), (4) Most deprived] |
| **Falls history and fear of falling in ELSA Wave 4** | | | |
| Any fall in the past year | hefla (if Wave=4) | 4 | Whether fallen down in the last year [Yes; No]  ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Number of falls in the past year | heflb (if Wave=4) | 4 | Number of times have fallen down in past year [Integer]  ‘Refusal’, ‘Don’t know’ and ‘Not applicable’ assumed to be no fall |
| Any MA fall in the past year | heflc (if Wave=4) | 4 | Fall: whether injured seriously enough to need medical treatment [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable and ‘Item not applicable’ assumed to be ‘No’ |
| Falls history categorical variable | hefla; heflb; heflc (if Wave=4) | 4 | Categories: (1) No falls history; (2) Single non-MA fall history; (3) Recurrent non-MA fall history; (4) Single MA fall history; (5) Recurrent falls with at least 1 MA fall |
| Fear of falling | heatt15 | 4 | Walking symptom: fear of falling [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’  **Imputation (logistic) for Wave 5 responses** |
| **Falls incidence between ELSA Waves 4 and 5** | | | |
| Any fall | hefla (if Wave=5) | 5 | Whether fallen down (since last interview) [Yes; No]  ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Number of falls | heflb (if Wave=5) | 5 | Number of times have fallen down (since last interview) [Integer]  ‘Refusal’, ‘Don’t know’ and ‘Not applicable’ assumed to be no fall |
| Any MA fall | heflc (if Wave=5) | 5 | Fall: whether injured seriously enough to need medical treatment [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Falls incidence categorical variable | hefla; heflb; heflc (if Wave=5) | 5 | Categories: (1) No falls incidence; (2) Single non-MA fall incidence; (3) Recurrent non-MA falls incidence; (4) Single MA fall incidence; (5) Recurrent falls with at least 1 MA fall |
| **Receipt of routine GP contact and falls risk assessment** | | | |
| GP routine contact | hebpchk | 4/5 | Blood pressure: whether checked by doctor or nurse in past year [Yes; No]  ‘Refusal’, ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘No’ |
| Falls risk assessment (1) | hefld | 4 | Whether doctor or nurse tried to understand causes of fall with respondent [Yes; No]  ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘No’ |
| Falls risk assessment (2) | hefle | 4 | Whether doctor or nurse tested balance or strength or watched respondent walk [Yes; No]  ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘No’ |
| Falls risk assessment (3) | heflf | 4 | Whether doctor or nurse recommended additional tests [Yes; No]  ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘No’ |
| **Receipt of any falls prevention intervention – occupational therapy, physiotherapy, exercise and/or HAM** | | | |
| Occupational therapy or physiotherapy | hehpsot | 4/5 | Occupational therapy or physiotherapy for physical functioning difficulties [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘Not mentioned’ |
| Exercise | hehpsex | 4/5 | Exercise class to help with physical functioning difficulties [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘Not mentioned’ |
| Home assessment and modification | hoadpwd; hoadprs; hoadphr; hoadpad; hoadpap; hoadpbm; hoadpkm; hoadpli; hoadpcl; hoadpal | 4/5 | Types of adaptations in property: (1) widened doorways/hallways; (2) ramps or street level entrances; (3) hand rails; (4) automatic or easy open doors; (5) accessible parking/drop-off site; (6) bathroom modifications; (7) kitchen modifications; (8) life; (9) chair lift or stair glide; (10) alerting devices [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘Not mentioned’ |
| **Frailty index components** | | | |
| Angina | hedawan | 4/5 | Diagnosed angina  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Arrhythmia | hedawar | 4/5 | Diagnosed abnormal heart rhythm  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Arthritis | hedbwar | 4/5 | Chronic: diagnosed arthritis  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Asthma | hedbwas | 4/5 | Chronic: diagnosed asthma  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Cancer | hedbwca | 4/5 | Chronic: diagnosed cancer  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Cataract | heopcca | 4/5 | Whether confirms cataract diagnosis  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Depression | hepsyde | 4/5 | Psychiatric problem: depression  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Diabetes | hedawdi | 4/5 | Diagnosed diabetes or high blood sugar  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Diabetic eye disease | heopcdi | 4/5 | Whether confirms diabetic eye disease diagnosed  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Diabetic kidney disease | hekidn | 4/5 | Diabetes: whether been told has kidney trouble  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Glaucoma | heopcgl | 4/5 | Whether confirms glaucoma diagnosis  ‘Refusal’, ‘Don’t know’, ‘CAPI/interview error’ and ‘Item not applicable’ assumed to be ‘No’ |
| Heart attack | hedawmi | 4/5 | Diagnosed heart attack  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Heart disease – other | hedawhf; hedawot | 4/5 | Diagnosed congestive heart failure; Diagnosed other heart disease  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Heart murmur | hedawhm | 4/5 | Diagnosed heart murmur; Diagnosed abnormal heart rhythm  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| High blood pressure | hedawbp | 4/5 | Diagnosed high blood pressure  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| High cholesterol | hedawch | 4/5 | Diagnosed high cholesterol  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Lung disease | hedbwlu | 4/5 | Chronic: diagnosed lung disease  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Macular degeneration | heopcmd | 4/5 | Whether confirms macular degeneration diagnosis  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Osteoporosis | hedbwos | 4/5 | Chronic: diagnosed osteoporosis  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Stroke | hedawst | 4/5 | Diagnosed stroke  ‘Refusal’, ‘Don’t know’, ‘CAPI/Interview error’ and ‘Item not applicable’ assumed to be no diagnosis |
| Self-reported seeing difficulty | heeye | 4/5 | Self-reported eyesight (while using lenses, if appropriate) [Excellent; Very good; Good; Fair; Poor; Legally blind]  ‘Refusal’ and ‘Don’t know’ assumed ‘Excellent’ based on EQ-5D |
| Self-reported hearing difficulty | hehear | 4/5 | Self-reported hearing (while using hearing aid if appropriate) [Excellent; Very good; Good; Fair; Poor]  ‘Refusal’ and ‘Don’t know’ assumed ‘Good’ based on EQ-5D |
| Slow walking speed | fstgs\_tm | 4/5 | Time to walk 8 feet (in seconds)  **Imputation (truncated regression)** for: ‘Under 60’ ‘Proxy interview’; ‘NA all through – unknown reason’; ‘Participant refused at some stage; ‘Participant gave don’t know response’; ‘Able but no aid available’; ‘Unwilling to do test’; ‘Interviewer refused to answer’; ‘Interviewer gave DK response’; ‘No available space’; ‘No gtspd – both times extreme’; ‘No gtspd – A extreme, B not completed’; ‘CAPI interview/error’ (n=897 for W4-5)  ‘Unable to walk alone’, ‘Health restriction’, ‘Interviewer felt not safe’, ‘Respondent felt would be unsafe when test described’, ‘Walk A attempted but not completed’, ‘Walk A stopped by interviewer for safety’ marked as a separate variable [nophysical] “Unable to participate in physical tests YN” (n=1,004 for gait test W4-5) |
| Balance problem | hebal | 4 | How often respondent has problems with balance when walking on level surface [Always; Very often; Often; Sometimes; Never; Never walks; Can’t walk]  **Imputation (ordinal logit) for Wave 5 responses**  ‘Item not applicable’ and ‘Don’t know’ assumed to be ‘Sometimes’ based on EQ-5D mean  ‘Never walks’ and ‘Can’t walk’ kept in [hebal1] as ordinal category |
| Weak grip strength | mmgsd1 | Nurse | Grip strength: 1st measurement dominant hand (kg)  ‘Not applicable’ treated as missing response  **Imputation (truncated regression) for missing Wave 4 and all Wave 5 responses** |
| Weak leg strength | mmrrfti; mmrrsc | Nurse | [mmrrfti] Chair rise: time to complete 5 rises (seconds)  ‘Don’t know’ and ‘Not applicable’ treated as missing response  [mmrrsc] Chair rise: Whether respondent feels it is safe to attempt multiple chair rises [Yes; No]; ‘No’ (n=94) added to [nophysical] variable  **Imputation (truncated regression) for missing Wave 4 and all Wave 5 responses** |
| Urinary incontinence | heinct | 4/5 | Incontinence: whether lost urine beyond control in last 12 months [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Significant weight loss | weight | Nurse | Weight (kg) in nurse data in **Waves 2 and 4**  Of 4,121 in main study sample, 1,065 did not have weight data from Wave 2: assumed that these 1,065 individuals did not experience weight change between Waves 2 and 4.  Assumed ‘not applicable’ (n=10 in main study sample) had average sample weight and did not experience weight change between W2-4  **Imputation (truncated regression) for missing Wave 4 and all Wave 5 responses** |
| Cognitive impairment – prospective memory | cfmersp; cfprom | 4/5 | [cfmersp] Definitive result of prospective memory test [Correct response; Incorrect response; Not applicable]; all 939 individuals with ‘Not applicable’ response were not able to conduct the prospective memory test [cfprom!=1 (Yes for being able to conduct test)]: i.e., ‘Not applicable’ assumed to be ‘Unable to conduct test’ |
| Self-reported physical exhaustion | pscedb; pscedh | 4/5 | [pscedb] Whether felt everything they did during past week was an effort [Yes; No]; [pscedh] Whether could not get going much of the time during past week [Yes; No]  ‘Refusal’, ‘Don’t know’ and ‘Item not applicable assumed to be ‘No’ |
| Self-rated health | hehelf | 4/5 | Self-reported general health [Excellent; Very good; Good; Fair; Poor]  ‘Item not applicable’ assumed to be ‘Fair’ based on mean EQ-5D; ‘Refusal’, ‘Don’t know’ and ‘Schedule not applicable’ assumed to be ‘Good’ based on mean EQ-5D  ‘Poor’ included as deficit in frailty index |
| Self-rated pain | hepain | 4/5 | Whether often troubled by pain [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Self-reported long-standing illness | heill | 4/5 | Whether has self-reported long-standing illness [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Low physical activity | palevel | 4/5 | Physical activity summary [Sedentary; Low; Moderate; High]  Used ‘Sedentary’ and ‘Low’ as indicator of low physical activity  ‘Not known’ assumed to be ‘High’ based on EQ-5D mean |
| Obesity (BMI>=30) | bmiobe; height; weight | Nurse | [bmiobe]: Body mass index (BMI) in kg/m2, categorised into underweight (BMI <18.5), normal weight (18.5 ≤ BMI <25), overweight (25 ≤ BMI ≤30), and obese (BMI >30)  Grouped into two categories: obese (BMI >30); not obese (BMI ≤30).  **Imputation (truncated regression) for missing Wave 4 and all Wave 5 responses** |
| Limitation to dressing | headldr | 4/5 | ADL: difficulty dressing, including putting on shoes and socks [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Limitation to mobility | headlwa | 4/5 | ADL: difficulty walking across a room [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Limitation to bathing or showering | headlba | 4/5 | ADL: difficulty bathing or showering [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Limitation to eating | headlea | 4/5 | ADL: difficulty eating, such as cutting up food [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Limitation to getting in and out of bed | headlbe | 4/5 | ADL: difficulty getting in and out of bed [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Limitation to using the toilet | headlwc | 4/5 | ADL: difficulty using the toilet, including getting up or down [Yes; No]  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty using map | headlma | 4/5 | IADL: difficulty using map to figure out how to get around strange place  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty recognizing physical danger | headlda | 4/5 | IADL: recognising when in physical danger  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty preparing a hot meal | headlpr | 4/5 | IADL: preparing a hot meal  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty shopping for groceries | headlsh | 4/5 | IADL: shopping for groceries  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty making telephone calls | headlte | 4/5 | IADL: making telephone calls  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty communicating | headlco | 4/5 | IADL: communication (speech, hearing or eyesight)  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty taking medication | headlme | 4/5 | IADL: taking medications  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty doing work around the house | headlho | 4/5 | IADL: doing work around the house or garden  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Difficulty managing money | headlmo | 4/5 | IADL: managing money, such as bills and expenses  ‘Refusal’, ‘Don’t know’, ‘Schedule not applicable’ and ‘Item not applicable’ assumed to be ‘No’ |
| Polypharmacy (5+ medications) | hemda; hemdb; hemda1; hehrtmd (W4 only); hechmd; helng; heama; hepmed; herosmd; hepsya (W4 only) | 4/5 except for 2 | High blood pressure: whether taking medication; Diabetes: whether taking medication; Stroke: whether taking medication for blood pressure; Whether taking blood-thinning medication; Cholesterol: whether taking medication to lower cholesterol level; Whether taking medication for lung condition; Whether taking medication for asthma; Knee or hip pain: whether taking medication (has osteoarthritis); Whether take medication to control chest pain; Depression: whether has taken medication in last 2 years or had counselling  ‘Item not applicable’, ‘CAPI/interview error’ and ‘Don’t know’ assumed to be ‘No’ |
| Living alone | scptr | 4/5 | Whether respondent has a husband, wife or partner with whom they live [Yes; No]  ‘Not applicable’ and ‘Not answered’ assumed to be ‘Yes’ based on prevalence of older persons living alone in the UK [184]. |
| **Other covariates** | | | |
| High physical activity | palevel | 4/5 | Physical activity summary [Sedentary; Low; Moderate; High]  Used ‘High’ as indicator of high physical activity  ‘Not known’ assumed to be ‘High’ based on EQ-5D mean |
| Abnormal gait/balance | fstgs\_tm; hebal | 4/5 | See slow walking speed and balance problem above. |
| **EQ-5D attributes** | | | |
| Mobility | hefunc; nohtbcbe | 4 | [hefunc] Difficulty walking ¼ mile unaided [No difficulty; Some difficulty; Much difficulty; Unable to do this]; ‘Some difficulty’ and higher assumed to correspond to ‘Some problems with mobility’ based on prevalence  [nohtbcbe] Respondent confined to bed [Yes; No]; ‘Yes’ assumed to correspond to ‘Confined to bed’ based on prevalence |
| Self-care | headldr; headlwa; headlba; headlea; headlbe; headlwc; | 4/5 | ADL limitations: based on prevalence, 1 to 5 limitations assumed to correspond to ‘Some problems with self-care’; 6 limitations assumed to correspond to ‘Unable to self-care’ |
| Usual activities | headlma headlda headlpr headlsh headlte headlco headlme headlho headlmo | 4/5 | IADL limitations; based on prevalence, 1 to 5 limitations assumed to correspond to ‘Some problems with doing usual activities’; 6 limitations assumed to correspond to ‘Unable to do usual activities’ |
| Pain/discomfort | hepaa; hepain | 4/5 | [hepaa] Severity of pain most of the time [Mild; Moderate; Severe]; [hepain] Whether often troubled by pain [Yes; No]; ‘Mild and moderate’ severity of pain and ‘Yes’ to often troubled by pain assumed to correspond to ‘Some pain/discomfort’ based on prevalence; ‘Severe’ severity of pain assumed to correspond to ‘Extreme pain/discomfort’ based on prevalence |
| Anxiety/depressions | scdcc; hepsyan | 4/5 | [scdcc] Feels what happens in life is often determined by factors beyond his/her control [Strongly agree; Moderately agree; Slightly agree; Slightly disagree; Moderately disagree; Strongly disagree]; [hepsyan] Psychiatric problem has: anxiety [Yes; No]; ‘Strongly agree’ assumed to correspond to ‘Some anxiety/depression’ based on prevalence; ‘Yes’ to anxiety problem assumed to correspond to ‘Extreme anxiety/depression’ based on prevalence |
| **Other outcomes** | | | |
| CASP-19 score | CASP19 | 4/5 | Imputation (truncated regression)for: ‘Refusal’ and ‘Not applicable’ |
| Productivity – paid employment | dhwork | 4/5 | Whether respondent was in paid employment (last week) (from household grid) [Yes; No]  ‘Not applicable’ assumed to be ‘No’. |
| Productivity – unpaid work/volunteering | erfvoft; erivoft | 4/5 | How often over the past 12 months have you: volunteered/generally helped; given unpaid help? [At least once a week; Less than once a week but at least once; Less often; One-off activity]  Changed to binary [Yes; No]: ‘Yes’ for regularly engaging in unpaid work; ‘Refusal’, ‘Don’t know’, ‘Item not applicable’ assumed ‘No’. |
| Productivity – informal caregiving | erlvolpe | 4/5 | Unpaid help: providing personal care for someone who is sick or frail [Mentioned; Not mentioned]  ‘Refusal’, ‘Don’t know’ and ‘Item not applicable’ assumed to be ‘Not mentioned’. |
| Receipt of community healthcare | hehphnu; hehpwnu; hehpdnu; hehppnu; hehptnu; hehpmnu; hehpbnu | 4/5 | Whether receives help from health visitor or district nurse to: move around house; wash/dress; prepare a meal or eat; shop/do work around house; use phone/manage money; take medication; with other difficulty. [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed ‘Not mentioned’.  Intensity of community care need measured by the number of above items requiring help. |
| Receipt of social care | hehphla; hehpwla; hehpdla; hehppla; hehptla; hehpmla; hehpbla | 4/5 | Whether receives help from local authority/social services to: move around house; wash/dress; prepare a meal or eat; shop/do work around house; use phone/manage money; take medication; with other difficulty. [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed ‘Not mentioned’.  Intensity of social care need measured by the number of above items requiring help. |
| Frequency of social care receipt | hehpla | 4 | Local authority or social service help: how often received in last month  [Every day or nearly every day; Two or three times a week; Once a week; Less often; Not at all]  ‘Item not applicable’ assumed ‘Not at all’. |
| Receipt of OOP care | hehphpp; hehpwpp; hehpdpp; hehpppp; hehptpp; hehpmpp; hehpbpp | 4/5 | Whether receives help from private paid help to: move around house; wash/dress; prepare a meal or eat; shop/do work around house; use phone/manage money; take medication; with other difficulty. [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed ‘Not mentioned’.  Intensity of OOP care need measured by the number of above items requiring help. |
| Frequency of OOP care receipt | hehppd | 4 | Private paid help: how often received in last month  [Every day or nearly every day; Two or three times a week; Once a week; Less often; Not at all]  ‘Item not applicable’ assumed ‘Not at all’. |
| Receipt of informal care | By help item and relation1 | 4/5 | Whether receives help from < spouse or partner; son; daughter; sister; brother; other relative; friend or neighbour > to: move around house; wash/dress; prepare a meal or eat; shop/do work around house; use phone/manage money; take medication; with other difficulty. [Mentioned; Not mentioned]  ‘Don’t know’ and ‘Item not applicable’ assumed ‘Not mentioned’.  Intensity of informal care need measured by the number of above items requiring help. |
| **Abbreviation:** CAPI: computer-assisted personal interview; CASP-19: control, autonomy, self-realisation and pleasure, 19 items; HAM: home assessment and modification; LTC: long-term care; OOP: out-of-pocket; SES: socioeconomic status; W4/5: Wave 4/5  1 hehphsp; hehphso; hehphda; hehphsi; hehphbr; hehphor; hehphfr; hehphot; hehpwsp; hehpwso; hehpwda; hehpwsi; hehpwbr; hehpwor; hehpwfr; hehpwot; hehpdsp; hehpdso; hehpdda; hehpdsi; hehpdbr; hehpdor; hehpdfr; hehpdot; hehppsp; hehppso; hehppda; hehppsi; hehppbr; hehppor; hehppfr; hehppot; hehptsp; hehptso; hehptda; hehptsi; hehptbr; hehptor; hehptfr; hehptot; hehpmsp; hehpmso; hehpmda; hehpmsi; hehpmbr; hehpmor; hehpmfr; hehpmot; hehpbsp; hehpbso; hehpbda; hehpbsi; hehpbbr; hehpbor; hehpbfr; hehpbot. | | | |

## Systematic review of community-based falls prevention RCTs

The systematic review followed the PRISMA 2009 guidelines [185] and covered the same four academic databases as the 2012 Cochrane Review of RCTs of community-based falls prevention interventions [47]: Cochrane Library, Medline, Embase and CINAHL. The search strategy was similarly based on that of the 2012 Cochrane Review, namely an intersection between terms related to falls, older persons and RCTs. Table E2 shows the Medline search strategy.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table E2** Medline search strategy for randomised controlled trials of community-based falls prevention interventions. | | | | |
| Search strategy for Medline (Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R)) – search run on 18th July 2019 | | | | |
| **Theme** | **Type** | **Ref** | **Search Term** | # |
| Falls | FT1 | 1 | (fall or falls or falling or faller\* or fallen or fell or slip\* or trip\* or stumbl\*).ti,ab. | 453689 |
|  | MeSH | 2 | exp Accidental falls/ | 21633 |
|  |  | 3 | 1 or 2 | 459485 |
| Older persons | FT | 4 | (old or older or senior\* or elder\* or aged or geriatric\* or frail\* or pensioner).ti,ab. | 1873544 |
|  | MeSH | 5 | exp Aged/ or Frailty/ | 2895794 |
|  |  | 6 | 4 or 5 | 4208078 |
| RCTs | FT | 7 | (“randomi#ed controlled trial” or “controlled clinical trial” or randomi#ed or placebo or randomly or trial or groups).ti,ab. | 2668057 |
|  | MeSH | 8 | exp Clinical trial/ or exp Randomized controlled trial/ | 816384 |
|  |  | 9 | 7 or 8 | 2972470 |
|  |  | 10 | 3 AND 6 AND 9 | 25093 |
| Exclusions |  | 11 | Limit to Humans | 22536 |
|  |  | 12 | (news or comment or editorial or letter or case reports).pt. or case report.ti. | 3637952 |
|  |  | 13 | 11 NOT 12 | 22246 |
|  |  | 14 | Limit 13 to English | 20567 |
|  |  | 15 | Limit 14 to 1st January 2012 – 31st December 2018 | 6965 |
| **Abbreviation:** FT: free text; MeSH: medical subjective heading; RCT: randomised controlled trial  1 Free text (covering title and abstract); exp \*: Explode and focus; exp: Explode only | | | | |

Table E3 shows the inclusion and exclusion criteria for the systematic review. The criteria were based on those of the 2012 Cochrane Review [47].

|  |  |  |
| --- | --- | --- |
| **Table E3** Inclusion and exclusion criteria for systematic review of RCTs (and previous reviews of RCTs) of community-based falls prevention interventions. | | |
|  | **Inclusion criteria** | **Exclusion criteria** |
| **Age** | (i) Inclusion criteria of 60 and over  (ii) Sample mean age minus one standard deviation above 60 |  |
| **Residence** | (i) Community-dwelling adults (including assisted-living residences without residential health-related care)  (ii) If mixed residence, majority of sample living in community |  |
| **Intervention** | Any intervention designed to reduce falls in older people in community setting | Rehabilitation programmes for specific diseases (e.g., stroke and Parkinson’s disease) with falls prevention component |
| **Comparator** | (i) ‘Usual care’ – no change in usual activity; (ii) ‘Placebo’ control – intervention not thought to reduce falls or change falls risk factors (e.g., general health education or social visits); (iii) Another falls prevention intervention |  |
| **Outcome** | Fall-related outcomes: number of fallers (RR efficacy); number of falls (RaR efficacy); any types of faller or fall (e.g., injurious fall, fall requiring medical attention, fracture) |  |
| **Study design** | (i) Randomised controlled trials (RCTs)  (ii) Previous systematic reviews of RCTs |  |
| **Date** | 1st January 2012 to 31st December 2018 |  |
| **Language** | English |  |
| **Abbreviation:** RaR: rate ratio; RCT: randomised controlled trial; RR: relative risk | | |

Table E4 shows the references of included UK-based RCTs that were not aligned with the current or recommended practices in Sheffield.

|  |  |  |
| --- | --- | --- |
| **Table E4** UK community-based falls prevention randomised controlled trials not aligned with current or recommended practices in Sheffield. | | |
| **Intervention type1** | **Reference** | **N** |
| Vitamin D supplementation | [186-193] | 8 |
| Multifactorial risk assessment | [194-198] | 5 |
| Cardiac pacing | [155, 199, 200] | 3 |
| Multiple-component intervention | [201, 202] | 2 |
| Cataract surgery | [147, 203] | 2 |
| Proactive home assessment and modification | [204, 205] | 2 |
| Brisk walking | [206] | 1 |
| Cognitive behavioural therapy | [207] | 1 |
| Medication change | [208] | 1 |
| Nutrition | [209] | 1 |
| Occupational therapy reablement | [210] | 1 |
| Paramedic assessment and referral | [211] | 1 |
| Podiatry | [52] | 1 |
| Otago + multisensory balance training vs. Otago + flexibility training | [212] | 1 |
| Exercise + calcium vs. Calcium only | [213] | 1 |
| Treadmill with virtual reality vs. Treadmill only | [214] | 1 |
| Balance training vs. Conventional physiotherapy | [215] | 1 |
| Multifactorial risk assessment at Falls Clinic vs. GP practice | [216] | 1 |
| 1 Compared to usual care or no intervention unless specified. | | |

## Model baseline characteristics

### Institutionalisation rate

There were 7,321 individuals aged 60+ in ELSA Wave 4, including community-dwelling and institutionalised persons. Of these 7,255 (99.1%) were living in the community, the rest institutionalised. Table E5 shows the number of individuals living in institutions by age group and sex in ELSA Wave 4 and the odds of being institutionalised relative to male aged 65-69.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table E5** Age and sex subgroups in ELSA Wave 4 institutionalised cohort. | | | | |
|  | **Raw data** | | **Odds of being institutionalised relative to male aged 65-69** | |
| **Age group** | **Male (% of total sub-population1)** | **Female (% of total sub-population)** | **Male** | **Female** |
| 60-64 | 3 (0.3) | 0 (0) | 1.00 | 0 |
| 65-69 | 2 (0.3) | 1 (0.1) | 1.00 (reference) | 0.33 |
| 70-74 | 2 (0.3) | 3 (0.4) | 1.00 | 1.33 |
| 75-79 | 3 (0.6) | 3 (0.6) | 2.00 | 2.00 |
| 80-84 | 2 (0.7) | 10 (2.9) | 2.33 | 9.67 |
| 85-89 | 6 (4.6) | 19 (7.6) | 15.33 | 25.33 |
| 90+ | 1 (2.2) | 11 (12.0) | 7.33 | 40.00 |
| **Total** | 19 (0.6) | 47 (1.2) |  |  |
| 1 Both community-dwelling and institutionalised persons in the respective age group and sex subgroup. | | | | |

### Falls history

Table E6 shows the proportions of baseline falls history type assigned to simulated individuals by their age group, sex and SES quartile at model entry.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table E6** Proportions of baseline falls history types by age group, sex and SES quartile in ELSA. | | | | | |
|  | No falls history | Single non-MA fall history | Recurrent non-MA falls history | Single MA fall history | Recurrent falls with 1+ MA fall |
| ***Male – Most privileged social quartile*** | | | | | |
| Age 60-64 | 83.5 | 9.1 | 5.5 | 1.2 | 0.7 |
| Age 65-69 | 83.2 | 6.7 | 6.4 | 2.2 | 1.5 |
| Age 70-74 | 77.7 | 10.9 | 5.5 | 3.4 | 2.5 |
| Age 75-79 | 73.3 | 10.6 | 9.3 | 4.6 | 2.2 |
| Age 80-84 | 68.4 | 13.8 | 11.3 | 3.9 | 2.6 |
| Age 85-89 | 61.9 | 11.4 | 14.3 | 3.8 | 8.6 |
| Age 90+ | 61.5 | 12.0 | 22.0 | 0.5 | 4.0 |
| ***Male – 2nd social quartile*** | | | | | |
| Age 60-64 | 81.2 | 9.2 | 7.5 | 0.7 | 1.4 |
| Age 65-69 | 79.3 | 11.2 | 6.9 | 2.2 | 0.4 |
| Age 70-74 | 80.0 | 11.1 | 5.2 | 2.2 | 1.5 |
| Age 75-79 | 77.4 | 9.1 | 7.0 | 5.9 | 0.6 |
| Age 80-84 | 65.2 | 17.0 | 9.3 | 4.2 | 4.3 |
| Age 85-89 | 62.6 | 10.7 | 6.7 | 9.3 | 10.7 |
| Age 90+ | 42.1 | 26.3 | 15.8 | 5.3 | 10.5 |
| ***Male – 3rd social quartile*** | | | | | |
| Age 60-64 | 77.3 | 9.8 | 8.4 | 2.7 | 1.8 |
| Age 65-69 | 78.5 | 6.8 | 10.5 | 2.6 | 1.6 |
| Age 70-74 | 77.7 | 10.9 | 6.8 | 2.7 | 1.9 |
| Age 75-79 | 73.4 | 11.8 | 7.4 | 4.8 | 2.6 |
| Age 80-84 | 66.4 | 14.0 | 14.0 | 3.5 | 2.1 |
| Age 85-89 | 69.5 | 11.4 | 12.9 | 5.7 | 0.5 |
| Age 90+ | 59.5 | 0.5 | 20.0 | 13.3 | 6.7 |
| ***Male – Most deprived social quartile*** | | | | | |
| Age 60-64 | 73.7 | 9.1 | 12.4 | 3.2 | 1.6 |
| Age 65-69 | 75.1 | 7.6 | 14.5 | 1.4 | 1.4 |
| Age 70-74 | 72.5 | 11.8 | 10.5 | 2.6 | 2.6 |
| Age 75-79 | 74.2 | 9.3 | 5.2 | 4.1 | 7.2 |
| Age 80-84 | 57.7 | 17.3 | 11.5 | 5.8 | 7.7 |
| Age 85-89 | 69.5 | 0.5 | 10.0 | 10.0 | 10.0 |
| Age 90+ | 56.1 | 28.6 | 0.5 | 0.5 | 14.3 |
| ***Female – Most privileged social quartile*** | | | | | |
| Age 60-64 | 77.9 | 9.4 | 7.8 | 3.0 | 1.9 |
| Age 65-69 | 75.4 | 10.7 | 6.9 | 5.3 | 1.7 |
| Age 70-74 | 78.2 | 9.1 | 5.8 | 3.7 | 3.2 |
| Age 75-79 | 69.8 | 14.0 | 7.3 | 6.4 | 2.5 |
| Age 80-84 | 60.9 | 13.2 | 12.7 | 6.4 | 6.8 |
| Age 85-89 | 62.0 | 9.3 | 8.7 | 10.0 | 10.0 |
| Age 90+ | 71.0 | 5.8 | 11.6 | 5.8 | 5.8 |
| ***Female – 2nd social quartile*** | | | | | |
| Age 60-64 | 77.0 | 10.7 | 5.4 | 4.1 | 2.8 |
| Age 65-69 | 69.4 | 14.8 | 8.6 | 3.6 | 3.6 |
| Age 70-74 | 68.5 | 14.3 | 12.3 | 2.8 | 2.1 |
| Age 75-79 | 70.4 | 12.0 | 7.3 | 6.9 | 3.4 |
| Age 80-84 | 59.6 | 13.4 | 10.3 | 10.3 | 6.4 |
| Age 85-89 | 59.2 | 21.4 | 7.1 | 10.2 | 2.1 |
| Age 90+ | 60.0 | 11.1 | 15.5 | 6.7 | 6.7 |
| ***Female – 3rd social quartile*** | | | | | |
| Age 60-64 | 73.2 | 10.0 | 10.0 | 5.0 | 1.8 |
| Age 65-69 | 72.6 | 10.7 | 8.9 | 4.8 | 3.0 |
| Age 70-74 | 69.6 | 12.8 | 9.8 | 4.2 | 3.6 |
| Age 75-79 | 66.5 | 8.2 | 11.7 | 7.4 | 6.2 |
| Age 80-84 | 67.7 | 10.8 | 9.9 | 7.2 | 4.4 |
| Age 85-89 | 64.7 | 13.7 | 7.9 | 8.5 | 5.2 |
| Age 90+ | 62.5 | 12.5 | 12.5 | 2.1 | 10.4 |
| ***Female – Most deprived social quartile*** | | | | | |
| Age 60-64 | 72.0 | 11.4 | 8.7 | 3.9 | 4.0 |
| Age 65-69 | 65.5 | 12.8 | 9.9 | 5.4 | 6.4 |
| Age 70-74 | 71.3 | 11.7 | 7.8 | 5.7 | 3.5 |
| Age 75-79 | 66.0 | 11.8 | 11.7 | 4.6 | 5.9 |
| Age 80-84 | 51.4 | 11.8 | 11.8 | 14.7 | 10.3 |
| Age 85-89 | 52.9 | 11.8 | 17.6 | 5.9 | 11.8 |
| Age 90+ | 69.5 | 10.0 | 10.0 | 0.5 | 10.0 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; SES: socioeconomic status | | | | | |

### Frailty index

The literature recommends that a multivariate frailty index should: (i) incorporate at least 30 deficit items and that each item should be an adverse health outcome associated with age; (ii) not saturated at early old age; (iii) have prevalence greater than 1%; and (iv) have less than 5% missing values in study sample [217]. Accordingly, each deficit item was checked for: (i) increasing prevalence with age; (ii) less than 100% prevalence at age 65 – a criterion used for eFI [218]; and (iii) greater than 1% prevalence across the whole population aged 60 and over – which excluded Alzheimer’s disease or dementia, Parkinson’s disease, and schizophrenia or psychosis. Six variables – gait speed (time to walk 8 feet), self-reported balance problem severity, grip strength (weight in kg lifted with dominant hand), leg strength (time to complete five chair rises), weight and body mass index category – had more than 5% missing data. Data for these variables were imputed using multivariate single imputation (see Table E1).

Table E7 shows the mean and standard deviation parameters for lognormal distributions of multivariate frailty scores (range 0-100) assigned to simulated individuals by 5-year age group, sex, social deprivation quartile and baseline falls history type at model entry.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table E7** Mean and standard deviation of lognormally distributed frailty index (range 0-100) by age group, sex, SES quartile and falls history type. | | | | | | |
| ***Male in 1st social quartile (most privileged)*** | | | | | | |
| MS1Age1FH0  Mean: 6.40  SD: 5.41 | MS1Age2FH0  Mean: 7.33  SD: 6.22 | MS1Age3FH0  Mean: 9.10  SD: 7.30 | MS1Age4FH0  Mean: 11.55  SD: 7.28 | MS1Age5FH0  Mean: 15.15  SD: 9.24 | MS1Age6FH0  Mean: 17.99  SD: 9.69 | MS1Age7FH0  Mean: 24.13  SD: 11.24 |
| MS1Age1FH1  Mean: 6.59  SD: 5.76 | MS1Age2FH1  Mean: 8.86  SD: 6.54 | MS1Age3FH1  Mean: 11.47  SD: 8.00 | MS1Age4FH1  Mean: 11.83  SD: 8.31 | MS1Age5FH1  Mean: 18.51  SD: 10.16 | MS1Age6FH1  Mean: 15.54  SD: 7.31 | MS1Age7FH1  Mean: 16.99  SD: 12.00 |
| MS1Age1FH2  Mean: 12.73  SD: 11.98 | MS1Age2FH2  Mean: 13.60  SD: 8.72 | MS1Age3FH2  Mean: 19.96  SD: 12.81 | MS1Age4FH2  Mean: 19.80  SD: 11.26 | MS1Age5FH2  Mean: 24.48  SD: 10.87 | MS1Age6FH2  Mean: 27.31  SD: 13.07 | MS1Age7FH2  Mean: 22.55  SD: 15.10 |
| MS1Age1FH3  Mean: 17.31  SD: 13.00 | MS1Age2FH3  Mean: 8.38  SD: 4.17 | MS1Age3FH3  Mean: 10.15  SD: 5.67 | MS1Age4FH3  Mean: 15.72  SD: 8.14 | MS1Age5FH3  Mean: 19.87  SD: 13.36 | MS1Age6FH3  Mean: 12.50  SD: 4.00 | MS1Age7FH3  Mean: 15.18  SD: 10.41 |
| MS1Age1FH4  Mean: 9.23  SD: 3.70 | MS1Age2FH4  Mean: 14.23  SD: 9.34 | MS1Age3FH4  Mean: 18.34  SD: 14.15 | MS1Age4FH4  Mean: 25.00  SD: 9.25 | MS1Age5FH4  Mean: 25.00  SD: 13.32 | MS1Age6FH4  Mean: 18.80  SD: 5.99 | MS1Age7FH4  Mean: 24.04  SD: 4.08 |
| ***Male in 2nd social quartile*** | | | | | | |
| MS2Age1FH0  Mean: 6.40  SD: 5.41 | MS2Age2FH0  Mean: 7.01  SD: 5.78 | MS2Age3FH0  Mean: 8.53  SD: 6.69 | MS2Age4FH0  Mean: 10.51  SD: 8.19 | MS2Age5FH0  Mean: 11.89  SD: 8.45 | MS2Age6FH0  Mean: 15.26  SD: 9.76 | MS2Age7FH0  Mean: 18.09  SD: 11.35 |
| MS2Age1FH1  Mean: 6.59  SD: 5.76 | MS2Age2FH1  Mean: 10.19  SD: 9.31 | MS2Age3FH1  Mean: 11.41  SD: 8.37 | MS2Age4FH1  Mean: 8.72  SD: 7.33 | MS2Age5FH1  Mean: 16.97  SD: 9.13 | MS2Age6FH1  Mean: 13.94  SD: 10.06 | MS2Age7FH1  Mean: 12.26  SD: 7.04 |
| MS2Age1FH2  Mean: 12.73  SD: 11.98 | MS2Age2FH2  Mean: 18.09  SD: 12.57 | MS2Age3FH2  Mean: 16.09  SD: 12.76 | MS2Age4FH2  Mean: 20.19  SD: 14.05 | MS2Age5FH2  Mean: 19.97  SD: 15.40 | MS2Age6FH2  Mean: 24.83  SD: 9.28 | MS2Age7FH2  Mean: 31.92  SD: 5.70 |
| MS2Age1FH3  Mean: 17.31  SD: 13.00 | MS2Age2FH3  Mean: 3.85  SD: 2.72 | MS2Age3FH3  Mean: 16.03  SD: 15.89 | MS2Age4FH3  Mean: 11.86  SD: 9.22 | MS2Age5FH3  Mean: 16.08  SD: 11.19 | MS2Age6FH3  Mean: 23.46  SD: 16.17 | MS2Age7FH3  Mean: 18.41  SD: 9.54 |
| MS2Age1FH4  Mean: 9.23  SD: 3.70 | MS2Age2FH4  Mean: 14.42  SD: 1.92 | MS2Age3FH4  Mean: 36.54  SD: 5.44 | MS2Age4FH4  Mean: 23.08  SD: 11.64 | MS2Age5FH4  Mean: 36.54  SD: 11.04 | MS2Age6FH4  Mean: 31.92  SD: 6.46 | MS2Age7FH4  Mean: 26.68  SD: 8.69 |
| ***Male in 3rd social quartile*** | | | | | | |
| MS3Age1FH0  Mean: 9.38  SD: 8.69 | MS3Age2FH0  Mean: 10.32  SD: 7.91 | MS3Age3FH0  Mean: 11.60  SD: 8.47 | MS3Age4FH0  Mean: 13.22  SD: 9.69 | MS3Age5FH0  Mean: 14.78  SD: 8.32 | MS3Age6FH0  Mean: 18.25  SD: 10.05 | MS3Age7FH0  Mean: 27.35  SD: 10.87 |
| MS3Age1FH1  Mean: 11.40  SD: 9.70 | MS3Age2FH1  Mean: 10.95  SD: 8.80 | MS3Age3FH1  Mean: 15.14  SD: 10.58 | MS3Age4FH1  Mean: 16.11  SD: 9.70 | MS3Age5FH1  Mean: 15.58  SD: 9.00 | MS3Age6FH1  Mean: 17.31  SD: 5.90 | MS3Age7FH1  Mean: 29.80  SD: 6.51 |
| MS3Age1FH2  Mean: 19.28  SD: 12.75 | MS3Age2FH2  Mean: 19.86  SD: 11.62 | MS3Age3FH2  Mean: 24.54  SD: 12.17 | MS3Age4FH2  Mean: 22.79  SD: 8.85 | MS3Age5FH2  Mean: 20.10  SD: 8.22 | MS3Age6FH2  Mean: 20.73  SD: 11.49 | MS3Age7FH2  Mean: 21.79  SD: 6.18 |
| MS3Age1FH3  Mean: 18.11  SD: 10.16 | MS3Age2FH3  Mean: 23.08  SD: 15.90 | MS3Age3FH3  Mean: 13.85  SD: 8.25 | MS3Age4FH3  Mean: 21.75  SD: 11.39 | MS3Age5FH3  Mean: 18.85  SD: 17.75 | MS3Age6FH3  Mean: 23.56  SD: 9.21 | MS3Age7FH3  Mean: 26.92  SD: 5.44 |
| MS3Age1FH4  Mean: 11.78  SD: 10.40 | MS3Age2FH4  Mean: 14.42  SD: 5.27 | MS3Age3FH4  Mean: 19.78  SD: 11.03 | MS3Age4FH4  Mean: 18.68  SD: 9.40 | MS3Age5FH4  Mean: 30.77  SD: 1.92 | MS3Age6FH4  Mean: 22.55  SD: 9.26 | MS3Age7FH4  Mean: 30.77  SD: 3.57 |
| ***Male in 4th social quartile*** | | | | | | |
| MS4Age1FH0  Mean: 11.40  SD: 8.54 | MS4Age2FH0  Mean: 14.13  SD: 9.64 | MS4Age3FH0  Mean: 13.44  SD: 9.37 | MS4Age4FH0  Mean: 15.49  SD: 11.72 | MS4Age5FH0  Mean: 15.00  SD: 8.56 | MS4Age6FH0  Mean: 19.78  SD: 14.21 | MS4Age7FH0  Mean: 24.04  SD: 11.05 |
| MS4Age1FH1  Mean: 14.93  SD: 8.61 | MS4Age2FH1  Mean: 12.59  SD: 8.79 | MS4Age3FH1  Mean: 15.38  SD: 8.55 | MS4Age4FH1  Mean: 18.59  SD: 8.33 | MS4Age5FH1  Mean: 23.50  SD: 12.08 | MS4Age6FH1  Mean: 22.23  SD: 12.08 | MS4Age7FH1  Mean: 25.00  SD: 5.44 |
| MS4Age1FH2  Mean: 25.25  SD: 10.01 | MS4Age2FH2  Mean: 19.14  SD: 9.62 | MS4Age3FH2  Mean: 21.27  SD: 11.84 | MS4Age4FH2  Mean: 21.54  SD: 5.67 | MS4Age5FH2  Mean: 32.05  SD: 12.08 | MS4Age6FH2  Mean: 28.85  SD: 12.08 | MS4Age7FH2  Mean: 27.11  SD: 12.08 |
| MS4Age1FH3  Mean: 10.58  SD: 4.51 | MS4Age2FH3  Mean: 20.19  SD: 20.40 | MS4Age3FH3  Mean: 14.42  SD: 5.55 | MS4Age4FH3  Mean: 19.71  SD: 13.08 | MS4Age5FH3  Mean: 32.05  SD: 13.64 | MS4Age6FH3  Mean: 17.31  SD: 13.64 | MS4Age7FH3  Mean: 19.74  SD: 13.64 |
| MS4Age1FH4  Mean: 27.56  SD: 14.56 | MS4Age2FH4  Mean: 27.88  SD: 17.68 | MS4Age3FH4  Mean: 23.56  SD: 3.28 | MS4Age4FH4  Mean: 15.11  SD: 8.49 | MS4Age5FH4  Mean: 20.19  SD: 8.08 | MS4Age6FH4  Mean: 34.62  SD: 8.08 | MS4Age7FH4  Mean: 28.85  SD: 8.08 |
| ***Female in 1st social quartile (most privileged)*** | | | | | | |
| FS1Age1FH0  Mean: 7.10  SD: 5.78 | FS1Age2FH0  Mean: 8.62  SD: 6.80 | FS1Age3FH0  Mean: 11.40  SD: 7.84 | FS1Age4FH0  Mean: 14.45  SD: 8.60 | FS1Age5FH0  Mean: 17.35  SD: 10.19 | FS1Age6FH0  Mean: 22.83  SD: 12.45 | FS1Age7FH0  Mean: 27.98  SD: 12.55 |
| FS1Age1FH1  Mean: 6.85  SD: 5.81 | FS1Age2FH1  Mean: 10.24  SD: 7.83 | FS1Age3FH1  Mean: 12.46  SD: 8.43 | FS1Age4FH1  Mean: 13.77  SD: 6.85 | FS1Age5FH1  Mean: 18.37  SD: 10.60 | FS1Age6FH1  Mean: 21.29  SD: 9.50 | FS1Age7FH1  Mean: 31.25  SD: 11.14 |
| FS1Age1FH2  Mean: 10.81  SD: 8.35 | FS1Age2FH2  Mean: 11.68  SD: 9.35 | FS1Age3FH2  Mean: 12.91  SD: 9.49 | FS1Age4FH2  Mean: 17.81  SD: 9.84 | FS1Age5FH2  Mean: 24.04  SD: 10.46 | FS1Age6FH2  Mean: 25.59  SD: 11.11 | FS1Age7FH2  Mean: 33.41  SD: 12.25 |
| FS1Age1FH3  Mean: 8.85  SD: 5.83 | FS1Age2FH3  Mean: 10.40  SD: 8.54 | FS1Age3FH3  Mean: 11.43  SD: 5.46 | FS1Age4FH3  Mean: 16.06  SD: 9.55 | FS1Age5FH3  Mean: 21.02  SD: 10.89 | FS1Age6FH3  Mean: 20.51  SD: 7.54 | FS1Age7FH3  Mean: 21.63  SD: 6.55 |
| FS1Age1FH4  Mean: 14.79  SD: 11.44 | FS1Age2FH4  Mean: 15.77  SD: 9.67 | FS1Age3FH4  Mean: 17.44  SD: 9.93 | FS1Age4FH4  Mean: 34.38  SD: 17.09 | FS1Age5FH4  Mean: 26.79  SD: 9.74 | FS1Age6FH4  Mean: 35.64  SD: 7.15 | FS1Age7FH4  Mean: 40.38  SD: 21.47 |
| ***Female in 2nd social quartile*** | | | | | | |
| FS2Age1FH0  Mean: 7.79  SD: 5.62 | FS2Age2FH0  Mean: 9.85  SD: 8.60 | FS2Age3FH0  Mean: 11.60  SD: 7.99 | FS2Age4FH0  Mean: 16.44  SD: 10.23 | FS2Age5FH0  Mean: 17.22  SD: 9.23 | FS2Age6FH0  Mean: 20.49  SD: 11.29 | FS2Age7FH0  Mean: 28.85  SD: 8.76 |
| FS2Age1FH1  Mean: 8.82  SD: 5.50 | FS2Age2FH1  Mean: 12.43  SD: 9.28 | FS2Age3FH1  Mean: 13.18  SD: 9.39 | FS2Age4FH1  Mean: 17.31  SD: 9.52 | FS2Age5FH1  Mean: 18.22  SD: 11.63 | FS2Age6FH1  Mean: 21.43  SD: 11.65 | FS2Age7FH1  Mean: 25.38  SD: 7.50 |
| FS2Age1FH2  Mean: 17.08  SD: 11.11 | FS2Age2FH2  Mean: 14.18  SD: 13.09 | FS2Age3FH2  Mean: 18.79  SD: 11.04 | FS2Age4FH2  Mean: 23.87  SD: 16.08 | FS2Age5FH2  Mean: 21.03  SD: 9.97 | FS2Age6FH2  Mean: 25.27  SD: 8.34 | FS2Age7FH2  Mean: 29.67  SD: 13.82 |
| FS2Age1FH3  Mean: 10.21  SD: 11.60 | FS2Age2FH3  Mean: 11.15  SD: 10.00 | FS2Age3FH3  Mean: 11.78  SD: 6.29 | FS2Age4FH3  Mean: 17.19  SD: 8.44 | FS2Age5FH3  Mean: 20.55  SD: 13.52 | FS2Age6FH3  Mean: 21.35  SD: 11.52 | FS2Age7FH3  Mean: 27.56  SD: 7.77 |
| FS2Age1FH4  Mean: 19.23  SD: 14.99 | FS2Age2FH4  Mean: 17.12  SD: 8.62 | FS2Age3FH4  Mean: 6.41  SD: 4.33 | FS2Age4FH4  Mean: 28.85  SD: 14.50 | FS2Age5FH4  Mean: 27.50  SD: 11.68 | FS2Age6FH4  Mean: 28.85  SD: 19.04 | FS2Age7FH4  Mean: 30.13  SD: 10.94 |
| ***Female in 3rd social quartile*** | | | | | | |
| FS3Age1FH0  Mean: 9.13  SD: 7.21 | FS3Age2FH0  Mean: 10.95  SD: 8.38 | FS3Age3FH0  Mean: 13.08  SD: 8.27 | FS3Age4FH0  Mean: 15.34  SD: 9.00 | FS3Age5FH0  Mean: 20.52  SD: 11.17 | FS3Age6FH0  Mean: 21.37  SD: 9.84 | FS3Age7FH0  Mean: 27.69  SD: 14.30 |
| FS3Age1FH1  Mean: 12.02  SD: 9.68 | FS3Age2FH1  Mean: 11.61  SD: 7.34 | FS3Age3FH1  Mean: 16.29  SD: 12.88 | FS3Age4FH1  Mean: 16.58  SD: 8.00 | FS3Age5FH1  Mean: 18.80  SD: 8.29 | FS3Age6FH1  Mean: 25.92  SD: 10.11 | FS3Age7FH1  Mean: 27.24  SD: 7.64 |
| FS3Age1FH2  Mean: 17.27  SD: 12.12 | FS3Age2FH2  Mean: 18.89  SD: 11.67 | FS3Age3FH2  Mean: 19.03  SD: 10.96 | FS3Age4FH2  Mean: 27.11  SD: 13.38 | FS3Age5FH2  Mean: 24.08  SD: 11.54 | FS3Age6FH2  Mean: 29.81  SD: 11.29 | FS3Age7FH2  Mean: 38.14  SD: 15.69 |
| FS3Age1FH3  Mean: 7.55  SD: 5.90 | FS3Age2FH3  Mean: 12.82  SD: 7.12 | FS3Age3FH3  Mean: 14.65  SD: 8.76 | FS3Age4FH3  Mean: 22.41  SD: 9.36 | FS3Age5FH3  Mean: 17.84  SD: 7.66 | FS3Age6FH3  Mean: 22.78  SD: 11.10 | FS3Age7FH3  Mean: 19.23  SD: 41.42 |
| FS3Age1FH4  Mean: 19.23  SD: 12.92 | FS3Age2FH4  Mean: 20.64  SD: 15.24 | FS3Age3FH4  Mean: 29.81  SD: 14.53 | FS3Age4FH4  Mean: 24.65  SD: 11.43 | FS3Age5FH4  Mean: 28.67  SD: 9.44 | FS3Age6FH4  Mean: 29.57  SD: 11.72 | FS3Age7FH4  Mean: 34.23  SD: 20.05 |
| ***Female in 4th social quartile*** | | | | | | |
| FS4Age1FH0  Mean: 12.52  SD: 7.24 | FS4Age2FH0  Mean: 14.23  SD: 9.28 | FS4Age3FH0  Mean: 14.11  SD: 8.97 | FS4Age4FH0  Mean: 17.61  SD: 9.68 | FS4Age5FH0  Mean: 21.98  SD: 12.08 | FS4Age6FH0  Mean: 19.66  SD: 9.22 | FS4Age7FH0  Mean: 22.80  SD: 5.71 |
| FS4Age1FH1  Mean: 13.40  SD: 8.88 | FS4Age2FH1  Mean: 17.31  SD: 11.17 | FS4Age3FH1  Mean: 16.24  SD: 9.46 | FS4Age4FH1  Mean: 20.62  SD: 9.51 | FS4Age5FH1  Mean: 21.88  SD: 12.25 | FS4Age6FH1  Mean: 28.37  SD: 5.30 | FS4Age7FH1  Mean: 25.00  SD: 5.30 |
| FS4Age1FH2  Mean: 24.56  SD: 9.29 | FS4Age2FH2  Mean: 22.21  SD: 17.08 | FS4Age3FH2  Mean: 23.61  SD: 12.99 | FS4Age4FH2  Mean: 28.63  SD: 11.59 | FS4Age5FH2  Mean: 29.81  SD: 16.02 | FS4Age6FH2  Mean: 28.53  SD: 17.93 | FS4Age7FH2  Mean: 51.92  SD: 17.93 |
| FS4Age1FH3  Mean: 10.19  SD: 9.55 | FS4Age2FH3  Mean: 18.18  SD: 9.24 | FS4Age3FH3  Mean: 16.42  SD: 6.41 | FS4Age4FH3  Mean: 33.79  SD: 17.69 | FS4Age5FH3  Mean: 23.46  SD: 10.29 | FS4Age6FH3  Mean: 24.04  SD: 17.68 | FS4Age7FH3  Mean: 44.55  SD: 17.68 |
| FS4Age1FH4  Mean: 18.65  SD: 10.57 | FS4Age2FH4  Mean: 27.66  SD: 14.40 | FS4Age3FH4  Mean: 32.93  SD: 11.83 | FS4Age4FH4  Mean: 27.56  SD: 8.16 | FS4Age5FH4  Mean: 32.97  SD: 12.83 | FS4Age6FH4  Mean: 33.17  SD: 9.85 | FS4Age7FH4  Mean: 38.46  SD: 9.85 |
| **Subgroup abbreviations:** MS1Age1FH0 – male, 1st social quartile (most privileged), 1st age group (60-64) and falls history type 0 (no falls history); FS4Age5FH3 – female, 4th social quartile (most deprived), 5th age group (80-84) and falls history type 3 (single MA fall history) | | | | | | |

## Model fit comparisons for baseline characteristics and outcomes

Table E8 shows the Akaike and Bayesian information criterion (AIC and BIC) values for different covariate combinations assessed to identify the best-fit model for the baseline characteristic variables incorporated in the model. The best-fit models are highlighted in yellow. Variables which were not available as an option in the model fit comparisons for a given dependent variable (due to the sequence of baseline covariate estimation) are shown in grey.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table E8** Model fit comparisons based on information criteria for baseline characteristics incorporated in simulation model. | | | | | | | | | | | | | | | | | |
| # | AIC | BIC | 5-yr age gr | Age | Age & Age^2 | Sex | SDQ | Falls hist | FI cat | FI | FI & FI^2 | High PA | CI | Fear | Abn | Paid work | Other |
| **Dependent variable: High physical activity (binary); N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 11020.4 | 11155.4 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |  |  |  |  |  |  |
| 2 | 11014.7 | 11112.2 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  |  |  |  |  |  |  |
| 3 | 11010.6 | 11115.7 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  |  |  |  |  |  |
| 4 | 11006.1 | 11081.1 |  |  | ˟ | ˟ | ˟ |  | ˟ |  |  |  |  |  |  |  |  |
| 5 | 10873.6 | 10933.7 |  |  | ˟ | ˟ | ˟ |  |  | ˟ |  |  |  |  |  |  |  |
| 6 | 10873.9 | 10941.5 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ |  |  |  |  |  |  |
| 7 | 10875.1 | 10972.6 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  |  |  |  |  |  |  |
| 8 | 10878.9 | 10931.5 |  | ˟ |  | ˟ | ˟ |  |  | ˟ |  |  |  |  |  |  |  |
| **Dependent variable: Cognitive impairment (binary); N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 12727.3 | 12869.9 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  |  |  |  |  |
| 2 | 12726.2 | 12831.3 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  |  |  |  |  |
| 3 | 12720.3 | 12832.9 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  |  |  |  |  |
| 4 | 12714.7 | 12812.3 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ |  |  |  |  |  |
| 5 | 12715.0 | 12820.0 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  |  |  |  |
| 6 | 12719.4 | 12791.5 |  |  | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ |  |  |  |  |  |
| 7 | 12720.7 | 12798.7 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ |  |  |  |  |  |
| **Dependent variable: Fear of falling (binary); N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 4939.4 | 5089.5 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  |  |  |
| 2 | 4939.6 | 5052.1 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  |  |  |
| 3 | 4941.1 | 5061.1 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  |  |  |
| 4 | 5004.5 | 5102.1 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ |  |  |  |  |
| 5 | 4880.7 | 4985.8 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ |  |  |  |  |
| 6 | 4877.2 | 4959.7 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ | ˟ | ˟ |  |  |  |  |
| 7 | 4877.5 | 4952.5 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  | ˟ |  |  |  |  |
| 8 | 4875.8 | 4943.3 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |  |  |  |  |  |
| 9 | 4875.5 | 4950.6 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ | ˟ |  |  |  |  |  |
| **Dependent variable: Abnormal gait and/or balance (binary); N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 10094.4 | 10252.0 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ |  |  |  |
| 2 | 10119.0 | 10239.0 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ |  |  |  |
| # | AIC | BIC | 5-yr age gr | Age | Age & Age^2 | Sex | SDQ | Falls hist | FI cat | FI | FI & FI^2 | High PA | CI | Fear | Abn | Paid work | Other |
| 3 | 10082.7 | 10210.3 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ |  |  |  |
| 4 | 9604.6 | 9717.2 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ |  |  |  |
| 5 | 9603.0 | 9723.1 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |  |
| 6 | 9618.8 | 9701.4 |  |  | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  |  |  |
| **Dependent variable: EQ-5D; N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | -3979.9 | -3814.8 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 2 | -3982.4 | -3854.8 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 3 | -3992.1 | -3857.1 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 4 | -4746.6 | -4626.5 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 5 | -4808.5 | -4681.0 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 6 | -4735.2 | -4637.7 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 7 | -4809.7 | -4689.7 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  |  |
| 8 | -4810.3 | -4697.8 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ |  | ˟ |  |  |
| 9 | -4811.4 | -4706.4 |  |  | Q | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ |  | ˟ |  |  |
| **Dependent variable: Paid employment; N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 9602.8 | 9767.9 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 2 | 9625.9 | 9753.5 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 3 | 9547.6 | 9682.7 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 4 | 9514.9 | 9635.0 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 5 | 9509.0 | 9636.6 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 6 | 9511.3 | 9608.8 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 7 | 9510.8 | 9600.9 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  | ˟ |  |  |
| 8 | 9509.3 | 9591.8 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  |  |  |  |
| 9 | 9510.5 | 9589.6 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ |  |  |  |  |  |
| 10 | 9516.5 | 9580.5 |  |  | ˟ | ˟ |  |  |  |  | ˟ | ˟ | ˟ |  |  |  |  |
| **Dependent variable: Unpaid volunteering; N=7,255** | | | | | | | | | | | | | | | | | |
| 1 | 8159.6 | 8318.0 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| 2 | 8201.6 | 8325.6 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| 3 | 8158.5 | 8289.4 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| 4 | 8167.1 | 8284.2 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| 5 | 8149.7 | 8273.7 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| # | AIC | BIC | 5-yr age gr | Age | Age & Age^2 | Sex | SDQ | Falls hist | FI cat | FI | FI & FI^2 | High PA | CI | Fear | Abn | Paid work | Other |
| 6 | 8151.3 | 8268.4 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | Q | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| 7 | 8153.6 | 8243.1 |  |  | ˟ | ˟ | ˟ |  |  |  | Q | ˟ | ˟ | ˟ | ˟ | ˟ |  |
| 8 | 8151.8 | 8234.4 |  |  | ˟ | ˟ | ˟ |  |  |  | Q | ˟ | ˟ |  | ˟ | ˟ |  |
| 9 | 8177.0 | 8239.0 |  |  | ˟ | ˟ |  |  |  |  | Q | ˟ | ˟ |  | ˟ | ˟ |  |
| **Dependent variable: CASP-19 (rescaled to 0-1); N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | -17217 | -17036 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ | UV |
| 2 | -17212 | -17070 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ | UV |
| 3 | -17220 | -17070 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ | UV |
| 4 | -17611 | -17476 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ | ˟ | UV |
| 5 | -17620 | -17478 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ | UV |
| 6 | -17598 | -17486 |  |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ | ˟ | UV |
| 7 | -17622 | -17487 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  | ˟ | ˟ | ˟ | UV |
| 8 | -17622 | -17494 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  | ˟ | ˟ | UV |
| 9 | -17622 | -17502 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  | ˟ |  | UV |
| **Dependent variable: Out-of-pocket care receipt; N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 3165.7 | 3345.8 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S |
| 2 | 3159.9 | 3302.5 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S |
| 3 | 3159.7 | 3309.8 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S |
| 4 | 3231.5 | 3359.0 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C; S |
| 5 | 3129.1 | 3264.2 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S |
| 6 | 3127.9 | 3232.9 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S |
| 7 | 3126.4 | 3223.9 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  | ˟ |  | C; S |
| 8 | 3125.1 | 3215.1 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  |  |  | C; S |
| 9 | 3122.6 | 3197.6 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  |  |  |  |
| **Dependent variable: Informal care receipt; N=13,422** | | | | | | | | | | | | | | | | | |
| 1 | 11206.8 | 11394.4 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 2 | 11203.7 | 11353.8 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 3 | 11203.6 | 11361.2 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 4 | 10922.4 | 11127.4 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 5 | 10889.6 | 11032.2 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 6 | 10888.5 | 11001.1 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| # | AIC | BIC | 5-yr age gr | Age | Age & Age^2 | Sex | SDQ | Falls hist | FI cat | FI | FI & FI^2 | High PA | CI | Fear | Abn | Paid work | Other |
| 7 | 10886.4 | 10976.4 |  | ˟ |  | ˟ |  |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 8 | 10884.5 | 10967.0 |  | ˟ |  | ˟ |  |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; O |
| 9 | 10885.3 | 10960.4 |  | ˟ |  | ˟ |  |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C |
| **Dependent variable: Multiple informal care needs given any informal care receipt; N=3,401** | | | | | | | | | | | | | | | | | |
| 1 | 3746.7 | 3900.0 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 2 | 3742.3 | 3864.9 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 3 | 3744.2 | 3872.9 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 4 | 3678.3 | 3788.7 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 5 | 3645.4 | 3761.9 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 6 | 3640.2 | 3732.2 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C; S; O |
| 7 | 3639.5 | 3725.3 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  | ˟ |  | C; S; O |
| 8 | 3636.6 | 3710.2 |  | ˟ |  | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ |  | ˟ |  | O |
| **Dependent variable: Routine GP contact; N=13,280** | | | | | | | | | | | | | | | | | |
| 1 | 11340.8 | 11535.7 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I |
| 2 | 11419.7 | 11577.1 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I |
| 3 | 11327.5 | 11492.4 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I |
| 4 | 11264.1 | 11414.0 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I |
| 5 | 11092.6 | 11250.0 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I |
| 6 | 11092.2 | 11242.1 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  | C;S;O;I |
| 7 | 11093.7 | 11236.1 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  | C;S;I |
| **Dependent variable: Self-referred exercise uptake; N=13,173** | | | | | | | | | | | | | | | | | |
| 1 | 7779.2 | 7981.3 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G |
| 2 | 7784.1 | 7948.8 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G |
| 3 | 7773.5 | 7945.6 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G |
| 4 | 7776.5 | 7933.7 |  |  | ˟ | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G |
| 5 | 7746.3 | 7911.0 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G |
| 6 | 7744.4 | 7901.6 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ |  | ˟ |  | C;S;O;I;G |
| 7 | 7745.7 | 7895.4 |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ |  |  | ˟ |  | C;S;O;I;G |
| **Dependent variable: Incidence of any fall; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 6734.5 | 6923.0 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 2 | 6733.3 | 6888.2 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| # | AIC | BIC | 5-yr age gr | Age | Age & Age^2 | Sex | SDQ | Falls hist | FI cat | FI | FI & FI^2 | High PA | CI | Fear | Abn | Paid work | Other |
| 3 | 6734.5 | 6896.1 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 4 | 6734.2 | 6875.6 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 5 | 6729.0 | 6877.1 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 6 | 6729.3 | 6837.7 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 7 | 6729.4 | 6817.0 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 8 | 6727.5 | 6808.3 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  |  |
| 9 | 6725.8 | 6799.9 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |  | ˟ | ˟ |  |  |
| 10 | 6726.9 | 6794.2 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |  | ˟ |  |  |  |
| **Dependent variable: Incidence of recurrent fall given any fall; N=1,731** | | | | | | | | | | | | | | | | | |
| 1 | 2083.7 | 2236.4 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 2 | 2077.0 | 2202.5 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 3 | 2076.7 | 2207.7 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 4 | 2080.9 | 2195.5 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 5 | 2072.4 | 2192.5 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 6 | 2066.1 | 2153.4 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 7 | 2064.2 | 2146.0 |  | ˟ |  |  | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 8 | 2059.8 | 2125.3 |  | ˟ |  |  |  | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 9 | 2057.9 | 2117.9 |  | ˟ |  |  |  | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  |  |
| 10 | 2057.4 | 2112.0 |  | ˟ |  |  |  | ˟ |  |  | ˟ |  |  | ˟ | ˟ |  |  |
| 11 | 2056.2 | 2105.3 |  | ˟ |  |  |  | ˟ |  |  | ˟ |  |  |  | ˟ |  |  |
| **Dependent variable: Incidence of MA fall given single fall; N=984** | | | | | | | | | | | | | | | | | |
| 1 | 1151.0 | 1288.0 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 2 | 1152.9 | 1265.4 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 3 | 1153.6 | 1271.0 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 4 | 1156.1 | 1258.8 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 5 | 1156.5 | 1264.1 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 6 | 1154.3 | 1252.1 |  | ˟ |  | ˟ | ˟ | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 7 | 1149.7 | 1232.8 |  | ˟ |  | ˟ |  | ˟ |  |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 8 | 1149.1 | 1212.7 |  | ˟ |  | ˟ |  |  |  |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 9 | 1150.0 | 1186.3 |  | ˟ |  | ˟ |  |  |  |  |  | ˟ | ˟ | ˟ | ˟ |  |  |
| 10 | 1150.3 | 1179.6 |  | ˟ |  | ˟ |  |  |  |  |  | ˟ |  | ˟ | ˟ |  |  |
| # | AIC | BIC | 5-yr age gr | Age | Age & Age^2 | Sex | SDQ | Falls hist | FI cat | FI | FI & FI^2 | High PA | CI | Fear | Abn | Paid work | Other |
| 11 | 1148.5 | 1173.0 |  | ˟ |  | ˟ |  |  |  |  |  | ˟ |  |  | ˟ |  |  |
| 12 | 1146.7 | 1166.3 |  | ˟ |  | ˟ |  |  |  |  |  | ˟ |  |  |  |  |  |
| **Dependent variable: Incidence of MA fall given single fall; N=747** | | | | | | | | | | | | | | | | | |
| 1 | 862.0 | 986.5 | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 2 | 853.1 | 954.6 |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 3 | 855.0 | 961.1 |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 4 | 852.4 | 944.6 |  | ˟ |  | ˟ | ˟ | ˟ |  | ˟ |  | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 5 | 847.5 | 944.4 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  | C;S;O;I;G;F |
| 6 | 852.4 | 926.2 |  | ˟ |  | ˟ | ˟ | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 7 | 849.6 | 909.7 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |
| 8 | 847.7 | 903.1 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  | ˟ | ˟ | ˟ |  |  |
| 9 | 845.7 | 896.5 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |  | ˟ | ˟ |  |  |
| 10 | 844.4 | 890.5 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |  |  | ˟ |  |  |
| 11 | 842.5 | 884.0 |  | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |  |  |  |  |  |
| 12 | 847.8 | 870.9 |  | ˟ |  | ˟ |  |  |  |  | ˟ |  |  |  |  |  |  |
| **Abbreviation:** Q: Quadratic term only; AIC: Akaike information criterion; BIC: Bayesian information criterion; 5-yr age gr: 5-year age group; SDQ: social deprivation quartile; Falls hist: falls history type; FI cat: frailty index category; PA: physical activity; CI: cognitive impairment; Fear: fear of falling; Abn: abnormal gait/balance; C: community healthcare; S: social care; O: out-of-pocket care; I: informal care; G: GP routine contact; F: falls prevention intervention including conventional exercise; MA fall: fall requiring medical attention; UV: unpaid volunteering.  **Note:** Best-fit model for each dependent variable is highlighted in yellow. Covariates not available as options for the given dependent variable are highlighted in grey. | | | | | | | | | | | | | | | | | |

## Costing the interventions

### Multifactorial interventions

Table E9 replicates Table 5.32 for costing the multifactorial interventions.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table E9** Resource use and cost of multifactorial interventions. | | | |
| **Component** | **Resource use** | **Mean cost1** | **Reference** |
| **(1) Referral to multidisciplinary falls clinic (24,000 clients; 3,000 per clinic per year)** | | | |
| Risk screening and access | Reactive clients – A&E record screening for eligibility and invitation by letter/phone2 | £16.37 per client | [46] |
| Proactive clients – TUG test set-up and staff time and training3 | £10.83 per client | [97] |
| Bi-disciplinary assessment for 25% of cognitively intact reactive clients (n=903) | £121.46 per client | [46] |
| Falls clinic operation | 1 falls specialist geriatrician (medical consultant) – salary & oncosts | £121,393 annual fixed | [219] |
| 2 registrars – salary & oncosts | £112,644 annual fixed | [219] |
| 2 PTs (band 6 & 7) – salary & oncosts | £94,906 annual fixed | [219] |
| 2 OTs (band 6 & 7) – salary & oncosts | £94,906 annual fixed | [219] |
| 2 PT assistants (band 4) – salary & oncosts | £56,919 annual fixed | [219] |
| 2 OT assistants (band 4) – salary & oncosts | £56,919 annual fixed | [219] |
| 3 nurses (band 4) – salary & oncosts | £75,834 annual fixed | [219] |
| 1 falls prevention facilitator – salary & oncosts4 | £33,123 annual fixed | [219]; [93] |
| 2 administrative staffs – salary & oncosts5 | £58,754 annual fixed | [219] |
| Capital overheads – land and office6 | £9,256 annual fixed | [219] |
| Non-staff overheads – travel/transport, telephone, education and training, office supplies, clinical/general services, utilities7 | £400,898 annual fixed | [219] |
| ***Total cost per falls clinic*** | **£1,115,552 annual fixed** |  |
| ***Total cost for 7 falls clinics*** | **£7,808,864 annual fixed** |  |
| Outsourced services and equipment | 2 specialist outpatient visits for 30% of clients | £32.89 expected7 per client | [46] |
| Optician and/or ophthalmologist referral for 17.7% of clients | £51.33 expected per client | [46] |
| 1 podiatry visit for 17% of clients | £5.77 expected per client | [46] |
| Geriatric psychiatry for 6.9% of cognitively impaired clients | £0.16 expected per client | [46]; [220] |
| Walking aid for 25% of clients | £21.29 expected per client | [46] |
| Hip protectors for 17% of clients | £11.81 expected per client | [46] |
| New footwear for 19% of clients | £10.79 expected per client | [46] |
| HAM major modifications (social care) | £94.97 expected per client | [39] |
| ***Total cost per client*** | **£251.73** |  |
| Non-public sector cost per participant | Travel cost | £62.45 per year | [93] |
| HAM major modifications (self-funded) | £94.97 per receipt | [39] |
| Time opportunity cost – if employed | £348.80 per year |  |
| Time opportunity cost – if engaged in regular unpaid work | £87.20 per year |  |
| Time opportunity cost – informal caregiver for CI client | £348.80 per year |  |
| **(2) Bi-disciplinary assessment and treatment [153] (2,700 clients per year)** | | | |
| Risk screening and access | Reactive pathway screening and invitation2 | £16.37 per client | [46] |
| Bi-disciplinary assessment | Physician assessment | £121.46 per client | [46] |
| OT assessment for 92.1% of clients | £269.63 expected per client | [46]; [153] |
| Outsourced services and equipment | Specialist outpatient visit for 44.1% of clients | £45.90 expected per client | [46]; [153] |
| 2 GP visits for medication change for 21.7% of clients | £16.63 expected per client | [46]; [153] |
| Optician and/or ophthalmologist referral for 17.8% of clients | £51.62 expected per client | [46]; [153] |
| HAM major modifications (social care) for 92.1% of clients | £87.47 expected per client | [39]; [153] |
| Handouts and amenities | £22.71 per client | [93] |
| Non public sector cost per participant | Travel cost | £62.45 per year | [93] |
| HAM major modifications (self-funded) for 92.1% of clients | £87.47 expected per client | [39]; [153] |
| Time opportunity cost – if employed | £69.76 per year |  |
| Time opportunity cost – if engaged in regular unpaid work | £17.44 per year |  |
| **Abbreviation:** CI: cognitively impaired; HAM: home assessment and modification; MA fall: fall requiring medical attention; OT: occupational therapy/therapist; PT: physiotherapy/therapist; TUG: timed up and go  1 All costs are expressed in 2021/22 £. Earlier estimates were inflated at the annual rate of 1.98% which is the average NHS cost inflation between 2013 and 2019 [219]. Costs in Australian dollar were converted to £ at rate of £0.55/AUS$1.  2 This incorporated cost of 30 minutes of hospital staff time, 28% premium as cost of recruitment (i.e., letters and phone calls), and 50% premium as office overheads. The costs were converted from 2008/09 Australian dollar to 2021/22 £.  3 This included cost of set-up (i.e., office overheads) at £24 per GP practice which amounted to £0.02 per person when spread across all recommended scenario recipients. The 28% premium for recruitment was applied as in reactive pathway (see note 2) to obtain the final per-participant cost of £10.83.  4 Salary/oncosts of social work assistant from PSSRU depository were used [219].  5 Salary/oncosts of administrative staff for medical consultant were used [219].  6 Assumed to be four times the capital overheads for Dementia Memory Clinic operating 40 hours per week for 50.4 weeks per year and catering to 708 dementia patients as costed in PSSRU depository. The overheads were annuitized over 60 years at a discount of 3.5%, declining to 3% after 30 years [219].  7 Assumed to be two times the non-staff overheads for Dementia Memory Clinic [219].  8 Expected cost given the probability of receiving the given service. | | | |

For the falls clinic operation, the staffing pattern required to manage 3,000 clients per year was estimated from stakeholders consultations and literature. The current Sheffield Falls Clinic for 300 clients per year was operated by a multidisciplinary team of falls specialist geriatrician, registrar, lead PT, lead OT, group of PT/OT assistants/students, and nurse. Administration was handled centrally by the Assessment and Rehabilitation Centre. The multidisciplinary team ran a single afternoon session per week, meaning that it could operate 10 such sessions per week if allocated full-time responsibility and salary. This would nevertheless require staff expansion to cover the overall increased work volume (though not increased volume per session). Hence, the salaries and oncosts were estimated using the PSSRU unit costs [219] for: one falls specialist geriatrician (medical consultant in PSSRU); two registrars; two PTs (band 6 & 7); two OTs (band 6 & 7); two PT assistants (band 4); two OT assistants (band 4); three nurses (band 4); one falls prevention facilitator (assumed to have same salary/oncosts as social work assistant in PSSRU); and two administrative staffs (medical consultant administrative staffs). The last two types would provide administrative support which was previously provided centrally by the Assessment and Rehabilitation Centre. The inclusion of facilitator was based on a previous model that costed the work of a facilitator in coordinating referrals from other clinical settings [93]. The annual salary for the facilitator in this model was that of a social work assistant in PSSRU. In line with RCT Shaw (2003) [220], the multidisciplinary team did not include a geriatric psychiatrist despite 4.4% of clients being cognitively impaired. Those requiring such service – 6.9% of the cognitively impaired clients [220] – were referred to external geriatric psychiatrists.

For capital and non-staff overheads, the cost estimates were taken from the PSSRU unit cost depository that estimated the overheads for operating a dementia memory clinic [219]. The memory clinic ran for 40 hours per week and catered to 708 dementia patients. The non-staff overheads included costs of travel, telephone, education and training, office supplies, clinical and general services and utilities, while the capital overheads included the costs of four NHS offices and large open-plan area for shared use which were annuitized over 60 years at 3.5% discount rate and at 3% after 30 years. Although the client flow of the falls clinic (3,000) is around four times that of the memory clinic (708), the much lower proportion of cognitively impaired patients likely reduces the overhead requirement; hence, the required falls clinic overhead cost was assumed to be twice that of the memory clinic.

Proportions of falls clinic clients who were referred to different external services were obtained from model by Day and colleagues [46]: 30% of falls clinic clients were referred to two specialist outpatient visits at combined cost of £109.64 per person; 17.7% to one optician/ophthalmologist visit at £290.02 per person; and 17.0% to one podiatrist visit at £33.96 per person. For geriatric psychiatry referral, the proportion of clients referred was taken from Shaw (2003) [220] and assigned the cost of a specialist outpatient visit in Day [46]. From these data, the expected costs of outsourced services per client were estimated. Day also estimated the proportions requiring equipment for in-house services and their unit costs: 25% required new walking aid at £85.16 per person; 19% new footwear at £56.77 per person; and 17% hip protectors at £69.47 per person [46]. Moreover, the cost of major home modifications would be incurred outside the falls clinic by social care services and older persons themselves. The Public Health England model estimated the expected cost of major HAM equipment and assumed that 50% of the cost (£94.97 per person) would be borne by the local authorities and the other 50% by older persons [39]. Finally, the Comans model [93] estimated that handouts (e.g., falls education booklets) and amenities would cost £22.71 per client.

### Single-component interventions

Table E10 replicates Table 5.34 for costing the single-component interventions.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table E10** Resource use and cost of single-component interventions. | | | |
| **Component** | **Resource use** | **Mean cost1** | **Reference** |
| **(1) Reactive HAM under usual care** | | | |
| Risk screening and access | Hospital record screening for eligibility and invitation before discharge | £16.37 per client | [46] |
| Therapeutic component | OT (band 7) home visit and assessment (2 hours including travel) | £128.23 per client | [219] |
| HAM major modifications (social care) | £94.97 per client | [39] |
| Walking aid for 25% of clients | £21.29 expected2 per client | [46] |
| Hip protectors for 17% of clients | £11.81 expected per client | [46] |
| New footwear for 19% of clients | £10.79 expected per client | [46] |
| 2 referrals to community OT service for 20% of clients | £19.97 expected per client | [219] |
| Non-public sector cost per client | HAM major modifications (self-funded) | £94.97 | [39] |
| Time opportunity cost – informal caregiver for CI patient3 | £17.44 per year |  |
| Public sector cost | **Average cost per client** | **£303.43 per year** |  |
| **Average cost per client with intervention history4** | **£176.37 per year** |  |
| **(2) 20-week Tai Chi for cognitively impaired persons and their caregivers** | | | |
| Risk screening and access | Screening at GP contact (proactive only) | £10.83 per client | [97] |
| Travel cost (proactive only) | £62.45 per client | [93] |
| Ongoing administration5 | £50 per client | PCS |
| Direct marketing (self-referred only) | £25.31 per client | [46] |
| Therapeutic component | Staff time | £367.06 per client | [221] |
| Staff training | £8.25 per client | [39] |
| Staff travel | £15.01 per client | [39] |
| Equipment | £5 per client | [39] |
| Venue hire | £30 per client | [39] |
| Non public sector cost per client | Travel cost (self-referred only) | £62.45 | [93] |
| Time opportunity cost – if employed6 | £218 per year |  |
| Time opportunity cost – if engaged in regular unpaid work6 | £54.5 per year |  |
| Time opportunity cost – informal caregiver7 | £218 per year |  |
| Public sector cost | **Average cost per proactive client** | **£537.77 per year** |  |
| **Average cost per self-referred client8** | **£500.63 per year** |  |
| **(3) 24-week self-referred FaME and Otago for general-risk cognitively intact persons** | | | |
| Access | Direct marketing | £10.03 per client | [38] |
| Therapeutic component | Staff time | £126 per client | PCS |
| Staff training | £4.60 per client | [39] |
| Staff travel | £21.11 per client | [39] |
| Equipment | £20.02 per client | [39] |
| Venue hire | £18 per client | [39] |
| Non public sector cost per client | Travel cost | £62.45 | [93] |
| Time opportunity cost – if employed9 | £340.60 per year | [176] |
| Time opportunity cost – if engaged in regular unpaid work9 | £85.15 per year | [176] |
| Public sector cost | **Average cost per client** | **£199.76 per year** |  |
| **(4) 36-week self-referred FaME and Otago for high-risk cognitively intact persons** | | | |
| Access | Direct marketing | £10.03 per client | [38] |
| Therapeutic component | Staff time | £189 per client | PCS |
| Staff training | £4.60 per client | [39] |
| Staff travel | £31.66 per client | [39] |
| Equipment | £20.02 per client | [39] |
| Venue hire | £27 per client | [39] |
| Non public sector cost per client | Travel cost10 | £93.68 | [93] |
| Time opportunity cost – if employed9 | £340.60 per year | [176] |
| Time opportunity cost – if engaged in regular unpaid work9 | £85.15 per year | [176] |
| Public sector cost | **Average cost per client** | **£272.28 per year** |  |
| **Abbreviation:** FaME: Falls Management Exercise; HAM: home assessment and modification; OT: occupational therapy/therapist; PCS: personal communication with stakeholder  1 All costs are expressed in 2021/22 £. Earlier estimates were inflated at the annual rate of 1.98% which is the average NHS cost inflation between 2013 and 2019 [219]. Costs in Australian dollar were converted to £ at £0.55/AUS$1.  2 Expected cost given the probability of receiving the given service.  3 Assumed that cognitively impaired patients are accompanied by informal caregivers for 2 hours of OT home visit, incurring an hourly opportunity cost equal to the national living wage (£8.72).  4 Assumed that those with intervention history incurred 20% of the costs of HAM major modifications, equipment and community OT services.  5 The manager for Dance to Health Sheffield informed that each weekly session for 20 participants incurred an administrative cost of £25, which equates to £500 for a 20-week programme. This translates to £50 per client if each Tai Chi class is attended by 10 participant-caregiver dyads as mentioned in Nyman (2020).  6 Assumed that average time committed per participant is 25 hours according to the average exercise time in RCT [221]. Those in paid employment assumed to incur an hourly opportunity cost equal to the national living wage. Those engaged in unpaid work assumed to incur an hourly opportunity cost equal to quarter of the national living wage.  7 Assumed that cognitively impaired clients are accompanied by their informal caregivers for all 25 hours of intervention, incurring an hourly opportunity cost equal to the national living wage.  8 Under usual care, the cost of self-referred intervention is entirely self-paid.  9 According to Iliffe (2014) [176], 17% of general-risk persons receiving the 24-week intervention completed 75% of prescribed time for FaME and Otago exercises. Assuming the other 83% completed 50% of prescribed time and that the pattern was the same for 24-hour walking, then the average time committed was 39.06 hours. If the same pattern was applied to the 36-week intervention evaluated by Skelton (2005) [222] which contained 72 hours of FaME and Otago, the average time committed was again 39.06 hours. Time opportunity costs were assigned as in note 5.  10 Travel cost was assumed to be proportional to the programme duration. Hence, the 36-week programme for high-risk group incurred 1.5 times the travel cost of the 24-week programme for general-risk. | | | |

It was assumed that the equipment needs for reactive HAM recipients are the same as those for reactive multifactorial intervention recipients under RC (see Table E9); and hence their expected costs were calculated using data from the same source [46]. For community service referrals, Lockwood (2019) reported that 23.3% of the intervention group had at least one community OT service at 6-month follow-up, which was significantly higher than 3.3% in the control group. The difference in service use rate (20.0%) was attributed to HAM and that the same percentage would receive two community OT services in one year lasting two hours in total, with all costs accruing to social care.

For Tai Chi, Nyman (2020) reported that two Tai Chi instructors were hired to deliver the programme for 75 clients at total salary cost was £27,530 which amounted to £367.06 per client. For staff training, the PHE model [39] assumed that 50% of delivery staff require new training and that the cost of training one Tai Chi instructor was £618.66. If two Tai Chi instructors are required for 75 clients, then one instructor must be trained per 75 clients, amounting to £8.25 training cost per client. For staff travel, the PHE model estimated that this amounted to £36.78 per client for the 49-session Tai Chi. If the travel cost varies proportionally with the session number, then this amounts to £15.01 per client for 20 sessions. Tai Chi equipment was assumed to be £5 per participant for the instruction booklet that assisted the home-based component as in the PHE model. The Sheffield lead for Dance to Health informed that the venue cost ranged between free and around £45 per hour. The PHE model assumed hourly cost of £15. Twenty sessions would then cost £300 or £30 per client. The cost of marketing Tai Chi under the self-referred pathway was taken from a previous model [46]: two advertisements in local newspapers were required to recruit 12 participants to a 15-week Tai Chi class, amounting to £25.31 per participant.

For FaME and Otago interventions, only the hours that required professional supervision were costed under staff time. This amounted to 24 hours of FaME group exercise for general-risk persons and 36 hours of FaME for high-risk. Hence, the 24-hour home-based Otago exercise and twice-weekly walking for general-risk persons and the 36-hour home-based Otago exercise for high-risk persons were not assigned any costs except the cost of home exercise equipment. According to the Sheffield Dance to Health lead, each Dance to Health session – which incorporated FaME components into the dance routine – cost £80 as fee to postural stability instructor (PSI) and £25 as fee to lay volunteers. The per-session cost of £105 hence amounted to £2,520 over 24 weeks and £3,780 over 36 weeks. Since each class contained 20 participants, this amounted to £126 per participant for the 24-week programme and £189 per participant for the 36-week programme.

The cost of staff training of £4.60 per participant was taken from the PHE model which had costed the same 24-week FaME and Otago programme evaluated in Iliffe (2014). The training cost was assumed to be the same for the 36-week programme in Skelton (2005) for high-risk persons. The PHE model had also estimated the staff travel cost as £42.21 per participant for the 24-week programme. This per-participant rate was halved since it was assumed that there were 20 participants per class rather than 10 as assumed by the PHE model. Because there were 36 sessions in the 36-week programme and because staff travel cost varied proportionally with the number of sessions, the per-participant staff travel cost was multiplied by 1.5 for the 36-week programme. The per-participant cost of equipment for Otago home exercise – including the cost of instruction booklet, stretching band and floor mat – as estimated by the PHE model was included and was assumed to be the same for the 36-week programme. The cost of venue varied proportionally with the number of sessions. Using the per-session cost of £15, this amounted to £360 for the 24-week programme and £540 for the 36-week programme. These translated to £18 and £27 per participant, respectively.

To estimate the time opportunity cost, the average time committed by the participants to FaME and Otago had to be calculated. Iliffe (2014) reported that 17% of intervention group participants completed 75% of the 48 hours prescribed for FaME and Otago exercises. It was assumed that the other 83% completed 50% of the 48 hours. For the additional 24 hours of recommended walking, it was assumed that the completion pattern was the same: i.e., 17% completed 75% of time (18 hours) and 83% completed 50% of time (12 hours). The average time committed was then estimated as 39.06 hours. If the same completion pattern was assumed to hold for the 36-week programme that contained 72 hours of FaME and Otago exercises, then the average time committed was also 39.06 hours. These were valued at £8.72 per hour if the person was in paid employment and at £2.18 if in regular unpaid work. It was assumed that no informal caregiver regularly assisted self-referred FaME and Otago participants. Hence, there was no opportunity cost in terms of caregiver time foregone.

Overall, the per-participant cost of the 24-week programme was estimated to be £199.76. In comparison, Iliffe (2014) estimated the per-participant cost to be £255.02 in Nottingham, while the PHE model estimated it to be £236.71. The lower cost can be attributed to the larger class size accommodated by the Dance to Health adaptation of FaME. This cost was applied regardless of intervention history, even though it can be argued that direct marketing cost do not apply to experienced participants. The per-client cost of the 36-week programme was estimated to be £272.28.

## Formula for relative risk of being a recurrent faller given any fall

Falls rate ratio (RaR) can be expressed by equation (1):

where and are numbers of single fallers and recurrent fallers, respectively, in the intervention group, and and are the counterparts in the control group. and are the average numbers of falls experienced by recurrent fallers in the intervention group and control group, respectively. Hence, is the total number of falls experienced in the intervention group during the follow-up period. Falls rate for the group is obtained by dividing the total number of falls by the total person-years, , in the group. RaR is the falls rate in intervention group divided by that in the control group.

Let and express the ratios between the numbers of recurrent fallers and single fallers in the control group and intervention group, respectively. Equation (1) can then be modified to equation (2):

where and are the number of individuals at baseline in the control and intervention groups, respectively, and and are the average person-years per participant in the control and intervention groups, respectively. Note that would be close to 1 if the attrition rates between intervention and control groups are similar.

Let where is the total number of fallers (i.e., single and recurrent fallers) in the control group, and similarly in the intervention group. Then equation (2) can be modified to equation (3):

Since the definition of relative risk under ITT analysis is , then equation (3) can be modified to equation (4):

The relative risk of being a recurrent faller given any fall (*RRRF*)is:

Hence,

Substituting in (5) into (4), we obtain (6) which is the equation presented in Section 5.2.4.4:

## Other-cause mortality rates

Table E11 shows the annual other-cause mortality rates by age, sex and frailty category.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table E11** Annual other-cause mortality rate (range 0-1) by age, sex and frailty category. | | | | | | | | |
|  | **Male** | | | | **Female** | | | |
| **Age** | Fit | Mild | Moderate | Severe | Fit | Mild | Moderate | Severe |
| 60 | 0.0058 | 0.0112 | 0.0180 | 0.0263 | 0.0038 | 0.0073 | 0.0119 | 0.0173 |
| 61 | 0.0064 | 0.0122 | 0.0198 | 0.0288 | 0.0041 | 0.0079 | 0.0128 | 0.0187 |
| 62 | 0.0064 | 0.0123 | 0.0199 | 0.0290 | 0.0044 | 0.0085 | 0.0137 | 0.0200 |
| 63 | 0.0071 | 0.0137 | 0.0221 | 0.0322 | 0.0047 | 0.0090 | 0.0145 | 0.0212 |
| 64 | 0.0077 | 0.0147 | 0.0237 | 0.0346 | 0.0049 | 0.0094 | 0.0152 | 0.0222 |
| 65 | 0.0082 | 0.0158 | 0.0254 | 0.0371 | 0.0053 | 0.0102 | 0.0164 | 0.0240 |
| 66 | 0.0096 | 0.0184 | 0.0296 | 0.0432 | 0.0057 | 0.0110 | 0.0177 | 0.0259 |
| 67 | 0.0100 | 0.0192 | 0.0310 | 0.0452 | 0.0062 | 0.0119 | 0.0191 | 0.0279 |
| 68 | 0.0108 | 0.0207 | 0.0335 | 0.0488 | 0.0066 | 0.0127 | 0.0205 | 0.0299 |
| 69 | 0.0107 | 0.0205 | 0.0330 | 0.0482 | 0.0072 | 0.0137 | 0.0222 | 0.0324 |
| 70 | 0.0119 | 0.0228 | 0.0369 | 0.0537 | 0.0073 | 0.0140 | 0.0227 | 0.0330 |
| 71 | 0.0133 | 0.0256 | 0.0413 | 0.0603 | 0.0079 | 0.0151 | 0.0244 | 0.0356 |
| 72 | 0.0138 | 0.0266 | 0.0429 | 0.0625 | 0.0090 | 0.0174 | 0.0280 | 0.0409 |
| 73 | 0.0154 | 0.0296 | 0.0478 | 0.0697 | 0.0101 | 0.0193 | 0.0312 | 0.0454 |
| 74 | 0.0175 | 0.0336 | 0.0542 | 0.0790 | 0.0099 | 0.0191 | 0.0308 | 0.0450 |
| 75 | 0.0190 | 0.0365 | 0.0589 | 0.0859 | 0.0115 | 0.0220 | 0.0355 | 0.0518 |
| 76 | 0.0212 | 0.0406 | 0.0656 | 0.0957 | 0.0120 | 0.0230 | 0.0372 | 0.0542 |
| 77 | 0.0212 | 0.0407 | 0.0658 | 0.0959 | 0.0133 | 0.0256 | 0.0413 | 0.0602 |
| 78 | 0.0238 | 0.0456 | 0.0737 | 0.1074 | 0.0141 | 0.0272 | 0.0439 | 0.0640 |
| 79 | 0.0256 | 0.0492 | 0.0794 | 0.1158 | 0.0148 | 0.0284 | 0.0459 | 0.0669 |
| 80 | 0.0259 | 0.0498 | 0.0803 | 0.1171 | 0.0162 | 0.0311 | 0.0502 | 0.0732 |
| 81 | 0.0308 | 0.0592 | 0.0956 | 0.1393 | 0.0183 | 0.0352 | 0.0568 | 0.0828 |
| 82 | 0.0310 | 0.0596 | 0.0962 | 0.1403 | 0.0187 | 0.0359 | 0.0579 | 0.0844 |
| 83 | 0.0360 | 0.0692 | 0.1116 | 0.1628 | 0.0228 | 0.0437 | 0.0706 | 0.1029 |
| 84 | 0.0403 | 0.0774 | 0.1249 | 0.1822 | 0.0231 | 0.0444 | 0.0717 | 0.1045 |
| 85 | 0.0418 | 0.0802 | 0.1295 | 0.1888 | 0.0270 | 0.0519 | 0.0839 | 0.1223 |
| 86 | 0.0480 | 0.0921 | 0.1487 | 0.2169 | 0.0294 | 0.0565 | 0.0912 | 0.1330 |
| 87 | 0.0506 | 0.0971 | 0.1567 | 0.2285 | 0.0335 | 0.0643 | 0.1038 | 0.1514 |
| 88 | 0.0539 | 0.1036 | 0.1672 | 0.2438 | 0.0379 | 0.0728 | 0.1176 | 0.1715 |
| 89 | 0.0553 | 0.1062 | 0.1715 | 0.2500 | 0.0395 | 0.0757 | 0.1223 | 0.1783 |
| 90+ | 0.0776 | 0.1490 | 0.2406 | 0.3507 | 0.0524 | 0.1007 | 0.1626 | 0.2370 |

## Model fit comparisons for dynamic transitions

Table E12 shows the AIC and BIC values in model fit comparisons conducted for dynamic transitions of variables between model cycles.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table E12** Model fit comparisons based on information criteria for dynamic transitions of variables incorporated in simulation model. | | | | | | | | | | | | | | | | | |
| # | AIC | BIC | W4 age | Sex | SDQ | Falls inc | Falls hist | W4 frailty | Frailty change | High  PA | CI | Fear | Abn | EQ-5D | Paid work | Unpaid work | Other |
| **Dependent variable: Change in frailty (0-100); N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 39093.0 | 39308.5 | Gr | ˟ | ˟ | ˟ | ˟ | Cat |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 39083.9 | 39265.7 | Int | ˟ | ˟ | ˟ | ˟ | Cat |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 39085.9 | 39274.5 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 39002.4 | 39170.7 | Int | ˟ | ˟ | ˟ | ˟ | Sc |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 39002.1 | 39177.2 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 39006.1 | 39161.0 | Int | ˟ |  | ˟ | ˟ | Sc |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 38999.0 | 39140.4 | Int | ˟ | ˟ | ˟ |  | Sc |  | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 38997.4 | 39132.0 | Int | ˟ | ˟ | ˟ |  | Sc |  | ˟ | ˟ |  | ˟ |  |  |  | C;S;O;I |
| 9 | 38996.8 | 39124.7 | Int | ˟ | ˟ | ˟ |  | Sc |  | ˟ | ˟ |  |  |  |  |  | C;S;O;I |
| 10 | 38994.3 | 39102.1 | Int | ˟ | ˟ | ˟ |  | Sc |  | ˟ | ˟ |  |  |  |  |  | S;I |
| 11 | 38994.9 | 39095.9 | Int |  | ˟ | ˟ |  | Sc |  | ˟ | ˟ |  |  |  |  |  | S;I |
| **Dependent variable: High physical activity in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 4322.2 | 4537.7 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 4310.9 | 4492.7 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 4312.9 | 4501.4 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 4308.0 | 4476.3 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 4308.7 | 4483.8 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 4302.8 | 4444.2 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 4300.7 | 4415.2 | Int | ˟ | ˟ |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 4298.8 | 4406.5 | Int | ˟ | ˟ |  |  | Sc | ˟ | ˟ |  | ˟ | ˟ |  |  |  | C;S;O;I |
| 9 | 4297.0 | 4398.0 | Int | ˟ | ˟ |  |  | Sc | ˟ | ˟ |  |  | ˟ |  |  |  | C;S;O;I |
| 10 | 4297.9 | 4365.2 | Int | ˟ | ˟ |  |  | Sc | ˟ | ˟ |  |  | ˟ |  |  |  | I |
| 11 | 4305.6 | 4352.7 | Int | ˟ |  |  |  | Sc | ˟ | ˟ |  |  | ˟ |  |  |  | I |
| **Dependent variable: Cognitive impairment in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 5455.1 | 5684.0 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 5445.0 | 5640.3 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 5443.6 | 5645.6 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 5438.2 | 5620.0 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 5438.9 | 5627.4 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| # | AIC | BIC | W4 age | Sex | SDQ | Falls inc | Falls hist | W4 frailty | Frailty change | High  PA | CI | Fear | Abn | EQ-5D | Paid work | Unpaid work | Other |
| 6 | 5434.9 | 5589.7 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 5429.1 | 5557.0 | Int | ˟ | ˟ |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 5428.5 | 5536.3 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 9 | 5428.7 | 5529.6 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 10 | 5426.8 | 5521.1 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ |  | ˟ |  |  |  | C;S;O;I |
| 11 | 5423.6 | 5497.6 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ |  | ˟ |  |  |  | O;I |
| 12 | 5424.8 | 5492.1 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ |  |  |  |  |  | O;I |
| **Dependent variable: Abnormal gait/balance in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 3972.9 | 4188.3 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 3969.6 | 4151.4 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 3965.0 | 4153.5 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 3904.1 | 4072.4 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 3905.8 | 4080.9 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 3899.2 | 4047.3 | Int | ˟ |  | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 3894.8 | 4016.0 | Int | ˟ |  | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 3891.9 | 3992.9 | Int | ˟ |  | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | O |
| 9 | 3896.2 | 3970.3 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | O |
| **Dependent variable: GP routine contact in Wave 5; N=6,094** | | | | | | | | | | | | | | | | | |
| 1 | 4529.5 | 4751.1 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 2 | 4572.4 | 4760.5 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 3 | 4527.8 | 4722.5 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 4 | 4515.9 | 4697.2 | Int^2 | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 5 | 4477.2 | 4665.3 | Int^2 | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 6 | 4476.6 | 4637.8 | Int^2 | ˟ | ˟ | ˟ |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 7 | 4476.8 | 4631.3 | Int^2 | ˟ | ˟ | ˟ |  | Sc^2 | ˟ |  | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;G |
| 8 | 4476.2 | 4623.9 | Int^2 | ˟ | ˟ | ˟ |  | Sc^2 | ˟ |  | ˟ |  | ˟ |  |  |  | C;S;O;I;G |
| 9 | 4470.3 | 4597.9 | Int^2 | ˟ | ˟ | ˟ |  | Sc^2 | ˟ |  | ˟ |  | ˟ |  |  |  | S;I;G |
| 10 | 4471.8 | 4579.3 | Int^2 | ˟ |  | ˟ |  | Sc^2 | ˟ |  | ˟ |  | ˟ |  |  |  | S;I;G |
| **Dependent variable: Self-referred exercise demand in Wave 5; N=6,094** | | | | | | | | | | | | | | | | | |
| 1 | 3784.6 | 4006.8 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 2 | 3781.6 | 3970.1 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| # | AIC | BIC | W4 age | Sex | SDQ | Falls inc | Falls hist | W4 frailty | Frailty change | High  PA | CI | Fear | Abn | EQ-5D | Paid work | Unpaid work | Other |
| 3 | 3782.6 | 3977.9 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 4 | 3773.1 | 3948.1 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 5 | 3767.0 | 3948.8 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 6 | 3771.6 | 3926.5 | Int | ˟ | ˟ | ˟ |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 7 | 3772.3 | 3906.9 | Int | ˟ |  | ˟ |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 8 | 3770.7 | 3898.6 | Int | ˟ |  | ˟ |  | Sc^2 | ˟ | ˟ |  | ˟ | ˟ |  |  |  | C;S;O;I;F |
| 9 | 3770.2 | 3891.4 | Int | ˟ |  | ˟ |  | Sc^2 | ˟ | ˟ |  |  | ˟ |  |  |  | C;S;O;I;F |
| 10 | 3767.0 | 3861.2 | Int | ˟ |  | ˟ |  | Sc^2 | ˟ | ˟ |  |  | ˟ |  |  |  | O;F |
| 11 | 3775.2 | 3842.5 | Int | ˟ |  |  |  | Sc^2 | ˟ | ˟ |  |  | ˟ |  |  |  | O;F |
| **Dependent variable: Change in EQ-5D between Waves 4-5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | -3064.7 | -2835.8 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | Sc |  |  | C;S;O;I |
| 2 | -3079.1 | -2883.8 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | Sc |  |  | C;S;O;I |
| 3 | -3078.3 | -2876.3 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | Sc |  |  | C;S;O;I |
| 4 | -3217.4 | -3035.6 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ | Sc |  |  | C;S;O;I |
| 5 | -3218.4 | -3029.9 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ | Sc |  |  | C;S;O;I |
| 6 | -3237.5 | -3049.0 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ | Sc^2 |  |  | C;S;O;I |
| 7 | -3241.1 | -3079.5 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ | Sc^2 |  |  | C;S;O;I |
| 8 | -3242.9 | -3088.1 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ |  | ˟ | ˟ | ˟ | Sc^2 |  |  | C;S;O;I |
| 9 | -3244.9 | -3096.8 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ |  |  | ˟ | ˟ | Sc^2 |  |  | C;S;O;I |
| 10 | -3246.6 | -3105.2 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ |  |  |  | ˟ | Sc^2 |  |  | C;S;O;I |
| 11 | -3251.1 | -3143.4 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ |  |  |  | ˟ | Sc^2 |  |  |  |
| 12 | -3234.9 | -3154.1 | Int | ˟ | ˟ |  |  | Sc | ˟ |  |  |  | ˟ | Sc^2 |  |  |  |
| **Dependent variable: Paid employment in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 2705.8 | 2934.7 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 2 | 2693.8 | 2889.1 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 3 | 2693.3 | 2895.3 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 4 | 2691.2 | 2873 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 5 | 2693.1 | 2881.6 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 6 | 2692.7 | 2847.5 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 7 | 2691.1 | 2825.7 | Int | ˟ |  | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| # | AIC | BIC | W4 age | Sex | SDQ | Falls inc | Falls hist | W4 frailty | Frailty change | High  PA | CI | Fear | Abn | EQ-5D | Paid work | Unpaid work | Other |
| 8 | 2700.8 | 2808.5 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 9 | 2699.0 | 2800.0 | Int | ˟ |  |  |  | Sc | ˟ |  | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 10 | 2697.2 | 2791.4 | Int | ˟ |  |  |  | Sc | ˟ |  |  | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 11 | 2697.7 | 2785.2 | Int | ˟ |  |  |  | Sc | ˟ |  |  |  | ˟ |  | ˟ | ˟ | C;S;O;I |
| 12 | 2695.7 | 2776.5 | Int | ˟ |  |  |  | Sc | ˟ |  |  |  |  |  | ˟ | ˟ | C;S;O;I |
| 13 | 2694.5 | 2768.5 | Int | ˟ |  |  |  | Sc | ˟ |  |  |  |  |  | ˟ |  | C;S;O;I |
| 14 | 2693.2 | 2733.5 | Int | ˟ |  |  |  | Sc | ˟ |  |  |  |  |  | ˟ |  |  |
| **Dependent variable: Unpaid work in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 5027.4 | 5256.3 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 2 | 5030.9 | 5226.2 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 3 | 5023.7 | 5225.7 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 4 | 5018.2 | 5206.7 | Int^2 | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 5 | 5020.2 | 5215.4 | Int^2 | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 6 | 5011.4 | 5173.0 | Int^2 | ˟ | ˟ | ˟ |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 7 | 5010.6 | 5145.3 | Int^2 | ˟ | ˟ |  |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 8 | 5011.0 | 5139.0 | Int^2 | ˟ | ˟ |  |  | Sc^2 | ˟ |  | ˟ | ˟ | ˟ |  | ˟ | ˟ | C;S;O;I |
| 9 | 5009.1 | 5130.3 | Int^2 | ˟ | ˟ |  |  | Sc^2 | ˟ |  | ˟ |  | ˟ |  | ˟ | ˟ | C;S;O;I |
| 10 | 5007.6 | 5122.0 | Int^2 | ˟ | ˟ |  |  | Sc^2 | ˟ |  | ˟ |  | ˟ |  |  | ˟ | C;S;O;I |
| 11 | 5004.2 | 5091.7 | Int^2 | ˟ | ˟ |  |  | Sc^2 | ˟ |  | ˟ |  | ˟ |  |  | ˟ |  |
| **Dependent variable: Change in CASP-19 between Waves 4-5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | -9682.5 | -9473.8 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 2 | -9681.8 | -9506.7 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 3 | -9680.4 | -9498.6 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 4 | -9682.3 | -9514.0 |  | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 5 | -9683.0 | -9521.4 |  |  | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 6 | -9675.9 | -9534.5 |  |  |  | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 7 | -9718.7 | -9570.6 |  |  | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 8 | -9732.1 | -9577.2 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 9 | -9733.1 | -9585.0 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ |  | ˟ | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 10 | -9734.2 | -9592.8 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ |  |  | ˟ | CASP | ˟ | ˟ | C;S;O;I |
| 11 | -9735.5 | -9600.8 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ |  |  |  | CASP | ˟ | ˟ | C;S;O;I |
| # | AIC | BIC | W4 age | Sex | SDQ | Falls inc | Falls hist | W4 frailty | Frailty change | High  PA | CI | Fear | Abn | EQ-5D | Paid work | Unpaid work | Other |
| 12 | -9737.4 | -9609.5 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ |  |  |  | CASP |  | ˟ | C;S;O;I |
| 13 | -9738.7 | -9617.5 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ |  |  |  | CASP |  |  | C;S;O;I |
| 14 | -9741.2 | -9646.9 |  |  | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ |  |  |  | CASP |  |  |  |
| 15 | -9735.7 | -9661.6 |  |  |  | ˟ | ˟ | Sc^2 | ˟ | ˟ |  |  |  | CASP |  |  |  |
| **Dependent variable: OOP care receipt in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 1459.6 | 1681.8 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 1455.0 | 1643.5 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 1456.7 | 1652.0 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 1459.3 | 1634.3 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 1441.3 | 1623.1 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 1436.2 | 1591.1 | Int | ˟ | ˟ | ˟ |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 1433.5 | 1561.4 | Int | ˟ | ˟ |  |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 1432.4 | 1553.6 | Int | ˟ | ˟ |  |  | Sc^2 | ˟ | ˟ |  | ˟ | ˟ |  |  |  | C;S;O;I |
| 9 | 1426.4 | 1520.6 | Int | ˟ | ˟ |  |  | Sc^2 | ˟ | ˟ |  | ˟ | ˟ |  |  |  | O;I |
| 10 | 1426.8 | 1515.3 | Int | ˟ | ˟ |  |  | Sc^2 | ˟ | ˟ |  | ˟ |  |  |  |  | O;I |
| **Dependent variable: Informal care receipt in Wave 5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 4892.7 | 5121.6 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 4888.6 | 5083.9 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 4887.3 | 5089.3 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 4887.0 | 5075.6 |  | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 4831.4 | 5006.5 |  | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 4811.6 | 4993.4 |  | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 4810.1 | 4965.0 |  | ˟ | ˟ | ˟ |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 4804.0 | 4931.9 |  | ˟ | ˟ |  |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 9 | 4804.7 | 4912.4 |  | ˟ |  |  |  | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 10 | 4804.8 | 4905.8 |  | ˟ |  |  |  | Sc^2 | ˟ |  | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 11 | 4803.5 | 4897.8 |  | ˟ |  |  |  | Sc^2 | ˟ |  |  | ˟ | ˟ |  |  |  | C;S;O;I |
| 12 | 4801.5 | 4889.1 |  | ˟ |  |  |  | Sc^2 | ˟ |  |  |  | ˟ |  |  |  | C;S;O;I |
| 13 | 4798.9 | 4873.0 |  | ˟ |  |  |  | Sc^2 | ˟ |  |  |  | ˟ |  |  |  | S;O;I |
| **Dependent variable: Multiple informal care needs given any informal care receipt in Wave 5; N=1,615** | | | | | | | | | | | | | | | | | |
| 1 | 1676.2 | 1859.4 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| # | AIC | BIC | W4 age | Sex | SDQ | Falls inc | Falls hist | W4 frailty | Frailty change | High  PA | CI | Fear | Abn | EQ-5D | Paid work | Unpaid work | Other |
| 2 | 1673.8 | 1830.0 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 1675.3 | 1836.9 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 1671.8 | 1822.6 |  | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 1649.2 | 1789.3 |  | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 1650.8 | 1796.2 |  | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 1648.7 | 1767.2 |  | ˟ | ˟ | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 1644.9 | 1741.8 |  | ˟ | ˟ |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 9 | 1645.0 | 1736.5 |  |  | ˟ |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 10 | 1643.7 | 1719.1 |  |  |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 11 | 1641.7 | 1711.8 |  |  |  |  |  | Sc | ˟ |  | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 12 | 1638.8 | 1687.3 |  |  |  |  |  | Sc | ˟ |  | ˟ | ˟ | ˟ |  |  |  | C;O;I |
| 13 | 1640.6 | 1683.7 |  |  |  |  |  | Sc | ˟ |  | ˟ |  | ˟ |  |  |  | C;O;I |
| 14 | 1642.1 | 1679.8 |  |  |  |  |  | Sc | ˟ |  |  |  | ˟ |  |  |  | C;O;I |
| **Dependent variable: New LTC admission between Waves 4-5; N=6,205** | | | | | | | | | | | | | | | | | |
| 1 | 318.9 | 541.1 | Gr | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 2 | 315.5 | 504.1 | Int | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 3 | 317.3 | 512.6 | Int^2 | ˟ | ˟ | ˟ | ˟ | Cat | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 4 | 318.4 | 493.5 | Int | ˟ | ˟ | ˟ | ˟ | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 5 | 316.6 | 498.6 | Int | ˟ | ˟ | ˟ | ˟ | Sc^2 | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 6 | 315.2 | 463.3 | Int | ˟ | ˟ | ˟ |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 7 | 314.2 | 435.4 | Int | ˟ | ˟ |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 8 | 313.4 | 414.4 | Int | ˟ |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 9 | 311.6 | 405.9 | Int |  |  |  |  | Sc | ˟ | ˟ | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 10 | 309.7 | 397.2 | Int |  |  |  |  | Sc | ˟ |  | ˟ | ˟ | ˟ |  |  |  | C;S;O;I |
| 11 | 308.9 | 389.7 | Int |  |  |  |  | Sc | ˟ |  | ˟ |  | ˟ |  |  |  | C;S;O;I |
| 12 | 307.4 | 381.4 | Int |  |  |  |  | Sc | ˟ |  | ˟ |  |  |  |  |  | C;S;O;I |
| 13 | 304.9 | 365.5 | Int |  |  |  |  | Sc | ˟ |  | ˟ |  |  |  |  |  | C;S;O;I |
| 14 | 305.1 | 359.0 | Int |  |  |  |  |  | ˟ |  | ˟ |  |  |  |  |  | C;S;O;I |
| **Abbreviation:** AIC: Akaike information criterion; BIC: Bayesian information criterion; W4: ELSA Wave 4; Gr: 5-year age group; Int: age in integer; Int^2: including integer age squared; SDQ: social deprivation quartile; Falls inc: falls incidence between Waves 4-5; Falls hist: falls history in Wave 4; Cat: frailty category; Sc: frailty/EQ-5D score; Sc^2: including frailty/EQ-5D score squared; PA: physical activity; CI: cognitive impairment; Fear: fear of falling; Abn: abnormal gait/balance; C: community healthcare; S: social care; O: out-of-pocket care; I: informal care; G: GP contact in W4; F: falls exercise in W4; OOP: out-of-pocket.  **Note:** Best-fit model for each dependent variable is highlighted in yellow. Covariates not available as options for the given dependent variable are highlighted in grey. | | | | | | | | | | | | | | | | | |

## Prospective estimations for dynamic transitions

As mentioned in Section 5.2.6.3, only covariates which had strong ‘memories’ – i.e., where its ELSA Wave 4 value significantly influences the value taken in Wave 5 – are estimated prospectively. The results of estimation for high physical activity, self-referred exercise demand and change in EQ-5D were reported in Section 5.2.6.3 as illustrations. Other estimated covariates and outcomes are: (1) cognitive impairment; (2) abnormal gait and balance; (3) GP routine contact; (4) paid employment; (5) unpaid work status; (6) out-of-pocket care receipt; and (7) informal care receipt.

A notable exclusion is fear of falling which did not have a statistically significant association between Waves 4 and 5 values. This is likely due to the Wave 5 values already being imputed from the Wave 4 values and hence the ability of Wave 4 values to explain further variations in Wave 5 values has been exhausted. Fear of falling was hence updated using a modified form of the equation in Table 5.10. Access parameters other than GP routine contact and self-referred exercise demand were similarly updated cross-sectionally. These included reactive intervention access under UC (average 28.7% and stratified by frailty), proactive falls risk screening under UC (average 4.7% and stratified by frailty), proactive intervention access under UC (average 33.5% and stratified by frailty), and self-referred exercise access under UC (0.1% of those in most privileged quartile). The demand parameters for reactive and proactive multifactorial interventions under RC (taken from RCTs) were also assumed not to vary over time. The following outcomes were similarly updated cross-sectionally: primary and secondary healthcare costs – stratified by frailty; community healthcare (district nursing) receipt – stratified by frailty and cognitive status; and short-term social care receipt – stratified by frailty and cognitive status. Table E12 contains the results of model fit comparisons using AIC and BIC.

### Cognitive impairment

The proportion of ELSA population aged 60+ who were cognitively impaired *decreased* from 20.5% in ELSA Wave 4 to 19.7% in Wave 5. This can be attributed to the higher attrition between Waves for those who were cognitively impaired at Wave 4: the attrition rate was 22.4% for those with impairment and 12.4% among those without. Table E13 shows the coefficient estimates from the best-fit logistic regression for cognitive impairment in Wave 5.

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| **Table E13** Logistic regression coefficients for cognitive impairment in ELSA Wave 5. | | |
| ***Dependent variable: Cognitive impairment in Wave 5 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -5.265 (0.339) | <0.001 |
| Age W4 | 0.050 (0.005) | <0.001 |
| Female | -0.192 (0.070) | 0.006 |
| Frailty W4 (0-100) | 0.012 (0.005) | 0.012 |
| Change in frailty1 | 0.021 (0.005) | <0.001 |
| High physical activity W4 | -0.377 (0.107) | <0.001 |
| Cognitive impairment W4 | 1.347 (0.075) | <0.001 |
| Abnormal gait/balance W4 | 0.194 (0.093) | 0.037 |
| OOP care receipt W4 | -0.574 (0.193) | 0.003 |
| Informal care receipt W4 | 0.304 (0.091) | 0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; OOP: out-of-pocket; Ref: reference; SE: standard error; W4: ELSA Wave 4; W5: ELSA Wave 5  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### Abnormal gait and balance

Like cognitive impairment, the proportion of those who had abnormal gait/balance decreased from 28.0% in Wave 4 to 27.9% in Wave 5 despite the increase in age. This may again be attributed to the higher attrition among those with abnormal gait/balance in Wave 4: the attrition rate was 21.9% among those with abnormal gait/balance, compared to 11.6% among those without. Table E14 shows the coefficient estimates from the best-fit logistic regression.

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| **Table E14** Logistic regression coefficients for abnormal gait/balance in ELSA Wave 5. | | |
| ***Dependent variable: Abnormal gait/balance in Wave 5 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -6.773 (0.419) | <0.001 |
| Age W4 | 0.044 (0.006) | <0.001 |
| Female | -0.273 (0.085) | 0.001 |
| Falls incidence W5 (ref: No fall incidence) |  |  |
| *Single non-MA fall* | 0.085 (0.129) | 0.508 |
| *Recurrent non-MA falls* | 0.320 (0.143) | 0.026 |
| *Single MA fall* | 0.520 (0.180) | 0.004 |
| *Recurrent falls with MA* | 0.291 (0.224) | 0.195 |
| Frailty W4 (0-100) | 0.140 (0.007) | <0.001 |
| Change in frailty1 | 0.196 (0.008) | <0.001 |
| High physical activity W4 | -0.346 (0.132) | 0.009 |
| Cognitive impairment W4 | 0.267 (0.104) | 0.010 |
| Fear of falling W4 | 0.633 (0.183) | 0.001 |
| Abnormal gait/balance W4 | 1.767 (0.099) | <0.001 |
| OOP care receipt W4 | 0.532 (0.226) | 0.019 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; OOP: out-of-pocket; Ref: reference; SE: standard error; W4: ELSA Wave 4; W5: ELSA Wave 5  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### GP routine contact

The proportion of the population that received a routine GP contact in the past year was 81.3% in ELSA Wave 4 and 84.0% in Wave 5. The higher proportion in Wave 5 is consistent with the older age profile in Wave 5. Table E15 shows the coefficient estimates from the best-fit logistic regression. MA fallers in Wave 5 who are assumed to have received the reactive intervention were excluded from the analysis sample.

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| **Table E15** Logistic regression coefficients for GP routine contact in ELSA Wave 5. | | |
| ***Dependent variable: GP routine contact in Wave 5 (N=6,094)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -20.065 (3.041) | <0.001 |
| Age W4 | 0.568 (0.085) | <0.001 |
| Age^2 W4 | -0.004 (0.0006) | <0.001 |
| Female | -0.192 (0.079) | 0.015 |
| Falls incidence W5 (ref: No fall incidence) |  |  |
| *Single non-MA fall* | 0.269 (0.127) | 0.034 |
| *Recurrent non-MA falls* | 0.491 (0.165) | 0.003 |
| *Single MA fall* | 0.973 (0.247) | <0.001 |
| *Recurrent falls with MA* | 0.933 (0.364) | 0.010 |
| Frailty W4 (0-100) | 0.132 (0.013) | <0.001 |
| Frailty^2 W4 | -0.002 (0.0003) | <0.001 |
| Change in frailty1 | 0.038 (0.008) | <0.001 |
| Cognitive impairment W4 | -0.692 (0.095) | <0.001 |
| Abnormal gait/balance W4 | -0.329 (0.121) | 0.007 |
| Social care receipt W4 | -0.785 (0.302) | 0.009 |
| Informal care receipt W4 | -0.255 (0.120) | 0.034 |
| GP routine contact W4 | 1.799 (0.081) | <0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; Ref: reference; SE: standard error; W4: ELSA Wave 4; W5: ELSA Wave 5  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### Paid employment

There was an observable decline in the proportion of the older population who were in paid employment between ELSA Waves from 19.4% in Wave 4 to 15.4% in Wave 5. Table E16 shows the coefficient estimates from the best-fit logistic regression.

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| **Table E16** Logistic regression coefficients for paid employment in ELSA Wave 5. | | |
| ***Dependent variable: Paid employment in Wave 5 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | 1.819 (0.703) | 0.010 |
| Age W4 | -0.066 (0.010) | <0.001 |
| Female | -0.220 (0.102) | 0.032 |
| Frailty W4 (0-100) | -0.043 (0.009) | <0.001 |
| Change in frailty1 | -0.035 (0.011) | 0.001 |
| Paid employment W4 | 3.757 (0.116) | <0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; OOP: out-of-pocket; Ref: reference; SE: standard error; W4: ELSA Wave 4; W5: ELSA Wave 5  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### Unpaid work

There was a slight increase in the proportion of the older population being regularly engaged in unpaid work between ELSA Waves from 27.4% in Wave 4 to 28.6% in Wave 5. This may be attributed to the increases in age and the proportion of women in the population, both of which are associated with greater propensity to engage in unpaid work. Table E17 shows the coefficient estimates from the best-fit logistic regression.

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| **Table E17** Logistic regression coefficients for unpaid work in ELSA Wave 5. | | |
| ***Dependent variable: Unpaid work in Wave 5 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -12.856 (2.951) | <0.001 |
| Age W4 | 0.331 (0.083) | <0.001 |
| Age^2 W4 | -0.002 (0.0006) | <0.001 |
| Female | 0.313 (0.065) | <0.001 |
| SES (ref: Most privileged quartile) |  |  |
| *2nd quartile* | -0.266 (0.095) | 0.005 |
| *3rd quartile* | -0.233 (0.080) | 0.004 |
| *Most deprived quartile* | -0.236 (0.098) | 0.016 |
| Frailty W4 (0-100) | -0.013 (0.005) | 0.010 |
| Change in frailty1 | -0.012 (0.006) | 0.039 |
| Cognitive impairment W4 | -0.379 (0.091) | <0.001 |
| Abnormal gait/balance W4 | -0.299 (0.097) | 0.002 |
| Unpaid work W4 | 1.944 (0.065) | <0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; Ref: reference; SE: standard error; SES: socioeconomic status; W4: ELSA Wave 4; W5: ELSA Wave 5  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### Change in CASP-19

The average change in CASP-19 between Waves 4-5 was -0.005. Table E18 shows the coefficient estimates from the best-fit linear regression for between-wave CASP-19 change.

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| **Table E18** Linear regression coefficients for change in CASP-19 between ELSA Waves 4 and 5. | | |
| ***Dependent variable: Change in CASP-19 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | 0.421 (0.010) | <0.001 |
| SES (ref: Most privileged quartile) |  |  |
| *2nd quartile* | -0.001 (0.004) | 0.894 |
| *3rd quartile* | -0.005 (0.004) | 0.136 |
| *Most deprived quartile* | -0.014 (0.004) | 0.002 |
| Falls incidence W5 (ref: No fall incidence) |  |  |
| *Single non-MA fall* | -0.009 (0.004) | 0.039 |
| *Recurrent non-MA falls* | -0.021 (0.005) | <0.001 |
| *Single MA fall* | -0.008 (0.007) | 0.228 |
| *Recurrent falls with MA* | -0.024 (0.008) | 0.003 |
| Frailty W4 (0-100) | -0.005 (0.0004) | <0.001 |
| Frailty^2 W4 | 0.0001 (<0.0001) | 0.001 |
| Change in frailty1 | -0.005 (0.0002) | <0.001 |
| High physical activity W4 | 0.011 (0.004) | 0.003 |
| CASP-19 W4 | -0.495 (0.011) | <0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; Ref: reference; SE: standard error; SES: socioeconomic status; W4: ELSA Wave 4; W5: ELSA Wave 5  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### OOP care receipt

The proportion of the older population regularly receiving OOP care increased slightly from 3.4% in ELSA Wave 4 to 3.7% in Wave 5. Table E19 shows the coefficient estimates from the best-fit logistic regression.

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| **Table E19** Logistic regression coefficients for out-of-pocket care receipt in ELSA Wave 5. | | |
| ***Dependent variable: OOP care receipt in Wave 5 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -10.011 (0.763) | <0.001 |
| Age W4 | 0.051 (0.010) | <0.001 |
| Female | 0.712 (0.172) | <0.001 |
| SES (ref: Most privileged quartile) |  |  |
| *2nd quartile* | -0.485 (0.227) | 0.033 |
| *3rd quartile* | -0.698 (0.193) | <0.001 |
| *Most deprived quartile* | -1.117 (0.247) | <0.001 |
| Frailty W4 (0-100) | 0.174 (0.027) | <0.001 |
| Frailty^2 W4 | -0.002 (0.0005) | <0.001 |
| Change in frailty1 | 0.063 (0.010) | <0.001 |
| High physical activity W4 | -0.954 (0.435) | 0.028 |
| Fear of falling W4 | 0.659 (0.197) | 0.001 |
| OOP care receipt W4 | 1.851 (0.193) | <0.001 |
| Informal care receipt W4 | -0.579 (0.181) | 0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; Ref: reference; SE: standard error; SES: socioeconomic status; W4: ELSA Wave 4; W5: ELSA Wave 5; OOP: out-of-pocket  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

### Informal care receipt

The proportion of the older population regularly receiving any informal care increased from 24.9% in ELSA Wave 4 to 26.0% in Wave 5. Table E20 shows the coefficient estimates from the best-fit logistic regression.

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| **Table E20** Logistic regression coefficients for informal care receipt in ELSA Wave 5. | | |
| ***Dependent variable: Informal care receipt in Wave 5 (N=6,205)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -4.120 (0.161) | <0.001 |
| Female | 0.385 (0.076) | <0.001 |
| Frailty W4 (0-100) | 0.147 (0.013) | <0.001 |
| Frailty^2 W4 | -0.001 (0.0003) | <0.001 |
| Change in frailty1 | 0.104 (0.006) | <0.001 |
| Abnormal gait/balance W4 | 0.309 (0.095) | 0.001 |
| Social care receipt W4 | -0.657 (0.285) | 0.021 |
| OOP care receipt W4 | -0.526 (0.187) | 0.005 |
| Informal care receipt W4 | 1.389 (0.093) | <0.001 |
| Multiple informal care needs W4 | 0.724 (0.145) | <0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; Ref: reference; SE: standard error; W4: ELSA Wave 4; W5: ELSA Wave 5; OOP: out-of-pocket  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

There was an observable decrease in the proportion of those who received informal care for multiple care needs between ELSA Waves. In Wave 4, 45.5% of those who received any informal care received it for multiple needs, while in Wave 5, the proportion was 38.8%. This could be attributed to the higher attrition among those who received informal care for multiple needs in Wave 4: the attrition rate was 25.7% among those who received care for multiple needs and 17.2% among those who received care for a single need. Table E21 shows the coefficient estimates from the best-fit logistic regression. The sample is restricted to those who received any informal care.

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| **Table E21** Logistic regression coefficients for multiple informal care needs given informal care receipt in ELSA Wave 5. | | |
| ***Dependent variable: Multiple informal care needs given informal care receipt in Wave 5 (N=1,615)*** | | |
| **Explanatory variables** | **Coefficient (SE)** | **P-value** |
| Constant | -2.620 (0.165) | <0.001 |
| Frailty W4 (0-100) | 0.060 (0.008) | <0.001 |
| Change in frailty1 | 0.127 (0.009) | <0.001 |
| Cognitive impairment W4 | 0.269 (0.145) | 0.064 |
| Abnormal gait/balance W4 | 0.551 (0.146) | <0.001 |
| Community healthcare receipt W4 | -1.364 (0.694) | 0.049 |
| OOP care receipt W4 | -0.696 (0.262) | 0.008 |
| Multiple informal care needs W4 | 1.741 (0.159) | <0.001 |
| **Abbreviation:** ELSA: English Longitudinal Study of Ageing; MA fall: fall requiring medical attention; Ref: reference; SE: standard error; W4: ELSA Wave 4; W5: ELSA Wave 5; OOP: out-of-pocket  1 Covariate included in logistic regression is biannual change in frailty measured in ELSA. In model simulation, the annualized change in frailty is used instead to predict dependent variable. | | |

## Variance-covariance matrices for multivariate regressions

### Baseline variables

Tables E22.1-E22.13 show variance-covariance matrices for baseline variables, namely: high physical activity; cognitive impairment; fear of falling; abnormal gait/balance; EQ-5D; paid employment; unpaid work; CASP-19; out-of-pocket care receipt; informal care receipt; multiple informal care needs; GP routine contact; and self-referred exercise uptake.

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| **Table E22.1** Variance-covariance matrix for baseline high physical activity logistic regression (Table 5.8). | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Frailty | Constant |
| Age | 0.004883 |  |  |  |  |  |  |  |
| Age^2 | -3.4E-05 | 2.41E-07 |  |  |  |  |  |  |
| Sex | 6.88E-05 | -4.14E-07 | 0.002362 |  |  |  |  |  |
| SES2 | 2.46E-05 | -2.32E-07 | -5.6E-05 | 0.004251 |  |  |  |  |
| SES3 | 1.83E-05 | -1.18E-07 | -0.00016 | 0.001317 | 0.003507 |  |  |  |
| SES4 | -2.6E-05 | 2.87E-07 | -0.00016 | 0.001325 | 0.001377 | 0.008315 |  |  |
| Frailty | 1.09E-05 | -1.12E-07 | -1.4E-05 | -7.35E-06 | -2.2E-05 | -5.1E-05 | 1.85E-05 |  |
| Constant | -0.1726 | 0.001207 | -0.00605 | -0.00176 | -0.0016 | -0.00028 | -0.00033 | 6.123589 |
| **Abbreviation:** SES: socioeconomic status. | | | | | | | | |

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| **Table E22.2** Variance-covariance matrix for baseline cognitive impairment logistic regression (Table 5.9). | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Frailty | High PA | Constant |
| Age | 0.002376 |  |  |  |  |  |  |  |  |
| Age^2 | -1.6E-05 | 1.07E-07 |  |  |  |  |  |  |  |
| Sex | 9.07E-05 | -6.42E-07 | 0.002044 |  |  |  |  |  |  |
| SES2 | -6.9E-05 | 4.55E-07 | -8.5E-05 | 0.003801 |  |  |  |  |  |
| SES3 | -0.00011 | 7.75E-07 | -0.00017 | 0.00145 | 0.003047 |  |  |  |  |
| SES4 | -0.00016 | 1.25E-06 | -0.00017 | 0.00146 | 0.001529 | 0.005512 |  |  |  |
| Frailty | 5.39E-06 | -5.21E-08 | -9.94E-06 | -4.21E-06 | -1.2E-05 | -2.5E-05 | 5.06E-06 |  |  |
| High PA | 7.73E-05 | -4.01E-07 | 0.000155 | 7.37E-05 | 0.000136 | 0.000222 | 2.95E-05 | 0.004941 |  |
| Constant | -0.08755 | 0.000586 | -0.00601 | 0.001331 | 0.002524 | 0.004001 | -0.00017 | -0.00486 | 3.241771 |
| **Abbreviation:** PA: physical activity; SES: socioeconomic status. | | | | | | | | | |

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| **Table E22.3** Variance-covariance matrix for baseline fear of falling logistic regression (Table 5.10). | | | | | | | | | |
|  | Age | Sex | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | Constant |
| Age | 2.18E-05 |  |  |  |  |  |  |  |  |
| Sex | -1.8E-05 | 0.006321 |  |  |  |  |  |  |  |
| Falls hist1 | 2.67E-06 | 1.24E-05 | 0.012849 |  |  |  |  |  |  |
| Falls hist2 | 4.76E-05 | 0.000468 | 0.003272 | 0.009938 |  |  |  |  |  |
| Falls hist3 | -1.6E-05 | -0.00034 | 0.003296 | 0.0032 | 0.019201 |  |  |  |  |
| Falls hist4 | 7.92E-07 | -0.00034 | 0.003245 | 0.003489 | 0.003263 | 0.019088 |  |  |  |
| Frailty | -1E-05 | 7.45E-06 | -3.8E-05 | -9E-05 | -2.2E-05 | -7.3E-05 | 0.000177 |  |  |
| Frailty^2 | 1.09E-07 | -3.23E-07 | 8.19E-07 | 6.90E-07 | 6.02E-07 | 1.39E-07 | -2.97E-06 | 5.39E-08 |  |
| Constant | -0.00145 | -0.00897 | -0.00317 | -0.00596 | -0.00139 | -0.00111 | -0.00143 | 2.61E-05 | 0.143834 |

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| **Table E22.4** Variance-covariance matrix for baseline abnormal gait/balance logistic regression (Table 5.11). | | | | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | High PA | Cogim | Fear | Constant |
| Age | 0.003652 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -2.5E-05 | 1.67E-07 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | 8.44E-05 | -6.07E-07 | 0.00284 |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -0.0001 | 7.21E-07 | -0.00015 | 0.005524 |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | -8.8E-05 | 7.14E-07 | -0.00023 | 0.002162 | 0.004236 |  |  |  |  |  |  |  |  |  |  |
| SES4 | -3.7E-05 | 5.44E-07 | -0.00023 | 0.002164 | 0.00225 | 0.006969 |  |  |  |  |  |  |  |  |  |
| Falls hist1 | 2.15E-06 | -7.27E-08 | -6E-05 | -0.00013 | 1.86E-05 | -5E-05 | 0.006817 |  |  |  |  |  |  |  |  |
| Falls hist2 | 0.000161 | -9.85E-07 | 6.64E-06 | 2.81E-05 | -4.66E-06 | 0.000117 | 0.001046 | 0.008092 |  |  |  |  |  |  |  |
| Falls hist3 | 2.54E-05 | -3.15E-07 | -0.00037 | 2.77E-05 | -8.80E-06 | 1.83E-05 | 0.001066 | 0.001124 | 0.014542 |  |  |  |  |  |  |
| Falls hist4 | 0.000124 | -8.41E-07 | -0.0002 | 0.000117 | 0.000177 | -7.9E-05 | 0.001085 | 0.001286 | 0.001219 | 0.021945 |  |  |  |  |  |
| Frailty | -1.2E-05 | 6.57E-08 | -2.3E-05 | 4.00E-06 | -1E-05 | -2.7E-05 | -5.64E-06 | -3.7E-05 | -5.87E-06 | -4.3E-05 | 1.43E-05 |  |  |  |  |
| High PA | -1.2E-05 | 2.35E-07 | 0.000269 | 0.000113 | 0.000178 | 0.000303 | -5.1E-05 | -4.7E-05 | -0.00017 | -5.2E-05 | 5.29E-05 | 0.007659 |  |  |  |
| Cogim | -3.7E-05 | 1.98E-07 | -0.00013 | 0.000114 | -1.6E-05 | 3.08E-05 | -0.00051 | -0.00114 | -0.00108 | -0.00134 | -7.2E-05 | 5.16E-05 | 0.010673 |  |  |
| Fear | 9.7E-05 | -8.86E-07 | 0.000194 | -0.0001 | -0.00012 | -0.00014 | 0.000114 | -2.1E-05 | 0.000182 | 2.21E-05 | -5.53E-06 | 0.000184 | 9.26E-05 | 0.003992 |  |
| Constant | -0.13362 | 0.000899 | -0.00679 | 0.001742 | 0.000905 | -0.00168 | -0.00053 | -0.00683 | -0.00046 | -0.00453 | 0.000317 | -0.00253 | 0.002387 | -0.0034 | 4.914181 |
| **Abbreviation:** Cogim: cognitive impairment; Fear: fear of falling; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | | | | |

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| **Table E22.5** Variance-covariance matrix for baseline EQ-5D linear regression (Table 5.14). | | | | | | | | | | | | | | |
|  | Age^2 | Sex | SES2 | SES3 | SES4 | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | Cogim | Abngaitbal | Constant |
| Age^2 | 2.98E-12 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -7.36E-11 | 1.26E-05 |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -9.90E-11 | -4.48E-07 | 2.36E-05 |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | 3.65E-10 | -9.93E-07 | 8.22E-06 | 1.85E-05 |  |  |  |  |  |  |  |  |  |  |
| SES4 | 1.13E-09 | -9.79E-07 | 8.32E-06 | 8.78E-06 | 0.000035 |  |  |  |  |  |  |  |  |  |
| Falls hist1 | -2.51E-10 | -4.42E-07 | -6.66E-07 | -4.63E-08 | -2.49E-07 | 3.27E-05 |  |  |  |  |  |  |  |  |
| Falls hist2 | 5.54E-10 | -1.61E-08 | 1.54E-07 | -4.02E-08 | 2.50E-07 | 4.70E-06 | 4.22E-05 |  |  |  |  |  |  |  |
| Falls hist3 | -5.87E-10 | -1.63E-06 | -1.93E-07 | -2.47E-07 | -1.58E-07 | 4.66E-06 | 5.28E-06 | 7.73E-05 |  |  |  |  |  |  |
| Falls hist4 | -1.57E-10 | -1.23E-06 | 3.28E-07 | 5.16E-07 | -6.20E-07 | 4.98E-06 | 7.50E-06 | 5.97E-06 | 0.000111 |  |  |  |  |  |
| Frailty | -2.01E-10 | -1.35E-07 | -5.94E-08 | -1.81E-07 | -3.71E-07 | -1.26E-07 | -2.29E-07 | -1.70E-07 | -1.48E-07 | 2.92E-07 |  |  |  |  |
| Frailty^2 | 2.53E-12 | 1.19E-09 | 1.08E-09 | 2.84E-09 | 5.40E-09 | 1.99E-09 | -6.52E-10 | 2.28E-09 | -4.66E-09 | -5.75E-09 | 1.40E-10 |  |  |  |
| Cogim | -1.11E-09 | 8.89E-07 | -5.40E-07 | -4.45E-07 | -4.66E-07 | 7.93E-07 | 2.76E-07 | 8.95E-07 | 1.34E-07 | -2.73E-09 | -1.69E-09 | 2.02E-05 |  |  |
| Abngaitbal | -1.16E-09 | 1.02E-06 | -8.05E-07 | -1.05E-06 | -1.52E-06 | -4.46E-07 | -1.68E-06 | -1.06E-06 | -1.45E-06 | -7.49E-07 | 2.56E-09 | -1.08E-06 | 2.61E-05 |  |
| Constant | -1.29E-08 | -1.7E-05 | -6.07E-06 | -6.62E-06 | -8.81E-06 | -1.06E-06 | -3.82E-06 | 2.97E-06 | 1.41E-06 | -6.35E-07 | 1.97E-08 | 1.19E-06 | 7.33E-06 | 0.000101 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; SES: socioeconomic status. | | | | | | | | | | | | | | |

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| **Table E22.6** Variance-covariance matrix for baseline paid employment logistic regression (Table 5.15). | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Frailty | Frailty^2 | High PA | Cogim | Constant |
| Age | 0.007238 |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -5.2E-05 | 3.68E-07 |  |  |  |  |  |  |  |  |  |
| Sex | 0.000343 | -2.23E-06 | 0.002784 |  |  |  |  |  |  |  |  |
| SES2 | 7.49E-05 | -5.67E-07 | -6.2E-05 | 0.005124 |  |  |  |  |  |  |  |
| SES3 | 6.14E-05 | -3.98E-07 | -0.0002 | 0.001632 | 0.003972 |  |  |  |  |  |  |
| SES4 | 0.000292 | -1.81E-06 | -0.00015 | 0.001662 | 0.001781 | 0.008957 |  |  |  |  |  |
| Frailty | -1.3E-05 | 4.71E-08 | -2.4E-05 | -2.3E-05 | -4.1E-05 | -9.4E-05 | 0.000121 |  |  |  |  |
| Frailty^2 | 1.44E-06 | -9.42E-09 | 7.83E-07 | 4.02E-07 | 2.30E-07 | 8.56E-07 | -3.97E-06 | 1.54E-07 |  |  |  |
| High PA | -6E-05 | 4.97E-07 | 0.000113 | 6.95E-05 | 0.000145 | 0.000223 | 8.16E-05 | -1.25E-06 | 0.003758 |  |  |
| Cogim | 0.00012 | -1.06E-06 | 0.000287 | -0.00017 | -0.00019 | -0.00029 | 1.01E-05 | -7.45E-07 | 0.00015 | 0.00562 |  |
| Constant | -0.25259 | 0.001792 | -0.01678 | -0.00382 | -0.00336 | -0.01212 | 0.000102 | -3.8E-05 | 4.22E-05 | -0.00438 | 8.850125 |
| **Abbreviation:** Cogim: cognitive impairment; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | |

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| **Table E22.7** Variance-covariance matrix for baseline unpaid work logistic regression (Table 5.16). | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Frailty^2 | High PA | Cogim | Abngaitbal | Paid emp | Constant |
| Age | 0.002694 |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -1.8E-05 | 1.27E-07 |  |  |  |  |  |  |  |  |  |  |
| Sex | 0.000141 | -9.41E-07 | 0.001645 |  |  |  |  |  |  |  |  |  |
| SES2 | -2.7E-05 | 1.54E-07 | -6.4E-05 | 0.002913 |  |  |  |  |  |  |  |  |
| SES3 | -6.6E-05 | 4.71E-07 | -0.00015 | 0.000996 | 0.00233 |  |  |  |  |  |  |  |
| SES4 | -0.00011 | 8.55E-07 | -0.00016 | 0.001004 | 0.001048 | 0.00493 |  |  |  |  |  |  |
| Frailty^2 | 1.52E-07 | -1.26E-09 | -2.23E-07 | -2.90E-08 | -1.61E-07 | -3.71E-07 | 5.92E-09 |  |  |  |  |  |
| High PA | 3.83E-05 | -1.73E-07 | 0.000124 | 5.47E-05 | 0.000105 | 0.000175 | 3.94E-07 | 0.002667 |  |  |  |  |
| Cogim | 7.23E-05 | -6.23E-07 | 0.00011 | -7.8E-05 | -6.4E-05 | -5.8E-05 | -1.91E-07 | 8.2E-05 | 0.00314 |  |  |  |
| Abngaitbal | 0.0002 | -1.55E-06 | 8.7E-05 | -0.0001 | -0.00017 | -0.00025 | -2.24E-06 | 0.000131 | -1E-04 | 0.003527 |  |  |
| Paid emp | 0.000688 | -4.36E-06 | 0.000257 | -8.17E-06 | -2.2E-05 | 0.000114 | 2.92E-07 | -0.00012 | 4.44E-05 | 5.75E-05 | 0.003327 |  |
| Constant | -0.09756 | 0.000667 | -0.00778 | 0.000268 | 0.001597 | 0.00274 | -4.78E-06 | -0.0027 | -0.00254 | -0.00666 | -0.02762 | 3.549661 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; Emp: employment; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | |

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| **Table E22.8** Variance-covariance matrix for baseline CASP-19 linear regression (Table 5.17). | | | | | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | High PA | Abngait-bal | Unpaid | Constant |
| Age | 6.21E-06 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -4.23E-08 | 2.89E-10 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | 2.73E-07 | -1.87E-09 | 4.90E-06 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -1.11E-07 | 7.11E-10 | -1.65E-07 | 9.08E-06 |  |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | -1.99E-07 | 1.49E-09 | -3.85E-07 | 3.17E-06 | 7.15E-06 |  |  |  |  |  |  |  |  |  |  |  |
| SES4 | -3.51E-07 | 2.83E-09 | -4.02E-07 | 3.21E-06 | 3.41E-06 | 1.35E-05 |  |  |  |  |  |  |  |  |  |  |
| Falls hist1 | 1.01E-08 | -1.53E-10 | -1.58E-07 | -2.50E-07 | -1.95E-08 | -1.13E-07 | 1.26E-05 |  |  |  |  |  |  |  |  |  |
| Falls hist2 | 6.93E-08 | -2.58E-10 | 5.77E-09 | 5.81E-08 | -2.33E-08 | 7.52E-08 | 1.82E-06 | 1.63E-05 |  |  |  |  |  |  |  |  |
| Falls hist3 | -1.40E-08 | -1.20E-10 | -6.48E-07 | -7.09E-08 | -9.77E-08 | -7.20E-08 | 1.79E-06 | 2.04E-06 | 2.98E-05 |  |  |  |  |  |  |  |
| Falls hist4 | 1.69E-07 | -1.21E-09 | -4.51E-07 | 1.21E-07 | 1.84E-07 | -2.73E-07 | 1.93E-06 | 2.90E-06 | 2.30E-06 | 4.28E-05 |  |  |  |  |  |  |
| Frailty | -7.07E-08 | 4.07E-10 | -4.88E-08 | -1.87E-08 | -6.29E-08 | -1.32E-07 | -4.85E-08 | -9.05E-08 | -7.08E-08 | -6.11E-08 | 1.16E-07 |  |  |  |  |  |
| Frailty^2 | 1.72E-09 | -1.08E-11 | 4.29E-10 | 3.25E-10 | 9.67E-10 | 1.90E-09 | 7.64E-10 | -2.19E-10 | 9.74E-10 | -1.73E-09 | -2.28E-09 | 5.51E-11 |  |  |  |  |
| High PA | 1.31E-07 | -6.66E-10 | 3.25E-07 | 1.61E-07 | 2.59E-07 | 4.05E-07 | -1.21E-08 | -9.55E-08 | -3.05E-07 | -1.34E-07 | 1.65E-07 | -2.40E-09 | 9.12E-06 |  |  |  |
| Abngaitbal | 6.48E-07 | -4.87E-09 | 4.08E-07 | -3.27E-07 | -4.18E-07 | -5.89E-07 | -1.82E-07 | -6.53E-07 | -4.05E-07 | -5.64E-07 | -2.93E-07 | 1.14E-09 | 1.83E-07 | 1.01E-05 |  |  |
| Unpaid | -4.98E-07 | 3.46E-09 | -4.88E-07 | 3.64E-08 | 1.49E-07 | 4.33E-07 | -3.37E-07 | -2.26E-07 | -8.02E-08 | -2.89E-07 | -1.37E-09 | 5.16E-10 | -1.87E-07 | 4.34E-07 | 6.06E-06 |  |
| Constant | -0.00023 | 1.53E-06 | -1.7E-05 | 1.62E-06 | 4.50E-06 | 9.02E-06 | -6.96E-07 | -3.88E-06 | 1.82E-06 | -5.44E-06 | 2.23E-06 | -5.38E-08 | -9.55E-06 | -2.1E-05 | 1.65E-05 | 0.00822 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; PA: physical activity; SES: socioeconomic status; Unpaid: unpaid work. | | | | | | | | | | | | | | | | |

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| **Table E22.9** Variance-covariance matrix for baseline out-of-pocket care receipt logistic regression (Table 5.20). | | | | | | | | | | |
|  | Age | Sex | SES2 | SES3 | SES4 | Frailty | Frailty^2 | High PA | Cogim | Constant |
| Age | 4.24E-05 |  |  |  |  |  |  |  |  |  |
| Sex | -3.5E-05 | 0.012755 |  |  |  |  |  |  |  |  |
| SES2 | 4.94E-06 | -0.00052 | 0.017435 |  |  |  |  |  |  |  |
| SES3 | 7.3E-05 | -0.00116 | 0.006492 | 0.014928 |  |  |  |  |  |  |
| SES4 | 0.000173 | -0.00125 | 0.006562 | 0.007052 | 0.038345 |  |  |  |  |  |
| Frailty | -2E-05 | 2.65E-05 | -0.0001 | -0.0002 | -0.00035 | 0.000374 |  |  |  |  |
| Frailty^2 | 2.36E-07 | -7.31E-07 | 1.36E-06 | 2.64E-06 | 4.32E-06 | -6.27E-06 | 1.13E-07 |  |  |  |
| High PA | 0.000101 | 0.000799 | 0.0004 | 0.000522 | 0.00102 | 0.000803 | -1.1E-05 | 0.092848 |  |  |
| Cogim | -0.00015 | 0.000177 | 7E-05 | 0.000574 | 0.000995 | -9.2E-05 | -8.77E-08 | 0.000865 | 0.014331 |  |
| Constant | -0.0029 | -0.01894 | -0.00439 | -0.00716 | -0.01257 | -0.00311 | 5.57E-05 | -0.02489 | 0.009638 | 0.29928 |
| **Abbreviation:** Cogim: cognitive impairment; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | |

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| **Table E22.10** Variance-covariance matrix for baseline informal care receipt logistic regression (Table 5.22). | | | | | | | | | | |
|  | Age | Sex | Frailty | Frailty^2 | High PA | Cogim | Fear | Abngaitbal | Community HC | Constant |
| Age | 1.09E-05 |  |  |  |  |  |  |  |  |  |
| Sex | -6.39E-06 | 0.002465 |  |  |  |  |  |  |  |  |
| Frailty | -4.58E-06 | -7.24E-06 | 7.41E-05 |  |  |  |  |  |  |  |
| Frailty^2 | 5.90E-08 | 6.66E-08 | -1.46E-06 | 3.35E-08 |  |  |  |  |  |  |
| High PA | 1.63E-05 | 0.000178 | 8.91E-05 | -1.27E-06 | 0.007492 |  |  |  |  |  |
| Cogim | -3.2E-05 | 0.000192 | 1.24E-05 | -3.24E-07 | 0.00015 | 0.003381 |  |  |  |  |
| Fear | -1.1E-05 | -9E-05 | -3.7E-05 | -4.83E-07 | 2.09E-05 | 0.00011 | 0.007453 |  |  |  |
| Abngaitbal | -3E-05 | 0.000231 | -0.00012 | 7.63E-07 | 0.00012 | -0.00012 | -0.00026 | 0.003578 |  |  |
| Community HC | -1.1E-05 | 0.000275 | 0.000102 | -4.74E-06 | 0.000148 | -0.00091 | 0.000102 | 4.62E-05 | 0.412264 |  |
| Constant | -0.0007 | -0.00352 | -0.00033 | 7.75E-06 | -0.00326 | 0.001129 | 0.001098 | 0.002152 | -4.9E-05 | 0.058874 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; Fear: fear of falling; HC: healthcare; PA: physical activity. | | | | | | | | | | |

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| **Table E22.11** Variance-covariance matrix for baseline multiple informal care needs logistic regression (Table 5.23). | | | | | | | | | | | | |
|  | Age | Sex | SES2 | SES3 | SES4 | Frailty | Frailty^2 | High PA | Cogim | Abngaitbal | OOP care | Constant |
| Age | 2.84E-05 |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -1.1E-05 | 0.007305 |  |  |  |  |  |  |  |  |  |  |
| SES2 | 1.46E-05 | -0.00015 | 0.014447 |  |  |  |  |  |  |  |  |  |
| SES3 | 5.97E-05 | -0.00035 | 0.005563 | 0.010622 |  |  |  |  |  |  |  |  |
| SES4 | 0.000111 | -0.00044 | 0.005635 | 0.005982 | 0.016446 |  |  |  |  |  |  |  |
| Frailty | -1E-05 | -2.9E-05 | -6.9E-05 | -0.00012 | -0.00022 | 0.000293 |  |  |  |  |  |  |
| Frailty^2 | 1.07E-07 | -2.33E-07 | 7.55E-07 | 1.39E-06 | 2.45E-06 | -4.86E-06 | 8.83E-08 |  |  |  |  |  |
| High PA | 5.43E-05 | 0.000796 | 0.000885 | 0.000549 | 0.000983 | 0.000268 | -3.51E-06 | 0.043255 |  |  |  |  |
| Cogim | -0.00011 | 0.0004 | -0.00041 | -0.0002 | 9.88E-05 | 4.38E-05 | -7.27E-07 | 0.000633 | 0.008431 |  |  |  |
| Abngaitbal | -8E-05 | 0.00052 | -0.00055 | -0.00081 | -0.00099 | -0.00047 | 4.82E-06 | 0.000162 | -0.00013 | 0.009948 |  |  |
| OOP care | -8.3E-05 | -0.00049 | 1.14E-05 | 0.000951 | 0.001697 | -4.6E-05 | -1.30E-06 | 0.000697 | 0.000667 | -0.0007 | 0.0224 |  |
| Constant | -0.00187 | -0.01047 | -0.00479 | -0.00705 | -0.00948 | -0.00255 | 4.6E-05 | -0.01201 | 0.004662 | 0.007284 | 0.006554 | 0.186829 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; OOP: out-of-pocket; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | |

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| **Table E22.12** Variance-covariance matrix for baseline GP contact logistic regression (Table 5.28). | | | | | | | | | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | Cogim | Fear | Abngaitbal | Comm HC | Social care | OOP care | Inf care | Constant |
| Age | 0.002927 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -0.00002 | 1.37E-07 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | 0.000116 | -7.95E-07 | 0.002434 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -6.8E-05 | 4.49E-07 | -7.5E-05 | 0.004338 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | -7.7E-05 | 5.72E-07 | -0.00017 | 0.001401 | 0.003456 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES4 | -0.00013 | 1.10E-06 | -0.00019 | 0.001414 | 0.001477 | 0.007774 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist1 | 1.01E-05 | -1.28E-07 | -0.0001 | -0.00012 | -2.1E-05 | -4.86E-06 | 0.006706 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist2 | 3.93E-05 | -1.77E-07 | -5.4E-05 | 7.05E-05 | -1.4E-05 | 8.86E-05 | 0.000829 | 0.011645 |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist3 | 0.000104 | -8.08E-07 | -0.0004 | -4.5E-05 | -5.3E-05 | -7.36E-06 | 0.000814 | 0.000938 | 0.026047 |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist4 | -8.50E-06 | 6.40E-08 | -0.00021 | 9.14E-05 | 0.00012 | 7.88E-05 | 0.000849 | 0.001443 | 0.001027 | 0.05873 |  |  |  |  |  |  |  |  |  |  |
| Frailty | -1.9E-05 | 8.92E-08 | -2.9E-05 | -7.72E-06 | -3E-05 | -6.5E-05 | -2.2E-05 | -3.1E-05 | -1.3E-05 | -2E-05 | 6.28E-05 |  |  |  |  |  |  |  |  |  |
| Frailty^2 | 5.15E-07 | -3.00E-09 | 4.02E-07 | 1.78E-07 | 4.39E-07 | 8.80E-07 | 4.36E-07 | -3.22E-07 | 5.34E-07 | -1.04E-06 | -1.15E-06 | 2.90E-08 |  |  |  |  |  |  |  |  |
| Cogim | 4.04E-06 | -2.55E-07 | 0.000236 | -0.00014 | -0.00012 | -0.00015 | 0.000164 | 3.44E-05 | 0.000101 | -3.3E-05 | -3.3E-05 | 3.50E-07 | 0.003368 |  |  |  |  |  |  |  |
| Fear | 4.44E-05 | -3.85E-07 | -4.4E-05 | 4.44E-06 | 2.49E-05 | -7.3E-05 | -0.00056 | -0.00171 | -0.00128 | -0.00149 | 1.94E-07 | -2.39E-06 | -2.4E-05 | 0.019903 |  |  |  |  |  |  |
| Abngaitbal | 0.000332 | -2.53E-06 | 0.00024 | -0.00018 | -0.00017 | -0.00031 | -1.9E-05 | -0.0003 | -0.00014 | -0.00021 | -0.00018 | 1.22E-06 | -0.00016 | -0.00041 | 0.005848 |  |  |  |  |  |
| Comm HC | 0.000139 | -8.14E-07 | 0.00048 | -0.00026 | -0.00012 | 0.000617 | 0.000178 | 0.00057 | -0.00102 | -0.0026 | 8.11E-05 | -5.22E-06 | -0.0005 | -0.00011 | 0.000196 | 0.116183 |  |  |  |  |
| Social care | 0.000823 | -5.87E-06 | -0.00023 | -2.6E-05 | 7.21E-06 | 0.000299 | 4.38E-05 | 0.000681 | 7.07E-05 | 0.00112 | 4.36E-05 | -6.08E-06 | -0.00036 | -0.00057 | -0.00012 | -0.00929 | 0.031937 |  |  |  |
| OOP care | 0.000564 | -4.18E-06 | -0.00031 | 0.000047 | 0.000306 | 0.000588 | 0.000201 | 0.00029 | 2.22E-06 | -0.00019 | -8E-05 | -5.35E-07 | 0.000365 | -0.00056 | -0.00023 | -0.00143 | 0.000859 | 0.024478 |  |  |
| Inf care | 0.000115 | -7.58E-07 | -0.00025 | 2.23E-05 | 4.07E-05 | 2.03E-05 | -1.6E-05 | -7.3E-05 | -0.00012 | -5.2E-05 | -0.00015 | 1.01E-06 | -0.00021 | -0.00049 | -0.00031 | -0.00053 | -9.21E-06 | -3.2E-05 | 0.005208 |  |
| Constant | -0.1058 | 0.000721 | -0.00766 | 0.001399 | 0.001683 | 0.003338 | -0.0005 | -0.00211 | -0.00327 | 0.000266 | 0.000625 | -1.6E-05 | 0.000125 | -0.00096 | -0.01056 | -0.00642 | -0.0281 | -0.01825 | -0.00356 | 3.842125 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; Comm HC: community healthcare; Fear: fear of falling; Inf: informal; OOP: out-of-pocket; SES: socioeconomic status. | | | | | | | | | | | | | | | | | | | | |

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| **Table E22.13** Variance-covariance matrix for baseline self-referred exercise uptake logistic regression (Table 5.30). | | | | | | | | | | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | High PA | Cogim | Abngaitbal | Comm HC | Social care | OOP care | Inf care | GP cont | Constant |
| Age | 0.005419 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -3.7E-05 | 2.54E-07 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | 0.000142 | -1.02E-06 | 0.004526 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -7.4E-05 | 4.86E-07 | -0.00018 | 0.006697 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | -0.00014 | 1.12E-06 | -0.00035 | 0.002451 | 0.005848 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES4 | -0.00012 | 1.23E-06 | -0.00039 | 0.002491 | 0.002682 | 0.011688 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist1 | 4.32E-05 | -3.63E-07 | -0.00012 | -0.00021 | -4.8E-05 | -0.00011 | 0.008664 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist2 | 9.15E-05 | -4.86E-07 | 6.48E-05 | 3.78E-06 | -6.8E-05 | 0.000235 | 0.001523 | 0.010995 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist3 | 7.26E-05 | -7.10E-07 | -0.00036 | 9.23E-05 | -3.39E-06 | 0.000158 | 0.001484 | 0.00157 | 0.0185 |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls hist4 | 3.08E-05 | -2.70E-07 | -0.00022 | 9.06E-05 | 0.000129 | 0.0002 | 0.001574 | 0.002109 | 0.001712 | 0.025008 |  |  |  |  |  |  |  |  |  |  |  |
| Frailty | -5.9E-05 | 3.44E-07 | -1E-05 | -1.8E-05 | -6E-05 | -0.00012 | -2.8E-05 | -4.8E-05 | -1.8E-05 | -1E-05 | 0.000107 |  |  |  |  |  |  |  |  |  |  |
| Frailty^2 | 1.06E-06 | -6.41E-09 | 7.96E-08 | 2.67E-07 | 8.44E-07 | 1.56E-06 | 3.59E-07 | -3.67E-07 | 4.42E-07 | -1.66E-06 | -1.97E-06 | 4.53E-08 |  |  |  |  |  |  |  |  |  |
| High PA | 0.000103 | -5.50E-07 | 0.000391 | 0.000164 | 0.000198 | 0.000317 | 2.02E-05 | -2.8E-05 | -3.1E-05 | -5.1E-05 | 0.00016 | -2.35E-06 | 0.006437 |  |  |  |  |  |  |  |  |
| Cogim | 0.000141 | -1.34E-06 | 0.000341 | -0.00019 | -9.5E-05 | -0.00012 | 0.000148 | 4.19E-05 | 0.000204 | 1.78E-05 | -1.6E-05 | -1.48E-07 | 0.000217 | 0.007033 |  |  |  |  |  |  |  |
| Abngaitbal | 0.000385 | -2.93E-06 | 0.000337 | -0.00021 | -0.00037 | -0.0005 | -0.0002 | -0.00041 | -0.00037 | -0.00032 | -0.0002 | 4.77E-07 | 7.81E-05 | -0.00023 | 0.00783 |  |  |  |  |  |  |
| Comm HC | 0.000749 | -5.18E-06 | 0.000666 | -0.00055 | -9.6E-05 | 0.000696 | 9.65E-05 | 0.000975 | -0.00088 | -0.00016 | 0.00021 | -8.01E-06 | 8.4E-05 | -0.00132 | 0.000449 | 0.137755 |  |  |  |  |  |
| Social care | 0.001228 | -8.92E-06 | -0.00017 | -3E-05 | 8.77E-05 | 0.000461 | 0.000202 | 0.000922 | 0.000119 | 0.001237 | 0.00011 | -6.71E-06 | -7.5E-05 | -0.00068 | -0.00031 | -0.01212 | 0.037507 |  |  |  |  |
| OOP care | 0.000861 | -6.35E-06 | -0.00046 | 0.000152 | 0.000473 | 0.000894 | 0.000367 | 0.000326 | -0.00011 | 0.00012 | -0.00011 | 1.75E-07 | 0.000188 | 0.00053 | -0.00037 | -0.00078 | 0.000612 | 0.017961 |  |  |  |
| Inf care | 0.00015 | -9.23E-07 | -0.00029 | 8.81E-05 | 7.23E-05 | 4.06E-05 | 6.98E-05 | -9.9E-05 | -0.00016 | -0.00017 | -0.00019 | 1.59E-06 | 0.0004 | -0.00029 | -0.00058 | -0.00068 | 3.41E-06 | 0.000421 | 0.005941 |  |  |
| GP cont | -0.00047 | 3.17E-06 | 0.000214 | -0.00014 | -0.0001 | -0.00023 | -0.0002 | -0.00038 | -0.00062 | -0.00061 | -0.00016 | 2.27E-06 | -5.1E-05 | 0.001081 | 0.000332 | 0.001093 | 0.000931 | 0.000217 | 0.000228 | 0.008667 |  |
| Constant | -0.19558 | 0.001332 | -0.01248 | 0.000988 | 0.003319 | 0.00219 | -0.00192 | -0.00432 | -0.0016 | -0.00065 | 0.001808 | -3.1E-05 | -0.00851 | -0.00552 | -0.01215 | -0.02952 | -0.04269 | -0.02827 | -0.0053 | 0.010872 | 7.102414 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; Comm HC: community healthcare; GP cont: GP contact; Inf: informal; OOP: out-of-pocket; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | | | | | | | | | | |

### Falls risk equations

Tables E23.1-E23.4 show variance-covariance matrices for falls risk equations, namely: risk of any fall; risk of recurrent fall given any fall; risk of MA fall given single fall; and risk of MA fall given recurrent falls.

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| **Table E23.1** Variance-covariance matrix for risk of any fall logistic regression (Table 5.39). | | | | | | | | | | | |
|  | Age | Sex | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | Fear | Abngaitbal | Constant |
| Age | 1.73E-05 |  |  |  |  |  |  |  |  |  |  |
| Sex | -1.00E-06 | 0.003762 |  |  |  |  |  |  |  |  |  |
| Falls hist1 | -7.52E-06 | -7.7E-05 | 0.008166 |  |  |  |  |  |  |  |  |
| Falls hist2 | 3.01E-05 | 0.000157 | 0.0014 | 0.010329 |  |  |  |  |  |  |  |
| Falls hist3 | -1.8E-05 | -0.00052 | 0.001424 | 0.001506 | 0.019997 |  |  |  |  |  |  |
| Falls hist4 | -6.65E-06 | -0.00019 | 0.00147 | 0.001916 | 0.001732 | 0.027461 |  |  |  |  |  |
| Frailty | -7.53E-06 | -4.1E-05 | -2.1E-05 | -4.7E-05 | -3E-05 | -1.6E-05 | 9.11E-05 |  |  |  |  |
| Frailty^2 | 9.77E-08 | 3.99E-07 | 5.26E-07 | -1.32E-08 | 6.23E-07 | -1.29E-06 | -1.90E-06 | 4.88E-08 |  |  |  |
| Fear | -8.13E-06 | -0.00024 | -0.00046 | -0.001 | -0.00115 | -0.00166 | -2.8E-05 | -2.45E-06 | 0.015632 |  |  |
| Abngaitbal | -4.3E-05 | 0.000345 | -8.1E-05 | -0.00022 | -9.5E-05 | -0.00014 | -0.00022 | 1.14E-06 | -0.00097 | 0.007085 |  |
| Constant | -0.00114 | -0.00549 | -0.0005 | -0.00303 | 0.001071 | 1.94E-05 | -4.92E-06 | 3.98E-06 | 0.001367 | 0.003087 | 0.088174 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Fear: fear of falling. | | | | | | | | | | | |

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| **Table E23.2** Variance-covariance matrix for risk of recurrent fall given any fall logistic regression (Table 5.40). | | | | | | | | | |
|  | Age | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | Abngaitbal | Constant |
| Age | 5.12E-05 |  |  |  |  |  |  |  |  |
| Falls hist1 | -3.3E-05 | 0.022703 |  |  |  |  |  |  |  |
| Falls hist2 | 2.47E-05 | 0.005171 | 0.022725 |  |  |  |  |  |  |
| Falls hist3 | -0.00014 | 0.005381 | 0.005461 | 0.056428 |  |  |  |  |  |
| Falls hist4 | -8.87E-06 | 0.005352 | 0.0058 | 0.00613 | 0.068443 |  |  |  |  |
| Frailty | -2.2E-05 | -8.1E-05 | 2.18E-05 | 5.90E-06 | -6.01E-06 | 0.000289 |  |  |  |
| Frailty^2 | 3.25E-07 | 1.29E-06 | -2.43E-06 | -1.67E-06 | -4.03E-06 | -5.76E-06 | 1.36E-07 |  |  |
| Abngaitbal | -0.00012 | -0.00015 | -0.00056 | -0.00115 | -0.00101 | -0.00079 | 5.73E-06 | 0.020423 |  |
| Constant | -0.00338 | -0.00192 | -0.00626 | 0.005955 | -0.0029 | -0.00055 | 1.65E-05 | 0.010861 | 0.243712 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance. | | | | | | | | | |

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| **Table E23.3** Variance-covariance matrix for risk of MA fall given single fall logistic regression (Table 5.41). | | | | |
|  | Age | Sex | High physical activity | Constant |
| Age | 8.86E-05 |  |  |  |
| Sex | 2.57E-05 | 0.022275 |  |  |
| High physical activity | 0.000377 | 0.001889 | 0.035489 |  |
| Constant | -0.00649 | -0.03842 | -0.03695 | 0.541368 |
| **Abbreviation:** MA fall: fall requiring medical attention. | | | | |

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| **Table E23.4** Variance-covariance matrix for risk of MA fall given recurrent falls logistic regression (Table 5.42). | | | | | | | | | |
|  | Age | Sex | Falls hist1 | Falls hist2 | Falls hist3 | Falls hist4 | Frailty | Frailty^2 | Constant |
| Age | 0.00011 |  |  |  |  |  |  |  |  |
| Sex | -5.84E-06 | 0.032243 |  |  |  |  |  |  |  |
| Falls hist1 | -0.00013 | 0.000928 | 0.071709 |  |  |  |  |  |  |
| Falls hist2 | 4.15E-05 | -7E-05 | 0.020133 | 0.042952 |  |  |  |  |  |
| Falls hist3 | -0.00017 | -0.00459 | 0.02064 | 0.021798 | 0.146538 |  |  |  |  |
| Falls hist4 | -5.6E-05 | -0.0035 | 0.020457 | 0.022027 | 0.0241 | 0.095825 |  |  |  |
| Frailty | -5.8E-05 | 0.000395 | -0.0002 | -0.00025 | -0.00077 | -0.00039 | 0.000769 |  |  |
| Frailty^2 | 8.28E-07 | -9.22E-06 | 2.88E-06 | -1.06E-06 | 6.96E-06 | -2.83E-06 | -1.5E-05 | 3.41E-07 |  |
| Constant | -0.00723 | -0.05521 | -0.00993 | -0.01801 | 0.010573 | -0.00246 | -0.00369 | 8.76E-05 | 0.65851 |
| **Abbreviation:** MA fall: fall requiring medical attention. | | | | | | | | | |

### Dynamic progressions

Tables E24.1-E24.14 show variance-covariance matrices for progressions of dynamic variables, namely: change in frailty; long-term care admission; high physical activity; cognitive impairment; abnormal gait/balance; GP routine contact; self-referred exercise uptake; change in EQ-5D; paid employment; unpaid work; change in CASP-19; out-of-pocket care receipt; informal care receipt; and multiple informal care needs.

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| **Table E24.1** Variance-covariance matrix for change in frailty linear regression (Table 5.45). | | | | | | | | | | | | | | |
|  | Age | SES2 | SES3 | SES4 | Falls inc1 | Falls inc2 | Falls inc3 | Falls inc4 | Frailty | High PA | Cogim | Social care | Inf care | Constant |
| Age | 0.000104 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -9.8E-05 | 0.046438 |  |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | -5.6E-05 | 0.018563 | 0.033687 |  |  |  |  |  |  |  |  |  |  |  |
| SES4 | 0.000103 | 0.018744 | 0.019563 | 0.0479 |  |  |  |  |  |  |  |  |  |  |
| Falls inc1 | -4.6E-05 | 0.001081 | 2.77E-06 | 7.50E-06 | 0.051679 |  |  |  |  |  |  |  |  |  |
| Falls inc2 | 5.26E-05 | 0.000596 | 0.0003 | 0.000312 | 0.007613 | 0.068128 |  |  |  |  |  |  |  |  |
| Falls inc3 | -0.00026 | 0.000328 | -0.00126 | -0.00106 | 0.007315 | 0.008073 | 0.122575 |  |  |  |  |  |  |  |
| Falls inc4 | -9.3E-05 | -0.00038 | -0.00168 | -0.00044 | 0.007912 | 0.011491 | 0.008836 | 0.16969 |  |  |  |  |  |  |
| Frailty | -3E-05 | -7.5E-05 | -0.00019 | -0.00044 | -0.00012 | -0.00045 | -4.8E-05 | -0.00058 | 0.000106 |  |  |  |  |  |
| High PA | 0.000134 | 0.001225 | 0.001911 | 0.002193 | 0.000415 | -0.00011 | -0.00143 | 0.000132 | 0.000324 | 0.036806 |  |  |  |  |
| Cogim | -0.00021 | -0.00182 | -0.0018 | -0.00154 | 3.61E-05 | 0.000683 | -0.00018 | 0.001402 | -8.8E-05 | 0.000507 | 0.035063 |  |  |  |
| Social care | -0.00022 | 0.002 | -0.0012 | 0.007529 | 0.004627 | 0.006377 | 0.002148 | 0.005337 | -0.00129 | -0.00266 | -0.00611 | 0.346528 |  |  |
| Inf care | 6.63E-05 | 0.000123 | 0.000536 | 8.89E-06 | 0.001677 | -0.00162 | -0.00153 | -0.00058 | -0.00096 | 0.001093 | -0.00128 | -0.00301 | 0.040767 |  |
| Constant | -0.00688 | -0.01079 | -0.01265 | -0.02153 | -0.0033 | -0.00604 | 0.012489 | 0.005992 | 0.001284 | -0.02153 | 0.010552 | 0.024503 | -0.00286 | 0.484097 |
| **Abbreviation:** Cogim: cognitive impairment; Inf: informal; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | | | |

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| **Table E24.2** Variance-covariance matrix for long-term care admission logistic regression (Table 5.46). | | | | | | | | |
|  | Age | D\_Frailty | Cogim | Community HC | Social care | OOP care | Informal care | Constant |
| Age | 0.000602 |  |  |  |  |  |  |  |
| D\_Frailty | -1.8E-05 | 0.000406 |  |  |  |  |  |  |
| Cogim | -0.00187 | -0.00074 | 0.17083 |  |  |  |  |  |
| Community HC | -6.9E-05 | 0.003652 | -0.02942 | 0.675834 |  |  |  |  |
| Social care | -0.00142 | 0.000382 | -0.00254 | -0.04268 | 0.166287 |  |  |  |
| OOP care | -0.00204 | 0.001563 | 0.016497 | 0.01015 | -0.00884 | 0.206094 |  |  |
| Informal care | -0.00111 | -0.00062 | -0.01784 | 0.001218 | -0.04095 | -0.02941 | 0.198538 |  |
| Constant | -0.04571 | -0.001 | 0.045033 | -0.02385 | 0.09859 | 0.123279 | -0.02525 | 3.682683 |
| **Abbreviation:** Cogim: cognitive impairment; D\_Frailty: change in frailty; HC: healthcare; OOP: out-of-pocket. | | | | | | | | |

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| **Table E24.3** Variance-covariance matrix for high physical activity in next cycle logistic regression (Table 5.48). | | | | | | | | | | |
|  | Age | Sex | SES2 | SES3 | SES4 | Frailty | D\_Frailty | High PA | Informal care | Constant |
| Age | 4.35E-05 |  |  |  |  |  |  |  |  |  |
| Sex | 2.78E-05 | 0.006224 |  |  |  |  |  |  |  |  |
| SES2 | -3.6E-05 | -0.00011 | 0.012169 |  |  |  |  |  |  |  |
| SES3 | -2.1E-05 | -0.00048 | 0.004334 | 0.009266 |  |  |  |  |  |  |
| SES4 | 9.59E-06 | -0.00054 | 0.004376 | 0.004588 | 0.017004 |  |  |  |  |  |
| Frailty | -1.4E-05 | -2.3E-05 | -2.1E-05 | -7E-05 | -0.00017 | 5.82E-05 |  |  |  |  |
| D\_Frailty | -8.57E-06 | -1.5E-05 | 1.06E-05 | 1.45E-06 | -2.1E-05 | 2.02E-05 | 8.38E-05 |  |  |  |
| High PA | -1.8E-05 | 1.84E-06 | 0.00016 | 0.000167 | -0.00012 | 0.000107 | -2.3E-05 | 0.006659 |  |  |
| Informal care | 4.66E-05 | -0.00047 | -9.72E-06 | 5.47E-05 | 0.000151 | -0.00041 | -8.4E-05 | -2.6E-05 | 0.020236 |  |
| Constant | -0.00283 | -0.01056 | -0.00163 | -0.00179 | -0.00291 | 0.000553 | 0.00033 | -0.00233 | -0.00117 | 0.205019 |
| **Abbreviation:** D\_Frailty: change in frailty; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | |

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| **Table E24.4** Variance-covariance matrix for self-referred exercise uptake in next cycle logistic regression (Table 5.49). | | | | | | | | | | | | | | |
|  | Age | Sex | Falls inc1 | Falls inc2 | Falls inc3 | Falls inc4 | Frailty | Frailty^2 | D\_Frailty | High PA | Abngaitbal | OOP care | Exercise | Constant |
| Age | 4.16E-05 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -8.85E-06 | 0.009244 |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc1 | -5.18E-06 | -0.00044 | 0.018714 |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc2 | 5.52E-05 | 0.000203 | 0.003174 | 0.021946 |  |  |  |  |  |  |  |  |  |  |
| Falls inc3 | -8.8E-05 | -0.00075 | 0.003097 | 0.003258 | 0.036506 |  |  |  |  |  |  |  |  |  |
| Falls inc4 | 1.35E-05 | -0.00029 | 0.003269 | 0.004624 | 0.003604 | 0.045016 |  |  |  |  |  |  |  |  |
| Frailty | -1.7E-05 | -3.3E-05 | -7.78E-07 | -0.00015 | -7.4E-05 | -0.00028 | 0.000219 |  |  |  |  |  |  |  |
| Frailty^2 | 2.16E-07 | 2.55E-07 | -2.88E-07 | 5.37E-07 | 1.28E-06 | 3.92E-06 | -4.52E-06 | 1.14E-07 |  |  |  |  |  |  |
| D\_Frailty | -7.97E-06 | 4.26E-06 | -1.7E-05 | -0.0001 | -5.5E-05 | -0.00019 | 5.96E-06 | 2.08E-08 | 5.16E-05 |  |  |  |  |  |
| High PA | 2.75E-05 | 0.000825 | 0.000311 | 0.000171 | -0.00043 | 8.4E-05 | 0.000387 | -5.58E-06 | 6.55E-05 | 0.013179 |  |  |  |  |
| Abngaitbal | -8.1E-05 | 0.000521 | -0.00021 | -0.00123 | -1.5E-05 | -0.0018 | -0.00045 | 3.93E-07 | -3.8E-05 | -6.6E-05 | 0.016691 |  |  |  |
| OOP care | -0.00013 | -0.00102 | 0.000269 | 0.000541 | 0.001211 | -0.00087 | -0.00018 | -1.06E-06 | 3.03E-05 | 0.000253 | -0.00033 | 0.043357 |  |  |
| Exercise | 3.71E-05 | -0.00089 | 0.000123 | -7.1E-05 | 3.36E-05 | -0.00022 | -9.2E-05 | 1.59E-06 | 3.14E-05 | -0.00102 | 0.000255 | -0.00078 | 0.011423 |  |
| Constant | -0.00269 | -0.01454 | -0.00184 | -0.00493 | 0.005157 | 2.49E-05 | -0.00035 | 1.38E-05 | 0.0003 | -0.00992 | 0.006512 | 0.011241 | -0.0028 | 0.214982 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; D\_Frailty: change in frailty; OOP: out-of-pocket; PA: physical activity. | | | | | | | | | | | | | | |

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| **Table E24.5** Variance-covariance matrix for change in EQ-5D linear regression (Table 5.50). | | | | | | | | | | | | | | | |
|  | Age | Sex | SES2 | SES3 | SES4 | Falls inc1 | Falls inc2 | Falls inc3 | Falls inc4 | Frailty | D\_Frailty | Abngaitbal | EQ-5D | EQ-5D^2 | Constant |
| Age | 1.22E-07 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -8.53E-10 | 2.32E-05 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -1.14E-07 | -8.18E-07 | 0.000051 |  |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | -7.95E-08 | -2.40E-06 | 2.04E-05 | 3.72E-05 |  |  |  |  |  |  |  |  |  |  |  |
| SES4 | 1.02E-07 | -2.39E-06 | 2.06E-05 | 2.17E-05 | 5.29E-05 |  |  |  |  |  |  |  |  |  |  |
| Falls inc1 | -4.34E-08 | -8.70E-07 | 1.19E-06 | 8.55E-08 | 6.24E-08 | 5.68E-05 |  |  |  |  |  |  |  |  |  |
| Falls inc2 | 1.15E-07 | -1.27E-07 | 7.76E-07 | 5.67E-07 | 7.72E-07 | 8.66E-06 | 7.61E-05 |  |  |  |  |  |  |  |  |
| Falls inc3 | -2.50E-07 | -2.32E-06 | 4.89E-07 | -1.05E-06 | -6.87E-07 | 8.38E-06 | 9.46E-06 | 0.000136 |  |  |  |  |  |  |  |
| Falls inc4 | 2.41E-08 | -2.11E-06 | -1.24E-07 | -1.35E-06 | 3.39E-07 | 9.15E-06 | 1.44E-05 | 1.09E-05 | 0.00019 |  |  |  |  |  |  |
| Frailty | -4.32E-08 | -1.44E-07 | -6.26E-08 | -1.59E-07 | -3.48E-07 | -5.14E-08 | -4.00E-07 | -1.06E-07 | -5.42E-07 | 1.68E-07 |  |  |  |  |  |
| D\_Frailty | -2.48E-08 | -4.59E-08 | -1.83E-08 | -1.68E-09 | -1.04E-07 | -1.00E-07 | -3.93E-07 | -2.88E-07 | -6.50E-07 | 3.23E-08 | 1.76E-07 |  |  |  |  |
| Abngaitbal | -3.04E-07 | 2.06E-06 | -8.90E-07 | -1.06E-06 | -1.04E-06 | -4.28E-07 | -2.77E-06 | 9.09E-07 | -4.63E-06 | -1.17E-06 | -6.10E-08 | 4.81E-05 |  |  |  |
| EQ-5D | -1.57E-06 | -2.98E-06 | -1.93E-06 | -2.72E-06 | -2.60E-06 | 4.52E-06 | 5.45E-06 | 5.07E-06 | -2.71E-06 | 5.92E-07 | -5.28E-07 | 6.26E-06 | 0.001149 |  |  |
| EQ-5D^2 | 7.21E-07 | 3.53E-06 | 1.84E-06 | 3.59E-06 | 6.78E-06 | -3.05E-06 | -2.76E-07 | -3.46E-06 | 4.10E-06 | 1.77E-06 | 7.00E-07 | -2.20E-06 | -0.00091 | 0.000827 |  |
| Constant | -7.12E-06 | -3.3E-05 | -9.88E-06 | -9.54E-06 | -2.3E-05 | -4.28E-06 | -1.5E-05 | 1.35E-05 | 1.62E-06 | 2.86E-08 | 1.03E-06 | 1.75E-05 | -0.00017 | 7.14E-05 | 0.00064 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; D\_Frailty: change in frailty; SES: socioeconomic status. | | | | | | | | | | | | | | | |

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| **Table E24.6** Variance-covariance matrix for cognitive impairment in next cycle logistic regression (Table E13). | | | | | | | | | | |
|  | Age | Sex | Frailty | D\_Frailty | High PA | Cogim | Abngaitbal | OOP care | Informal care | Constant |
| Age | 2.21E-05 |  |  |  |  |  |  |  |  |  |
| Sex | -1.1E-05 | 0.004869 |  |  |  |  |  |  |  |  |
| Frailty | -4.58E-06 | -2.9E-05 | 2.48E-05 |  |  |  |  |  |  |  |
| D\_Frailty | -3.68E-06 | -1.4E-05 | 5.11E-06 | 3.01E-05 |  |  |  |  |  |  |
| High PA | 2.42E-05 | 0.000375 | 7.58E-05 | 2.37E-05 | 0.011344 |  |  |  |  |  |
| Cogim | -1.1E-05 | 0.000298 | -1.7E-05 | -7.68E-06 | -1.2E-05 | 0.005609 |  |  |  |  |
| Abngaitbal | -5.6E-05 | 0.000415 | -0.00022 | -1.6E-05 | 9.3E-05 | -5.8E-05 | 0.008695 |  |  |  |
| OOP care | -8.6E-05 | -0.0006 | -0.00012 | 1.24E-05 | -7.5E-05 | -7.00E-06 | -0.00014 | 0.03743 |  |  |
| Informal care | 3.14E-05 | -0.00042 | -0.00019 | -5.1E-05 | 0.000169 | -5.2E-05 | -0.00063 | -0.00039 | 0.00823 |  |
| Constant | -0.00149 | -0.00635 | 0.000148 | 0.000145 | -0.00493 | -0.00105 | 0.003725 | 0.007604 | -0.0011 | 0.115232 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; D\_Frailty: change in frailty; OOP: out-of-pocket; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | |

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| **Table E24.7** Variance-covariance matrix for abnormal gait/balance in next cycle logistic regression (Table E14). | | | | | | | | | | | | | | |
|  | Age | Sex | Falls inc1 | Falls inc2 | Falls inc3 | Falls inc4 | Frailty | D\_Frailty | High PA | Cogim | Fear | Abngaitbal | OOP care | Constant |
| Age | 3.16E-05 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -7.88E-06 | 0.007178 |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc1 | -1.7E-05 | -0.00022 | 0.016637 |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc2 | 2.55E-05 | -2.6E-05 | 0.002554 | 0.020566 |  |  |  |  |  |  |  |  |  |  |
| Falls inc3 | -6.7E-05 | -0.00086 | 0.002537 | 0.002496 | 0.032447 |  |  |  |  |  |  |  |  |  |
| Falls inc4 | -1.8E-05 | -0.00038 | 0.002642 | 0.002956 | 0.002559 | 0.050389 |  |  |  |  |  |  |  |  |
| Frailty | -3.78E-06 | -6.8E-05 | -1.8E-05 | -0.00011 | -1.3E-05 | -0.00013 | 4.28E-05 |  |  |  |  |  |  |  |
| D\_Frailty | -2.32E-06 | -5.2E-05 | -3.9E-05 | -7.3E-05 | -1.9E-05 | -9E-05 | 2.01E-05 | 6.61E-05 |  |  |  |  |  |  |
| High PA | 3.81E-05 | 0.00055 | 0.000232 | 0.000112 | -0.00106 | 0.000187 | 0.000144 | 4.99E-05 | 0.017455 |  |  |  |  |  |
| Cogim | -5.7E-05 | 0.000644 | -8.69E-06 | 0.000126 | -0.0002 | 7.25E-05 | -1.7E-05 | 1.01E-05 | 0.000205 | 0.010841 |  |  |  |  |
| Fear | 2.29E-06 | -0.00071 | 0.000109 | -0.00249 | -0.00058 | 8.23E-05 | -0.00017 | 7.91E-05 | 0.000315 | 0.000111 | 0.033364 |  |  |  |
| Abngaitbal | -3.7E-05 | 0.000321 | -0.00013 | 1.12E-05 | 0.000866 | -0.0003 | -0.00016 | 0.000192 | -9.6E-05 | -1.2E-05 | -0.00092 | 0.009845 |  |  |
| OOP care | -7E-05 | -0.00129 | -0.00056 | 0.000183 | 0.000655 | -0.00111 | -0.00018 | 5.09E-05 | 0.000206 | 0.000795 | -0.00082 | 0.000673 | 0.05105 |  |
| Constant | -0.00217 | -0.00954 | -0.00059 | -0.00257 | 0.003761 | 0.001396 | -0.00019 | -0.00029 | -0.00771 | 0.001029 | 0.001499 | 0.000438 | 0.007058 | 0.175884 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; D\_Frailty: change in frailty; Fear: fear of falling; OOP: out-of-pocket; PA: physical activity. | | | | | | | | | | | | | | |

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| **Table E24.8** Variance-covariance matrix for GP routine contact in next cycle logistic regression (Table E15). | | | | | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | Falls inc1 | Falls inc2 | Falls inc3 | Falls inc4 | Frailty | Frailty^2 | D\_Frailty | Cogim | Abngaitbal | Social care | Inf care | GP cont | Constant |
| Age | 0.007166 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -4.9E-05 | 3.41E-07 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | 0.000216 | -1.47E-06 | 0.006231 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc1 | 2.9E-05 | -2.29E-07 | -0.00026 | 0.016187 |  |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc2 | 0.000281 | -1.77E-06 | -8.8E-05 | 0.002061 | 0.027363 |  |  |  |  |  |  |  |  |  |  |  |
| Falls inc3 | -0.0002 | 7.90E-07 | -0.00082 | 0.001951 | 0.002127 | 0.060873 |  |  |  |  |  |  |  |  |  |  |
| Falls inc4 | 0.000749 | -5.15E-06 | -0.00037 | 0.002136 | 0.003301 | 0.002264 | 0.132633 |  |  |  |  |  |  |  |  |  |
| Frailty | -8.96E-06 | -5.82E-08 | -0.00012 | -6.2E-05 | -0.00012 | 2.18E-05 | -0.00028 | 0.000179 |  |  |  |  |  |  |  |  |
| Frailty^2 | 1.05E-06 | -5.85E-09 | 1.74E-06 | 4.95E-07 | -6.95E-07 | -4.48E-07 | 3.13E-06 | -3.47E-06 | 9.08E-08 |  |  |  |  |  |  |  |
| D\_Frailty | 1.37E-05 | -1.56E-07 | -3.9E-05 | -3.3E-05 | -0.00012 | -2.4E-05 | -0.00017 | 1.6E-05 | -7.01E-08 | 6.12E-05 |  |  |  |  |  |  |
| Cogim | -0.00017 | 7.95E-07 | 0.000718 | 4.66E-05 | 0.000484 | -0.00022 | 0.000147 | -0.0001 | 1.11E-06 | -5.6E-05 | 0.008939 |  |  |  |  |  |
| Abngaitbal | 0.000737 | -5.80E-06 | 0.000605 | -4.3E-05 | -0.00039 | 0.000307 | -0.00107 | -0.00044 | 2.50E-06 | 1.86E-05 | -0.00018 | 0.014702 |  |  |  |  |
| Social care | 0.000876 | -6.28E-06 | -0.00029 | 0.0015 | 0.002661 | 0.001271 | -0.00176 | 3.16E-05 | -1.4E-05 | -0.00019 | -0.00159 | -0.0002 | 0.090987 |  |  |  |
| Inf care | 0.000155 | -8.24E-07 | -0.00046 | 0.000765 | -6.8E-05 | -0.00068 | 0.000531 | -0.00042 | 2.17E-06 | -0.00011 | -0.0005 | -0.00072 | -0.00073 | 0.014385 |  |  |
| GP cont | -0.00027 | 1.70E-06 | 0.000139 | 0.000209 | 0.000662 | 0.000704 | -0.00017 | -0.00016 | 2.32E-06 | -2.6E-05 | 0.000542 | 0.000184 | 0.001413 | 0.000101 | 0.006635 |  |
| Constant | -0.25681 | 0.001763 | -0.01677 | -0.00213 | -0.0117 | 0.008977 | -0.0256 | 0.000275 | -3.2E-05 | -0.00033 | 0.005489 | -0.02324 | -0.02954 | -0.00483 | 0.007066 | 9.248633 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; D\_Frailty: change in frailty; GP cont: GP contact; Inf: informal. | | | | | | | | | | | | | | | | |

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| **Table E24.9** Variance-covariance matrix for paid employment in next cycle logistic regression (Table E16). | | | | | | |
|  | Age | Sex | Frailty | D\_Frailty | Paid employment | Constant |
| Age | 0.000101 |  |  |  |  |  |
| Sex | 7.42E-05 | 0.010451 |  |  |  |  |
| Frailty | -1.7E-05 | -6.9E-05 | 7.29E-05 |  |  |  |
| D\_Frailty | -1.5E-05 | -4.2E-05 | 1.42E-05 | 0.000114 |  |  |
| Paid employment | 0.000326 | 0.001098 | 7.59E-05 | -5.3E-05 | 0.01341 |  |
| Constant | -0.00681 | -0.02024 | 0.000551 | 0.000718 | -0.03271 | 0.494156 |
| **Abbreviation:** D\_Frailty: change in frailty. | | | | | | |

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| **Table E24.10** Variance-covariance matrix for unpaid work in next cycle logistic regression (Table E17). | | | | | | | | | | | | |
|  | Age | Age^2 | Sex | SES2 | SES3 | SES4 | Frailty | D\_Frailty | Cogim | Abngaitbal | Unpaid work | Constant |
| Age | 0.006914 |  |  |  |  |  |  |  |  |  |  |  |
| Age^2 | -4.8E-05 | 3.39E-07 |  |  |  |  |  |  |  |  |  |  |
| Sex | 0.000203 | -1.39E-06 | 0.004238 |  |  |  |  |  |  |  |  |  |
| SES2 | 4.12E-05 | -4.58E-07 | -0.00021 | 0.008939 |  |  |  |  |  |  |  |  |
| SES3 | -2.6E-05 | 4.91E-08 | -0.0005 | 0.003336 | 0.006447 |  |  |  |  |  |  |  |
| SES4 | -0.00051 | 3.69E-06 | -0.00056 | 0.003367 | 0.00358 | 0.009665 |  |  |  |  |  |  |
| Frailty | 6.73E-06 | -8.85E-08 | -3.6E-05 | -1.2E-05 | -3.5E-05 | -9.3E-05 | 2.42E-05 |  |  |  |  |  |
| D\_Frailty | -1.2E-05 | 4.99E-08 | -1.6E-05 | -4.41E-06 | -3.10E-06 | -2.5E-05 | 4.94E-06 | 3.6E-05 |  |  |  |  |
| Cogim | 1.83E-05 | -3.73E-07 | 0.000368 | -0.00032 | -0.00036 | -0.00042 | -2E-05 | -1.3E-05 | 0.008333 |  |  |  |
| Abngaitbal | 0.000524 | -3.94E-06 | 0.000343 | -0.00011 | -0.00016 | -0.00021 | -0.00024 | -1.1E-05 | -6.7E-05 | 0.009451 |  |  |
| Unpaid work | -0.00027 | 1.77E-06 | -0.00015 | -0.00016 | 1.59E-05 | 0.000241 | 9.20E-06 | -3.11E-06 | 8.02E-05 | 6.96E-05 | 0.004198 |  |
| Constant | -0.24487 | 0.001707 | -0.0133 | -0.00334 | -0.00057 | 0.016102 | -0.00017 | 0.000476 | -0.00077 | -0.01694 | 0.008566 | 8.707539 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; D\_Frailty: change in frailty; SES: socioeconomic status. | | | | | | | | | | | | |

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| **Table E24.11** Variance-covariance matrix for change in CASP-19 linear regression (Table E18). | | | | | | | | | | | | | |
|  | SES2 | SES3 | SES4 | Falls inc1 | Falls inc2 | Falls inc3 | Falls inc4 | Frailty | Frailty^2 | D\_Frailty | High PA | CASP-19 | Constant |
| SES2 | 1.79E-05 |  |  |  |  |  |  |  |  |  |  |  |  |
| SES3 | 7.21E-06 | 1.32E-05 |  |  |  |  |  |  |  |  |  |  |  |
| SES4 | 7.45E-06 | 7.96E-06 | 1.92E-05 |  |  |  |  |  |  |  |  |  |  |
| Falls inc1 | 4.14E-07 | 2.07E-08 | 5.49E-08 | 2E-05 |  |  |  |  |  |  |  |  |  |
| Falls inc2 | 3.13E-07 | 2.25E-07 | 2.27E-07 | 3.04E-06 | 2.66E-05 |  |  |  |  |  |  |  |  |
| Falls inc3 | 9.48E-08 | -4.42E-07 | -9.18E-08 | 2.89E-06 | 3.43E-06 | 4.74E-05 |  |  |  |  |  |  |  |
| Falls inc4 | -8.07E-08 | -5.68E-07 | 1.73E-08 | 3.18E-06 | 4.92E-06 | 3.84E-06 | 6.65E-05 |  |  |  |  |  |  |
| Frailty | -8.09E-08 | -1.38E-07 | -2.45E-07 | -4.86E-08 | -1.75E-07 | -1.40E-07 | -3.59E-07 | 1.997e |  |  |  |  |  |
| Frailty^2 | 1.45E-09 | 2.35E-09 | 4.38E-09 | 5.41E-10 | -3.10E-11 | 2.10E-09 | 2.69E-09 | -4.365e | 1.156e |  |  |  |  |
| D\_Frailty | -9.20E-09 | 3.54E-09 | -7.88E-09 | -3.65E-08 | -1.31E-07 | -1.17E-07 | -2.34E-07 | 4.657e | 1.027e | 6.043e |  |  |  |
| High PA | 4.41E-07 | 6.15E-07 | 4.93E-07 | 1.14E-07 | -1.87E-07 | -6.24E-07 | -2.23E-07 | 3.278e | -4.955e | 4.831e | 1.44E-05 |  |  |
| CASP-19 | 1.94E-06 | 4.08E-06 | 9.10E-06 | 4.31E-07 | 1.40E-06 | 1.34E-06 | -7.55E-07 | 1.075e | -2.155e | 2.793e | -1.52E-06 | 0.000128 |  |
| Constant | -8.05E-06 | -9.30E-06 | -1.2E-05 | -2.66E-06 | -1.74E-06 | -2.08E-06 | 1.87E-06 | -2.042e | 2.491e | -4.132e | -4.76E-06 | -0.00011 | 0.000107 |
| **Abbreviation:** D\_Frailty: change in frailty; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | | |

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| **Table E24.12** Variance-covariance matrix for out-of-pocket care receipt in next cycle logistic regression (Table E19). | | | | | | | | | | | | | |
|  | Age | Sex | SES2 | SES3 | SES4 | Frailty | Frailty^2 | D\_Frailty | High PA | Fear | OOP care | Inf care | Constant |
| Age | 9.18E-05 |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -2.7E-05 | 0.029619 |  |  |  |  |  |  |  |  |  |  |  |
| SES2 | -0.00017 | -0.0018 | 0.051535 |  |  |  |  |  |  |  |  |  |  |
| SES3 | -6.4E-05 | -0.00532 | 0.021147 | 0.037413 |  |  |  |  |  |  |  |  |  |
| SES4 | 0.000247 | -0.00491 | 0.020742 | 0.022835 | 0.061125 |  |  |  |  |  |  |  |  |
| Frailty | -5.1E-05 | 5.29E-05 | -0.00029 | -0.00066 | -0.00106 | 0.000721 |  |  |  |  |  |  |  |
| Frailty^2 | 5.84E-07 | -6.97E-07 | 3.74E-06 | 8.47E-06 | 1.3E-05 | -1.3E-05 | 2.60E-07 |  |  |  |  |  |  |
| D\_Frailty | -1E-05 | 8.38E-05 | -6.5E-05 | -5.2E-05 | -7.2E-05 | 1.88E-06 | 3.22E-07 | 9.73E-05 |  |  |  |  |  |
| High PA | 0.000157 | 0.001848 | 0.001724 | 0.002019 | 0.002639 | 0.001425 | -2.1E-05 | 9.59E-05 | 0.189463 |  |  |  |  |
| Fear | -1.3E-05 | 0.000113 | 0.000518 | -0.00187 | -0.00263 | -0.00036 | -2.24E-06 | -1E-05 | -0.00043 | 0.038688 |  |  |  |
| OOP care | -3.2E-05 | -0.00176 | -0.00063 | 0.00153 | 0.004705 | -0.0007 | 8.65E-06 | 0.000251 | -8.4E-05 | -0.00039 | 0.037193 |  |  |
| Inf care | 6.4E-05 | -0.00146 | 0.000403 | 0.002216 | 0.00181 | -0.00105 | 5.97E-06 | -0.00029 | 0.001543 | -0.00306 | -0.00128 | 0.032695 |  |
| Constant | -0.00616 | -0.04625 | -0.00013 | 0.001202 | -0.01807 | -0.00312 | 7.13E-05 | 5.46E-05 | -0.04222 | 0.0038 | 0.005952 | 0.003584 | 0.58157 |
| **Abbreviation:** D\_Frailty: change in frailty; Fear: fear of falling; Inf: informal; OOP: out-of-pocket; PA: physical activity; SES: socioeconomic status. | | | | | | | | | | | | | |

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| **Table E24.13** Variance-covariance matrix for informal care receipt in next cycle logistic regression (Table E20). | | | | | | | | | | |
|  | Sex | Frailty | Frailty^2 | D\_Frailty | Abngaitbal | Social care | OOP care | Inf care | Multiple inf care | Constant |
| Sex | 0.005814 |  |  |  |  |  |  |  |  |  |
| Frailty | -3E-05 | 0.00016 |  |  |  |  |  |  |  |  |
| Frailty^2 | 2.75E-07 | -3.47E-06 | 9.33E-08 |  |  |  |  |  |  |  |
| D\_Frailty | 8.50E-06 | 1.89E-06 | 1.53E-07 | 3.74E-05 |  |  |  |  |  |  |
| Abngaitbal | 0.000494 | -0.00031 | 1.47E-06 | -2.3E-05 | 0.008998 |  |  |  |  |  |
| Social care | -0.00044 | 0.000344 | -1.7E-05 | -9.6E-05 | -0.00045 | 0.081435 |  |  |  |  |
| OOP care | -0.0009 | -0.00011 | -1.82E-06 | -3.6E-05 | -0.00035 | -0.00464 | 0.034848 |  |  |  |
| Inf care | -0.00049 | -0.00017 | 2.82E-06 | 2.33E-05 | -3.6E-05 | -0.00045 | -0.00089 | 0.008586 |  |  |
| Multiple inf care | 0.001064 | 3.25E-05 | -5.19E-06 | 6.62E-05 | -0.00059 | -0.00201 | 0.001344 | -0.0056 | 0.021025 |  |
| Constant | -0.00908 | -0.00109 | 2.14E-05 | -0.0002 | 0.000351 | 7.61E-05 | 0.002426 | 0.000184 | -0.00116 | 0.025836 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; D\_Frailty: change in frailty; Inf: informal; OOP: out-of-pocket. | | | | | | | | | | |

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| **Table E24.14** Variance-covariance matrix for multiple informal care needs logistic regression (Table E21). | | | | | | | | |
|  | Frailty | D\_Frailty | Cogim | Abngaitbal | Community HC | OOP care | Multiple inf care | Constant |
| Frailty | 6.88E-05 |  |  |  |  |  |  |  |
| D\_Frailty | 2.55E-05 | 8.84E-05 |  |  |  |  |  |  |
| Cogim | -6.5E-05 | -8.5E-05 | 0.020978 |  |  |  |  |  |
| Abngaitbal | -0.00056 | -2.3E-05 | -0.00073 | 0.021228 |  |  |  |  |
| Community HC | -0.00065 | -0.0002 | -0.0102 | 0.003074 | 0.481901 |  |  |  |
| OOP care | -0.00034 | -0.00019 | 0.000534 | -0.00177 | -0.00417 | 0.068713 |  |  |
| Multiple inf care | -0.00035 | 0.000325 | -0.00092 | -8.4E-05 | -0.00752 | -0.00066 | 0.025347 |  |
| Constant | -0.00099 | -0.0009 | -0.00276 | -0.00016 | 0.012421 | 0.004172 | -0.00086 | 0.027117 |
| **Abbreviation:** Abngaitbal: abnormal gait/balance; Cogim: cognitive impairment; D\_Frailty: change in frailty; HC: healthcare; Inf: informal; OOP: out-of-pocket. | | | | | | | | |

# Appendix F: Model results

## Probabilistic sensitivity analysis

This section presents additional probabilistic sensitivity analysis results for Chapter 6. Figure F1 shows the average societal ICER (considering all-cause costs) of RC relative to UC stabilising at around £14,100 per QALY gained after 600 runs. Hence, the number of PSA runs were kept to 1,000.

**Figure F1** Average societal ICER considering all-cause costs of RC relative to UC under 40-year CUA by number of PSA runs. **Abbreviation:** CUA: cost-utility analysis; ICER: incremental cost-effectiveness ratio; PSA: probabilistic sensitivity analysis; RC: recommended care; UC: usual care.

Figure F2 shows the scatter plot of public sector outcomes from probabilistic runs conducted on base case 40-year CUA. The probability of RC being cost-effective relative to UC was 94.5% under the cost-effectiveness threshold of £20,000 per QALY gained and 100% under £30,000 per QALY gained.

Threshold: £30,000 per QALY gained

Threshold: £20,000 per QALY gained

**Figure F2** Scatter plot of probabilistic sensitivity analysis result for base case cost-utility analysis under public sector perspective and 40-year horizon. **Abbreviation:** QALY: quality-adjusted life year.

Figure F3 shows the CEAC for the base case public sector 40-year CUA. The probability of RC being cost-effective relative to UC crossed 50% at cost-effectiveness threshold of £14,540 per QALY gained. The CEAF began at the threshold value of £14,419 per QALY gained.

**Figure F3** Cost-effectiveness acceptability curve for base case cost-utility analysis under public sector perspective and 40-year horizon. **Abbreviation:** CEAF: cost-effectiveness acceptability frontier; QALY: quality-adjusted life year; RC: recommended care; UC: usual care.

## Subgroup analysis

This section presents subgroup results for the base case comparison.

### Outcomes by cohort

Table F1 shows the subgroup outcomes for the initial cohort aged 60+ at baseline and for the new cohorts entering as 60-year-olds at subsequent cycles.

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| **Table F1** Outcomes by cohort for base case 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **Initial cohort aged 60+ at baseline (n=125,244)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £4,881,117,084 | £4,821,364,087 | -£59,752,997 |
| *(2) Fall-related healthcare costs* | £351,014,119 | £296,762,792 | -£54,251,328 |
| *Public sector intervention costs3* | £15,844,344 | £185,765,944 | £169,921,600 |
| QALY | 864,289 | 873,590 | 9,301 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £9,387,197 |
| *Net private expenditure5* |  |  | £10,053,761 |
| *Net informal caregiving cost6* |  |  | -£11,519,567 |
| Societal gain, QALY equivalent |  |  | 181 QALYs |
| **Societal ICER using (1)7** |  |  | **£11,619 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£12,199 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£174,278,899** |
| **Societal INMB using (2)** |  |  | **£168,777,229** |
| **New entry cohorts aged 60 at model entry (n=259,948)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £5,172,976,103 | £5,105,506,496 | -£67,469,608 |
| *(2) Fall-related healthcare costs* | £307,409,758 | £256,277,725 | -£51,132,033 |
| *Public sector intervention costs* | £19,537,764 | £246,611,759 | £227,073,995 |
| QALY | 1,222,636 | 1,232,905 | 10,269 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £2,282,879 |
| *Net private expenditure* |  |  | £13,668,965 |
| *Net informal caregiving cost* |  |  | -£83,305,784 |
| Societal gain, QALY equivalent |  |  | 1,199 QALYs |
| **Societal ICER using (1)9** |  |  | **£13,918 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£15,342 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£184,429,962** |
| **Societal INMB using (2)** |  |  | **£168,092,387** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £11,845 per QALY gained using (1) and £12,437 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £15,542 per QALY gained using (1) and £17,133 using (2). | | | |

### Outcomes by age group at model entry

Table F2 shows the subgroup outcomes by five-year age group at model entry.

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| **Table F2** Outcomes by age group at model entry for base case 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **Aged 60-64 at model entry among initial cohort (n=29,077)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £1,295,563,238 | £1,280,659,209 | -£14,904,028 |
| *(2) Fall-related healthcare costs* | £84,148,287 | £70,843,148 | -£13,305,139 |
| *Public sector intervention costs3* | £4,292,997 | £50,473,135 | £46,180,138 |
| QALY | 283,967 | 287,051 | 3,084 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £8,379,759 |
| *Net private expenditure5* |  |  | £1,480,789 |
| *Net informal caregiving cost6* |  |  | -£14,637,398 |
| Societal gain, QALY equivalent |  |  | 359 QALYs |
| **Societal ICER using (1)7** |  |  | **£9,085 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£9,550 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£72,000,074** |
| **Societal INMB using (2)** |  |  | **£70,401,185** |
| **Aged 65-69 at model entry (n=25,093)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £1,068,761,942 | £1,055,067,977 | -£13,693,965 |
| *(2) Fall-related healthcare costs* | £75,952,881 | £63,618,898 | -£12,333,983 |
| *Public sector intervention costs* | £3,594,409 | £42,346,982 | £38,752,573 |
| QALY | 211,020 | 213,419 | 2,398 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £756,511 |
| *Net private expenditure* |  |  | £887,608 |
| *Net informal caregiving cost* |  |  | -£4,096,261 |
| Societal gain, QALY equivalent |  |  | 66 QALYs |
| **Societal ICER using (1)9** |  |  | **£10,168 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£10,719 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£48,877,475** |
| **Societal INMB using (2)** |  |  | **£47,517,492** |
| **Aged 70-74 at model entry (n=25,289)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £1,004,599,256 | £994,070,842 | -£10,528,414 |
| *(2) Fall-related healthcare costs* | £74,591,609 | £63,415,440 | -£11,176,169 |
| *Public sector intervention costs* | £3,271,570 | £39,366,924 | £36,095,354 |
| QALY | 173,643 | 175,535 | 1,892 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £922,329 |
| *Net private expenditure* |  |  | £3,151,993 |
| *Net informal caregiving cost* |  |  | £3,077,672 |
| Societal gain, QALY equivalent |  |  | -88 QALYs |
| **Societal ICER using (1)10** |  |  | **£14,174 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£13,815 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£28,546,893** |
| **Societal INMB using (2)** |  |  | **£29,194,647** |
| **Aged 75-79 at model entry (n=18,775)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £688,777,958 | £677,915,271 | -£10,862,687 |
| *(2) Fall-related healthcare costs* | £53,395,279 | £44,769,997 | -£8,625,283 |
| *Public sector intervention costs* | £2,229,433 | £26,171,839 | £23,942,407 |
| QALY | 101,028 | 101,931 | 903 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£617,665 |
| *Net private expenditure* |  |  | £552,947 |
| *Net informal caregiving cost* |  |  | -£603,118 |
| Societal gain, QALY equivalent |  |  | -9 QALYs |
| **Societal ICER using (1)11** |  |  | **£14,634 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£17,137 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£13,734,033** |
| **Societal INMB using (2)** |  |  | **£11,496,629** |
| **Aged 80-84 at model entry (n=14,457)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £467,008,915 | £461,024,033 | -£5,984,883 |
| *(2) Fall-related healthcare costs* | £36,351,496 | £30,876,666 | -£5,474,830 |
| *Public sector intervention costs* | £1,456,738 | £16,734,881 | £15,278,143 |
| QALY | 58,592 | 59,262 | 670 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £49,777 |
| *Net private expenditure* |  |  | £1,646,049 |
| *Net informal caregiving cost* |  |  | £2,893,593 |
| Societal gain, QALY equivalent |  |  | -75 QALYs |
| **Societal ICER using (1)12** |  |  | **£15,605 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£16,462 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£8,572,306** |
| **Societal INMB using (2)** |  |  | **£8,062,254** |
| **Aged 85-89 at model entry (n=8,232)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £238,515,929 | £236,140,760 | -£2,375,169 |
| *(2) Fall-related healthcare costs* | £17,908,811 | £15,561,214 | -£2,347,598 |
| *Public sector intervention costs* | £686,490 | £7,478,164 | £6,791,674 |
| QALY | 25,821 | 26,092 | 271 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£66,100 |
| *Net private expenditure* |  |  | £1,209,084 |
| *Net informal caregiving cost* |  |  | £1,694,790 |
| Societal gain, QALY equivalent |  |  | -50 QALYs |
| **Societal ICER using (1)13** |  |  | **£19,926 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£20,050 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£2,233,008** |
| **Societal INMB using (2)** |  |  | **£2,205,437** |
| **Aged 90+ at model entry (n=4,567)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £117,889,846 | £116,485,995 | -£1,403,850 |
| *(2) Fall-related healthcare costs* | £8,665,755 | £7,677,430 | -£988,326 |
| *Public sector intervention costs* | £312,707 | £3,194,018 | £2,881,312 |
| QALY | 10,218 | 10,299 | 81 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£37,413 |
| *Net private expenditure* |  |  | £1,125,290 |
| *Net informal caregiving cost* |  |  | £151,155 |
| Societal gain, QALY equivalent |  |  | -22 QALYs |
| **Societal ICER using (1)14** |  |  | **£24,726 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£31,681 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£315,110** |
| **Societal INMB using (2)** |  |  | **-£100,414** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £10,143 per QALY gained using (1) and £10,661 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £10,448 per QALY gained using (1) and £11,015 using (2).  10 The public sector ICERs are £13,511 per QALY gained using (1) and £13,169 using (2).  11 The public sector ICERs are £14,481 per QALY gained using (1) and £16,958 using (2).  12 The public sector ICERs are £13,863 per QALY gained using (1) and £14,624 using (2).  13 The public sector ICERs are £16,288 per QALY gained using (1) and £16,390 using (2).  14 The public sector ICERs are £18,095 per QALY gained using (1) and £23,184 using (2). | | | |

### Outcomes by sex

Table F3 shows the subgroup outcomes by sex.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F3** Outcomes by sex for base case 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **Male (n=183,881)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £4,418,365,849 | £4,389,336,842 | -£29,029,007 |
| *(2) Fall-related healthcare costs* | £195,909,838 | £170,535,909 | -£25,373,929 |
| *Public sector intervention costs3* | £12,962,962 | £181,930,407 | £168,967,446 |
| QALY | 1,009,664 | 1,016,957 | 7,293 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £4,398,468 |
| *Net private expenditure5* |  |  | £19,427,455 |
| *Net informal caregiving cost6* |  |  | -£27,870,521 |
| Societal gain, QALY equivalent |  |  | 214 QALYs |
| **Societal ICER using (1)7** |  |  | **£18,641 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£19,128 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£85,273,829** |
| **Societal INMB using (2)** |  |  | **£81,618,750** |
| **Female (n=201,311)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £5,635,727,338 | £5,537,533,741 | -£98,193,598 |
| *(2) Fall-related healthcare costs* | £462,514,040 | £382,504,608 | -£80,009,432 |
| *Public sector intervention costs* | £22,419,146 | £250,447,296 | £228,028,150 |
| QALY | 1,077,261 | 1,089,538 | 12,277 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £7,271,608 |
| *Net private expenditure* |  |  | £4,295,271 |
| *Net informal caregiving cost* |  |  | -£66,954,830 |
| Societal gain, QALY equivalent |  |  | 1,166 QALYs |
| **Societal ICER using (1)9** |  |  | **£9,659 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£11,011 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£273,439,532** |
| **Societal INMB using (2)** |  |  | **£255,255,366** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £19,188 per QALY gained using (1) and £19,689 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £10,575 per QALY gained using (1) and £12,057 using (2). | | | |

### Outcomes by socioeconomic status

Table F4 shows the subgroup outcomes by SES quartile.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F4** Outcomes by socioeconomic status quartile for base case 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **1st socioeconomic status quartile (n=132,844)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £3,202,571,699 | £3,166,850,629 | -£35,721,070 |
| *(2) Fall-related healthcare costs* | £210,350,293 | £177,216,531 | -£33,133,761 |
| *Public sector intervention costs3* | £11,181,285 | £144,517,691 | £133,280,563 |
| QALY | 796,280 | 803,121 | 6,841 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £8,010,569 |
| *Net private expenditure5* |  |  | -£3,236,404 |
| *Net informal caregiving cost6* |  |  | -£34,898,688 |
| Societal gain, QALY equivalent |  |  | 769 QALYs |
| **Societal ICER using (1)7** |  |  | **£12,819 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£13,159 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£130,756,961** |
| **Societal INMB using (2)** |  |  | **£128,169,652** |
| **2nd socioeconomic status quartile (n=71,780)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £1,725,402,199 | £1,705,189,086 | -£20,213,112 |
| *(2) Fall-related healthcare costs* | £117,132,131 | £98,833,621 | -£18,298,510 |
| *Public sector intervention costs* | £6,213,655 | £78,542,655 | £72,329,000 |
| QALY | 391,621 | 395,068 | 3,447 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £443,341 |
| *Net private expenditure* |  |  | £5,810,088 |
| *Net informal caregiving cost* |  |  | -£14,950,779 |
| Societal gain, QALY equivalent |  |  | 160 QALYs |
| **Societal ICER using (1)9** |  |  | **£14,450 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,981 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£52,115,888** |
| **Societal INMB using (2)** |  |  | **£54,030,490** |
| **3rd socioeconomic status quartile (n=118,935)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £3,276,107,364 | £3,232,673,931 | -£43,433,433 |
| *(2) Fall-related healthcare costs* | £210,656,929 | £176,496,459 | -£34,160,470 |
| *Public sector intervention costs* | £11,226,941 | £134,960,545 | £123,733,604 |
| QALY | 631,512 | 637,465 | 5,953 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £3,816,622 |
| *Net private expenditure* |  |  | £11,077,206 |
| *Net informal caregiving cost* |  |  | -£32,391,864 |
| Societal gain, QALY equivalent |  |  | 419 QALYs |
| **Societal ICER using (1)10** |  |  | **£12,602 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,057 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£110,863,064** |
| **Societal INMB using (2)** |  |  | **£101,590,100** |
| **4th socioeconomic status quartile (n=61,633)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £1,850,011,924 | £1,822,156,935 | -£27,854,989 |
| *(2) Fall-related healthcare costs* | £120,284,524 | £100,493,905 | -£19,790,619 |
| *Public sector intervention costs* | £6,764,885 | £74,417,313 | £67,652,428 |
| QALY | 267,512 | 270,840 | 3,328 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£600,455 |
| *Net private expenditure* |  |  | £10,071,835 |
| *Net informal caregiving cost* |  |  | -£12,584,021 |
| Societal gain, QALY equivalent |  |  | 32 QALYs |
| **Societal ICER using (1)11** |  |  | **£11,844 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,244 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£61,008,301** |
| **Societal INMB using (2)** |  |  | **£52,943,931** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £14,260 per QALY gained using (1) and £14,638 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £15,120 per QALY gained using (1) and £15,676 using (2).  10 The public sector ICERs are £13,488 per QALY gained using (1) and £15,046 using (2).  11 The public sector ICERs are £11,957 per QALY gained using (1) and £14,380 using (2). | | | |

Figures F4(a) and (b) show the equally distributed equivalent incremental net health benefit of RC relative to UC across the spectrums of relative and absolute inequality aversion parameters, respectively. SES quartile is taken as the subgroup delineating characteristic of equity relevance.

**Figure F4** Sensitivity of societal EDE INHB for SES-delineated equity analysis across parameter spectrum of: (a) relative inequality aversion; and (b) absolute inequality aversion. **Abbreviation:** EDE: equally distributed equivalent; INHB: incremental net health benefit; RC: recommended care; SES: socioeconomic status; UC: usual care.

### Outcomes by frailty category at model entry

Table F5 shows the subgroup outcomes by frailty category at model entry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F5** Outcomes by initial frailty category for base case 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **Fit category at model entry (n=244,231)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £5,826,094,424 | £5,767,683,441 | -£58,410,983 |
| *(2) Fall-related healthcare costs* | £324,111,696 | £275,254,176 | -£48,857,520 |
| *Public sector intervention costs3* | £17,933,939 | £248,444,499 | £237,076,461 |
| QALY | 1,494,891 | 1,505,833 | 10,942 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £10,227,163 |
| *Net private expenditure5* |  |  | £11,862,880 |
| *Net informal caregiving cost6* |  |  | -£65,531,860 |
| Societal gain, QALY equivalent |  |  | 1,065 QALYs |
| **Societal ICER using (1)7** |  |  | **£14,880 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£15,676 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£181,542,593** |
| **Societal INMB using (2)** |  |  | **£171,989,130** |
| **Mild frailty category at model entry (n=105,693)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £3,042,658,172 | £2,996,592,951 | -£46,065,221 |
| *(2) Fall-related healthcare costs* | £229,182,020 | £190,639,806 | -£38,542,215 |
| *Public sector intervention costs* | £11,767,896 | £135,248,016 | £123,480,120 |
| QALY | 498,178 | 504,682 | 6,504 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £680,906 |
| *Net private expenditure* |  |  | £8,062,598 |
| *Net informal caregiving cost* |  |  | -£29,102,192 |
| Societal gain, QALY equivalent |  |  | 362 QALYs |
| **Societal ICER using (1)9** |  |  | **£11,275 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£12,371 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£128,562,351** |
| **Societal INMB using (2)** |  |  | **£121,039,345** |
| **Moderate frailty category at model entry (n=28,528)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £933,836,914 | £914,376,961 | -£19,459,953 |
| *(2) Fall-related healthcare costs* | £89,271,727 | £73,172,956 | -£16,098,771 |
| *Public sector intervention costs* | £4,581,233 | £40,433,974 | £35,852,741 |
| QALY | 83,519 | 85,336 | 1,817 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £594,864 |
| *Net private expenditure* |  |  | £2,616,730 |
| *Net informal caregiving cost* |  |  | -£2,095,303 |
| Societal gain, QALY equivalent |  |  | 1 QALY |
| **Societal ICER using (1)10** |  |  | **£9,017 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£10,866 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£38,147,931** |
| **Societal INMB using (2)** |  |  | **£34,786,749** |
| **Severe frailty category at model entry (n=6,740)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £251,503,678 | £248,217,230 | -£3,286,448 |
| *(2) Fall-related healthcare costs* | £15,858,434 | £13,973,579 | -£1,884,855 |
| *Public sector intervention costs* | £1,099,040 | £8,251,215 | £7,152,175 |
| QALY | 10,336 | 10,643 | 307 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £167,143 |
| *Net private expenditure* |  |  | £1,180,518 |
| *Net informal caregiving cost* |  |  | £1,904,005 |
| Societal gain, QALY equivalent |  |  | -49 QALYs |
| **Societal ICER using (1)11** |  |  | **£14,959 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£20,382 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£3,887,083** |
| **Societal INMB using (2)** |  |  | **£2,485,490** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £16,328 per QALY gained using (1) and £17,202 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £11,903 per QALY gained using (1) and £13,060 using (2).  10 The public sector ICERs are £9,023 per QALY gained using (1) and £10,873 using (2).  11 The public sector ICERs are £12,590 per QALY gained using (1) and £17,155 using (2). | | | |

### Outcomes by other covariates at model entry

Table F6 shows the subgroup outcomes by physical activity status at model entry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F6** Outcomes by initial physical activity status for 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **High physical activity at model entry (n=82,460)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £1,940,938,986 | £1,921,824,646 | -£19,114,340 |
| *(2) Fall-related healthcare costs* | £108,715,022 | £92,345,927 | -£16,369,095 |
| *Public sector intervention costs3* | £6,122,662 | £84,726,644 | £78,603,982 |
| QALY | 493,144 | 497,474 | 4,330 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £6,381,636 |
| *Net private expenditure5* |  |  | £4,116,903 |
| *Net informal caregiving cost6* |  |  | -£21,892,919 |
| Societal gain, QALY equivalent |  |  | 403 QALYs |
| **Societal ICER using (1)7** |  |  | **£12,570 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£13,150 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£82,490,684** |
| **Societal INMB using (2)** |  |  | **£79,745,439** |
| **Not high physical activity at model entry (n=302,732)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £8,113,154,201 | £8,005,045,936 | -£108,108,265 |
| *(2) Fall-related healthcare costs* | £549,708,856 | £460,694,591 | -£89,014,265 |
| *Public sector intervention costs* | £29,259,446 | £347,651,060 | £318,391,613 |
| QALY | 1,593,781 | 1,609,020 | 15,240 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £5,288,440 |
| *Net private expenditure* |  |  | £19,605,822 |
| *Net informal caregiving cost* |  |  | -£72,932,432 |
| Societal gain, QALY equivalent |  |  | 977 QALYs |
| **Societal ICER using (1)9** |  |  | **£12,967 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,145 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£276,212,177** |
| **Societal INMB using (2)** |  |  | **£257,118,177** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £13,739 per QALY gained using (1) and £14,373 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £13,798 per QALY gained using (1) and £15,051 using (2). | | | |

Table F7 shows the subgroup outcomes by cognitive status at model entry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F7** Outcomes by initial cognitive status for 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **Cognitively intact at model entry (n=325,083)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £8,390,605,434 | £8,282,250,108 | -£108,355,326 |
| *(2) Fall-related healthcare costs* | £547,613,591 | £458,259,582 | -£89,354,009 |
| *Public sector intervention costs3* | £29,735,544 | £365,276,480 | £335,540,936 |
| QALY | 1,794,561 | 1,811,256 | 16,695 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £10,366,724 |
| *Net private expenditure5* |  |  | £17,969,354 |
| *Net informal caregiving cost6* |  |  | -£90,183,718 |
| Societal gain, QALY equivalent |  |  | 1,376 QALYs |
| **Societal ICER using (1)7** |  |  | **£12,571 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£13,623 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£314,963,934** |
| **Societal INMB using (2)** |  |  | **£295,962,617** |
| **Cognitively impaired at model entry (n=60,109)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £1,663,487,754 | £1,644,620,475 | -£18,867,279 |
| *(2) Fall-related healthcare costs* | £110,810,286 | £94,780,935 | -£16,029,351 |
| *Public sector intervention costs* | £5,646,564 | £67,101,224 | £61,454,660 |
| QALY | 292,364 | 295,238 | 2,874 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £1,303,352 |
| *Net private expenditure* |  |  | £5,753,371 |
| *Net informal caregiving cost* |  |  | -£4,641,633 |
| Societal gain, QALY equivalent |  |  | 3 QALYs |
| **Societal ICER using (1)9** |  |  | **£14,800 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£15,786 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£43,738,927** |
| **Societal INMB using (2)** |  |  | **£40,900,998** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £13,608 per QALY gained using (1) and £14,746 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £14,816 per QALY gained using (1) and £15,804 using (2). | | | |

Table F8 shows the subgroup outcomes by fear of falling status at model entry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F8** Outcomes by initial fear of falling status for 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **No fear of falling at model entry (n=367,640)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £9,494,922,194 | £9,377,123,970 | -£117,798,224 |
| *(2) Fall-related healthcare costs* | £609,664,870 | £512,519,766 | -£97,145,104 |
| *Public sector intervention costs3* | £32,654,964 | £408,474,667 | £375,819,703 |
| QALY | 2,025,483 | 2,043,838 | 18,355 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £10,358,495 |
| *Net private expenditure5* |  |  | £22,177,045 |
| *Net informal caregiving cost6* |  |  | -£96,532,831 |
| Societal gain, QALY equivalent |  |  | 1,412 QALYs |
| **Societal ICER using (1)7** |  |  | **£13,053 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,098 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£334,988,662** |
| **Societal INMB using (2)** |  |  | **£314,335,541** |
| **Fear of falling at model entry (n=17,552)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £559,170,994 | £549,746,613 | -£9,424,381 |
| *(2) Fall-related healthcare costs* | £48,759,007 | £40,520,751 | -£8,238,256 |
| *Public sector intervention costs* | £2,727,144 | £23,903,037 | £21,175,893 |
| QALY | 61,442 | 62,657 | 1,215 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £1,311,581 |
| *Net private expenditure* |  |  | £1,545,680 |
| *Net informal caregiving cost* |  |  | £1,707,479 |
| Societal gain, QALY equivalent |  |  | -32 QALYs |
| **Societal ICER using (1)9** |  |  | **£9,940 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£10,943 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£23,717,199** |
| **Societal INMB using (2)** |  |  | **£22,531,074** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £14,057 per QALY gained using (1) and £15,182 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £9,675 per QALY gained using (1) and £10,651 using (2). | | | |

Table F9 shows the subgroup outcomes by gait/balance status at model entry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F9** Outcomes by initial gait/balance status for 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **No abnormal gait/balance at model entry (n=306,863)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £7,693,078,618 | £7,605,671,025 | -£87,407,593 |
| *(2) Fall-related healthcare costs* | £473,701,595 | £399,299,108 | -£74,402,487 |
| *Public sector intervention costs3* | £25,592,957 | £329,422,972 | £303,830,015 |
| QALY | 1,782,506 | 1,797,759 | 15,253 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £14,478,556 |
| *Net private expenditure5* |  |  | £15,082,111 |
| *Net informal caregiving cost6* |  |  | -£81,002,509 |
| Societal gain, QALY equivalent |  |  | 1,340 QALYs |
| **Societal ICER using (1)7** |  |  | **£13,043 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£13,827 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£281,376,055** |
| **Societal INMB using (2)** |  |  | **£268,370,950** |
| **Abnormal gait/balance at model entry (n=78,329)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £2,361,014,570 | £2,321,199,558 | -£39,815,012 |
| *(2) Fall-related healthcare costs* | £184,722,282 | £153,741,409 | -£30,980,873 |
| *Public sector intervention costs* | £9,789,151 | £102,954,731 | £93,165,580 |
| QALY | 304,419 | 308,735 | 4,316 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£2,808,480 |
| *Net private expenditure* |  |  | £8,640,614 |
| *Net informal caregiving cost* |  |  | -£13,822,841 |
| Societal gain, QALY equivalent |  |  | 40 QALYs |
| **Societal ICER using (1)9** |  |  | **£12,248 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,276 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£77,325,305** |
| **Societal INMB using (2)** |  |  | **£68,491,166** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £14,189 per QALY gained using (1) and £15,041 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £12,360 per QALY gained using (1) and £14,407 using (2). | | | |

Table F10 shows the subgroup outcomes by falls history type at model entry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F10** Outcomes by falls history type at model entry for 40-year societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **No falls history (n=292,074)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £7,446,456,913 | £7,362,570,982 | -£83,885,931 |
| *(2) Fall-related healthcare costs* | £460,117,890 | £388,777,031 | -£71,340,859 |
| *Public sector intervention costs3* | £23,388,688 | £313,012,980 | £289,624,292 |
| QALY | 1,633,681 | 1,647,721 | 14,039 |
| Societal outcomes |  |  |  |
| *Net productivity4* |  |  | £11,442,078 |
| *Net private expenditure5* |  |  | £17,130,464 |
| *Net informal caregiving cost6* |  |  | -£66,113,947 |
| Societal gain, QALY equivalent |  |  | 1,007 QALYs |
| **Societal ICER using (1)7** |  |  | **£13,674 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,507 per QALY gained** |
| **Societal INMB using (1)8** |  |  | **£245,653,420** |
| **Societal INMB using (2)** |  |  | **£233,108,348** |
| **History of single non-MA fall (n=38,847)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £1,044,148,137 | £1,029,836,174 | -£14,311,963 |
| *(2) Fall-related healthcare costs* | £71,992,985 | £60,394,783 | -£11,598,202 |
| *Public sector intervention costs* | £3,552,756 | £44,696,822 | £41,144,066 |
| QALY | 207,793 | 209,751 | 1,958 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£2,005,028 |
| *Net private expenditure* |  |  | £3,181,559 |
| *Net informal caregiving cost* |  |  | -£9,140,507 |
| Societal gain, QALY equivalent |  |  | 66 QALYs |
| **Societal ICER using (1)9** |  |  | **£13,255 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,596 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£33,895,358** |
| **Societal INMB using (2)** |  |  | **£31,181,596** |
| **History of recurrent non-MA falls (n=32,301)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £921,287,577 | £904,729,125 | -£16,558,452 |
| *(2) Fall-related healthcare costs* | £74,657,208 | £61,453,608 | -£13,203,600 |
| *Public sector intervention costs* | £4,568,548 | £43,359,843 | £38,791,295 |
| QALY | 141,123 | 143,307 | 2,184 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £104,467 |
| *Net private expenditure* |  |  | £1,517,201 |
| *Net informal caregiving cost* |  |  | -£10,857,070 |
| Societal gain, QALY equivalent |  |  | 157 QALYs |
| **Societal ICER using (1)10** |  |  | **£9,495 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£10,928 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£48,012,325** |
| **Societal INMB using (2)** |  |  | **£44,657,473** |
| **History of single MA fall (n=13,217)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £372,715,925 | £366,336,806 | -£6,379,118 |
| *(2) Fall-related healthcare costs* | £28,038,580 | £23,143,605 | -£4,894,976 |
| *Public sector intervention costs* | £2,090,692 | £18,453,256 | £16,362,565 |
| QALY | 67,466 | 68,173 | 707 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £1,258,716 |
| *Net private expenditure* |  |  | £1,106,253 |
| *Net informal caregiving cost* |  |  | -£5,812,477 |
| Societal gain, QALY equivalent |  |  | 99 QALYs |
| **Societal ICER using (1)11** |  |  | **£12,375 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,214 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£14,219,523** |
| **Societal INMB using (2)** |  |  | **£12,735,381** |
| **History of recurrent falls with one or more MA fall (n=8,753)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £269,484,636 | £263,397,496 | -£6,087,140 |
| *(2) Fall-related healthcare costs* | £23,617,214 | £19,271,491 | -£4,345,724 |
| *Public sector intervention costs* | £1,781,424 | £12,854,802 | £11,073,378 |
| QALY | 36,862 | 37,542 | 681 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £869,842 |
| *Net private expenditure* |  |  | £787,249 |
| *Net informal caregiving cost* |  |  | -£2,901,350 |
| Societal gain, QALY equivalent |  |  | 50 QALYs |
| **Societal ICER using (1)12** |  |  | **£6,827 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£9,212 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£16,923,734** |
| **Societal INMB using (2)** |  |  | **£15,182,317** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Fixed intervention cost is divided across subgroup by the number of falls clinic users in each subgroup.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £14,654 per QALY gained using (1) and £15,548 using (2).  8 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  9 The public sector ICERs are £13,701 per QALY gained using (1) and £15,087 using (2).  10 The public sector ICERs are £10,179 per QALY gained using (1) and £11,715 using (2).  11 The public sector ICERs are £14,114 per QALY gained using (1) and £16,212 using (2).  12 The public sector ICERs are £7,326 per QALY gained using (1) and £9,885 using (2). | | | |

### Intervention user profile by pathway

Table F11 describes the characteristics of intervention users by pathway under UC and RC.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table F11** Characteristics of intervention users by pathway in 40-year base case analysis. | | | | |
|  | **Person-years (%) of intervention use by pathway1** | | | **Total** |
| **Reactive** | **Proactive** | **Self-referred** |
| **Usual care** | | | | |
| Total | 96,588 | 60,697 | 1,885 | 159,169 |
| Annual average | 2,414.7 | 1,517.4 | 47.1 | 3,979.2 |
| Age group at use |  |  |  |  |
| *Aged 60-64* | 7,819 (8.1) | 7,019 (11.6) | 426 (22.6) | 15,264 (9.6) |
| *Aged 65-69* | 9,675 (10.0) | 10,949 (18.0) | 407 (21.6) | 21,030 (13.2) |
| *Aged 70-74* | 14,036 (14.5) | 12,451 (20.5) | 366 (19.4) | 26,853 (16.9) |
| *Aged 75-79* | 20,357 (21.1) | 13,039 (21.5) | 303 (16.1) | 33,699 (21.2) |
| *Aged 80-84* | 22,462 (23.3) | 10,638 (17.5) | 223 (11.8) | 33,324 (20.9) |
| *Aged 85-89* | 15,252 (15.8) | 5,107 (8.4) | 116 (6.2) | 20,476 (12.9) |
| *Aged 90+* | 6,986 (7.2) | 1,493 (2.5) | 45 (2.4) | 8,524 (5.4) |
| Sex |  |  |  |  |
| *Male* | 29,393 (30.4) | 24,320 (40.1) | 893 (47.4) | 54,606 (34.3) |
| *Female* | 67,194 (69.6) | 36,377 (59.9) | 992 (52.6) | 104,564 (65.7) |
| Socioeconomic status |  |  |  |  |
| *1st quartile* | 30,549 (31.6) | 18,946 (31.2) | 1,885 (100.0) | 51,380 (32.3) |
| *2nd quartile* | 16,774 (17.4) | 10,421 (17.2) | 0 (0.0) | 27,195 (17.1) |
| *3rd quartile* | 30,900 (32.0) | 19,101 (31.5) | 0 (0.0) | 50,001 (31.4) |
| *4th quartile* | 18,365 (19.0) | 12,229 (20.1) | 0 (0.0) | 30,594 (19.2) |
| Frailty category at use |  |  |  |  |
| *Fit* | 2,243 (2.3) | 1,650 (2.7) | 561 (29.7) | 4,454 (2.8) |
| *Mild* | 24,618 (25.5) | 25,084 (41.3) | 930 (49.3) | 50,632 (31.8) |
| *Moderate* | 61,655 (63.8) | 31,353 (51.7) | 377 (20.0) | 93,386 (58.7) |
| *Severe* | 8,071 (8.4) | 2,610 (4.3) | 17 (0.9) | 10,697 (6.7) |
| Physical activity status at use |  |  |  |  |
| *High* | 4,852 (5.0) | 1,133 (1.9) | 303 (16.1) | 6,287 (3.9) |
| *Low* | 91,736 (95.0) | 59,564 (98.1) | 1,583 (83.9) | 152,883 (96.1) |
| Cognitive status at use |  |  |  |  |
| *Intact* | 62,536 (64.7) | 60,697 (100.0) | 1,469 (77.9) | 124,702 (78.3) |
| *Impaired* | 34,052 (35.3) | 0 (0.0) | 416 (22.1) | 34,468 (21.7) |
| Fear of falling at use |  |  |  |  |
| *No fear* | 59,754 (61.9) | 45,926 (75.7) | 1,699 (90.1) | 107,378 (67.5) |
| *Fear* | 36,834 (38.1) | 14,771 (24.3) | 186 (9.9) | 51,791 (32.5) |
| Gait/balance at use |  |  |  |  |
| *Normal gait/balance* | 23,598 (24.4) | 23,016 (37.9) | 1,237 (65.6) | 47,851 (30.1) |
| *Abnormal gait/balance* | 72,990 (75.6) | 37,681 (62.1) | 648 (34.4) | 111,319 (69.9) |
| Falls history at use |  |  |  |  |
| *No falls history* | 0 (0.0) | 19,311 (31.8) | 1,302 (69.1) | 20,613 (13.0) |
| *Single non-MA fall* | 0 (0.0) | 5,390 (8.9) | 267 (14.2) | 5,657 (3.6) |
| *Recurrent non-MA falls* | 0 (0.0) | 30,644 (50.5) | 262 (13.9) | 30,907 (19.4) |
| *Single MA fall* | 35,739 (37.0) | 2,155 (3.6) | 27 (1.4) | 37,920 (23.8) |
| *Recurrent falls with 1+ MA fall* | 60,849 (63.0) | 3,197 (5.3) | 26 (1.4) | 64,072 (40.3) |
| **Recommended care** | | | | |
| Total | 121,581 | 1,077,117 | 511,726 | 1,710,424 |
| Annual average | 3,039.5 | 26,927.9 | 12,793.1 | 42,760.6 |
| Age group at use |  |  |  |  |
| *Aged 60-64* | 18,068 (14.9) | 167,038 (15.5) | 113,031 (22.1) | 298,137 (17.4) |
| *Aged 65-69* | 17,331 (14.3) | 188,159 (17.5) | 117,420 (22.9) | 322,910 (18.9) |
| *Aged 70-74* | 20,991 (17.3) | 224,932 (20.9) | 100,461 (19.6) | 346,384 (20.3) |
| *Aged 75-79* | 23,444 (19.3) | 226,545 (21.0) | 78,856 (15.4) | 328,845 (19.2) |
| *Aged 80-84* | 21,580 (17.7) | 163,176 (15.1) | 57,022 (11.1) | 241,777 (14.1) |
| *Aged 85-89* | 14,028 (11.5) | 80,897 (7.5) | 32,091 (6.3) | 127,015 (7.4) |
| *Aged 90+* | 6,139 (5.0) | 26,370 (2.4) | 12,846 (2.5) | 45,355 (2.7) |
| Sex |  |  |  |  |
| *Male* | 40,457 (33.3) | 494,711 (45.9) | 148,975 (29.1) | 684,143 (40.0) |
| *Female* | 81,124 (66.7) | 582,406 (54.1) | 362,750 (70.9) | 1,026,280 (60.0) |
| Socioeconomic status |  |  |  |  |
| *1st quartile* | 40,806 (33.6) | 350,401 (32.5) | 179,930 (35.2) | 571,137 (33.4) |
| *2nd quartile* | 21,603 (17.8) | 194,002 (18.0) | 89,779 (17.5) | 305,385 (17.9) |
| *3rd quartile* | 38,845 (32.0) | 335,836 (31.2) | 158,871 (31.0) | 533,552 (31.2) |
| *4th quartile* | 20,327 (16.7) | 196,877 (18.3) | 83,146 (16.2) | 300,350 (17.6) |
| Frailty category at use |  |  |  |  |
| *Fit* | 12,483 (10.3) | 81,556 (7.6) | 110,419 (21.6) | 204,458 (12.0) |
| *Mild* | 51,071 (42.0) | 620,465 (57.6) | 252,444 (49.3) | 923,979 (54.0) |
| *Moderate* | 53,567 (44.1) | 353,347 (32.8) | 140,039 (27.4) | 546,953 (32.0) |
| *Severe* | 4,460 (3.7) | 21,748 (2.0) | 8,825 (1.7) | 35,033 (2.0) |
| Physical activity status at use |  |  |  |  |
| *High* | 10,956 (9.0) | 81,015 (7.5) | 96,804 (18.9) | 188,775 (11.0) |
| *Low* | 110,625 (91.0) | 996,102 (92.5) | 414,922 (81.1) | 1,521,648 (89.0) |
| Cognitive status at use |  |  |  |  |
| *Intact* | 86,628 (71.3) | 788,485 (73.2) | 395,520 (77.3) | 1,270,632 (74.3) |
| *Impaired* | 34,953 (28.7) | 288,632 (26.8) | 116,206 (22.7) | 439,791 (25.7) |
| Fear of falling at use |  |  |  |  |
| *No fear* | 85,981 (70.7) | 908,353 (84.3) | 450,569 (88.0) | 1,444,903 (84.5) |
| *Fear* | 35,600 (29.3) | 168,764 (15.7) | 61,157 (12.0) | 265,521 (15.5) |
| Gait/balance at use |  |  |  |  |
| *Normal gait/balance* | 48,504 (39.9) | 217,454 (20.2) | 350,695 (68.5) | 616,653 (36.1) |
| *Abnormal gait/balance* | 73,077 (60.1) | 859,663 (79.8) | 161,031 (31.5) | 1,093,771 (63.9) |
| Falls history at use |  |  |  |  |
| *No falls history* | 0 (0.0) | 518,972 (48.2) | 357,812 (69.9) | 876,784 (51.3) |
| *Single non-MA fall* | 0 (0.0) | 141,193 (13.1) | 92,858 (18.1) | 234,051 (13.7) |
| *Recurrent non-MA falls* | 0 (0.0) | 360,886 (33.5) | 51,525 (10.1) | 412,411 (24.1) |
| *Single MA fall* | 62,975 (51.8) | 30,413 (2.8) | 4,591 (0.9) | 97,979 (5.7) |
| *Recurrent falls with 1+ MA fall* | 58,606 (48.2) | 25,654 (2.4) | 4,939 (1.0) | 89,199 (5.2) |
| **Abbreviation:** MA fall: fall requiring medical attention  1 All outcomes were averaged across 20 model trial runs with different random number seeds. | | | | |

## Evaluation framework and falls epidemiology scenarios

### Changes to time horizon

Table F12 shows the societal CUA outcomes comparing RC to UC under the time horizons of 5, 10, 15, 20 and 30 years.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F12** Scenarios of 5-, 10-, 15-, 20- and 30-year time horizons for societal cost-utility analysis. | | | |
|  | **Usual care** | **Recommended care** | **Incremental** |
| **5-year time horizon (n=152,138)** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £1,849,611,631 | £1,829,897,263 | -£19,714,368 |
| *(2) Fall-related healthcare costs* | £101,303,106 | £85,069,262 | -£16,233,844 |
| *Public sector intervention costs* | £6,516,944 | £89,739,906 | £83,222,962 |
| QALY | 448,251 | 449,478 | 1,227 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | -£4,356,278 |
| *Net private expenditure4* |  |  | £14,145,932 |
| *Net informal caregiving cost5* |  |  | -£836,358 |
| Societal gain, QALY equivalent |  |  | -294 QALYs |
| **Societal ICER using (1)6** |  |  | **£68,077 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£71,808 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **-£35,521,833** |
| **Societal INMB using (2)** |  |  | **-£39,002,357** |
| **10-year time horizon (n=187,921)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £3,599,096,165 | £3,555,157,110 | -£43,939,055 |
| *(2) Fall-related healthcare costs* | £209,309,323 | £175,101,250 | -£34,208,073 |
| *Public sector intervention costs* | £12,612,505 | £166,007,887 | £153,395,381 |
| QALY | 830,217 | 834,105 | 3,888 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | -£1,328,093 |
| *Net private expenditure* |  |  | £18,442,428 |
| *Net informal caregiving cost* |  |  | -£18,774,415 |
| Societal gain, QALY equivalent |  |  | -17 QALYs |
| **Societal ICER using (1)8** |  |  | **£28,272 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£30,785 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£6,691,588** |
| **Societal INMB using (2)** |  |  | **-£3,039,393** |
| **15-year time horizon (n=222,612)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £5,163,749,028 | £5,095,770,591 | -£67,978,437 |
| *(2) Fall-related healthcare costs* | £311,397,486 | £261,631,065 | -£49,766,421 |
| *Public sector intervention costs* | £17,997,433 | £231,483,620 | £213,486,188 |
| QALY | 1,151,454 | 1,158,140 | 6,686 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £11,981,817 |
| *Net private expenditure* |  |  | £20,511,050 |
| *Net informal caregiving cost* |  |  | -£49,053,402 |
| Societal gain, QALY equivalent |  |  | 675 QALYs |
| **Societal ICER using (1)9** |  |  | **£19,765 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£22,239 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£75,347,594** |
| **Societal INMB using (2)** |  |  | **£57,135,578** |
| **20-year time horizon (n=252,846)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £6,500,266,055 | £6,416,275,041 | -£83,991,014 |
| *(2) Fall-related healthcare costs* | £406,217,223 | £340,013,243 | -£66,203,980 |
| *Public sector intervention costs* | £22,924,065 | £286,750,828 | £263,826,763 |
| QALY | 1,415,416 | 1,425,836 | 10,421 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £5,841,364 |
| *Net private expenditure* |  |  | £20,743,528 |
| *Net informal caregiving cost* |  |  | -£56,348,033 |
| Societal gain, QALY equivalent |  |  | 691 QALYs |
| **Societal ICER using (1)10** |  |  | **£16,185 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£17,786 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£153,505,433** |
| **Societal INMB using (2)** |  |  | **£135,718,399** |
| **30-year time horizon (n=317,525)** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £8,581,201,839 | £8,471,616,325 | -£109,585,515 |
| *(2) Fall-related healthcare costs* | £554,779,116 | £465,164,198 | -£89,614,919 |
| *Public sector intervention costs* | £39,519,947 | £372,515,702 | £332,995,755 |
| QALY | 1,810,486 | 1,826,345 | 15,858 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £10,648,465 |
| *Net private expenditure* |  |  | £22,740,785 |
| *Net informal caregiving cost* |  |  | -£82,650,953 |
| Societal gain, QALY equivalent |  |  | 1,176 QALYs |
| **Societal ICER using (1)11** |  |  | **£13,115 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,288 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£287,619,018** |
| **Societal INMB using (2)** |  |  | **£267,648,422** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £51,746 per QALY gained using (1) and £54,581 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  8 The public sector ICERs are £28,151 per QALY gained using (1) and £30,654 using (2).  9 The public sector ICERs are £20,558 per QALY gained using (1) and £22,515 using (2).  10 The public sector ICERs are £17,258 per QALY gained using (1) and £18,965 using (2).  11 The public sector ICERs are £14,088 per QALY gained using (1) and £15,347 using (2). | | | |

Figure F5 shows the societal INHBs for all-cause costs delineated by SES quartiles for RC vs. UC under five- to 40-year horizons.

**Figure F5** Societal per-capita incremental net health benefit considering all-cause costs by SES quartile and time horizon **Abbreviation:** ICER: incremental cost-effectiveness ratio; QALY: quality-adjusted life year; SES: socioeconomic status.

Table F13 shows the CUA outcomes of RC relative to UC under 80-year evaluation and 40-year intervention horizons.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F13** Societal cost-utility analysis of recommended care relative to usual care under 80-year evaluation and 40-year intervention horizons. | | | |
| N=385,192 | **Usual care** | **Recommended care** | **Incremental** |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £11,380,499,969 | £11,257,387,023 | -£123,112,946 |
| *(2) Fall-related healthcare costs* | £766,270,468 | £660,544,699 | -£105,725,769 |
| *Public sector intervention costs* | £35,378,395 | £432,394,421 | £397,016,026 |
| QALY | 2,277,214 | 2,298,783 | 21,570 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | £18,480,265 |
| *Net private expenditure4* |  |  | £24,804,249 |
| *Net informal caregiving cost5* |  |  | -£96,518,464 |
| Societal gain, QALY equivalent |  |  | 1,503 QALYs |
| **Societal ICER using (1)6** |  |  | **£11,871 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£12,625 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **£418,281,133** |
| **Societal INMB using (2)** |  |  | **£400,893,957** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £12,699 per QALY gained using (1) and £13,505 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | |

### Changes to discount rates

Table F14 presents the 40-year societal CUA outcomes under the discount rates of 0% and 6% for both health and cost outcomes.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F14** Scenarios of discount rate variations for 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Usual care** | **Recommended care** | **Incremental** |
| **0% discount rates for health and cost outcomes** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £19,043,000,718 | £18,804,158,243 | -£238,842,476 |
| *(2) Fall-related healthcare costs* | £1,283,630,231 | £1,080,452,217 | -£203,178,014 |
| *Public sector intervention costs* | £66,955,387 | £803,372,331 | £736,416,944 |
| QALY | 3,826,084 | 3,867,600 | 41,517 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | £28,132,717 |
| *Net private expenditure4* |  |  | £33,066,768 |
| *Net informal caregiving cost5* |  |  | -£191,878,650 |
| Societal gain, QALY equivalent |  |  | 3,116 QALYs |
| **Societal ICER using (1)6** |  |  | **£11,148 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£11,947 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **£841,403,618** |
| **Societal INMB using (2)** |  |  | **£805,739,157** |
| **6% discount rates for health and cost outcomes** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £6,923,588,664 | £6,835,978,010 | -£87,610,654 |
| *(2) Fall-related healthcare costs* | £442,811,032 | £371,541,329 | -£71,269,704 |
| *Public sector intervention costs* | £24,335,837 | £302,415,159 | £278,079,322 |
| QALY | 1,472,263 | 1,484,448 | 12,185 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £6,211,613 |
| *Net private expenditure* |  |  | £20,261,231 |
| *Net informal caregiving cost* |  |  | -£60,587,635 |
| Societal gain, QALY equivalent |  |  | 776 QALYs |
| **Societal ICER using (1)8** |  |  | **£14,696 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£15,956 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£198,357,077** |
| **Societal INMB using (2)** |  |  | **£182,016,126** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £11,985 per QALY gained using (1) and £12,844 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  8 The public sector ICERs are £15,631 per QALY gained using (1) and £16,972 using (2). | | | |

Figure F6 shows the societal per-capita INHBs (considering all-cause costs) delineated by socioeconomic status (SES) quartiles in the base case (3.5% discount rates) and in scenarios of 0% and 6% discount rates.

**Figure F6** Societal per-capita INHBs for all-cause care costs by SES quartile under base case comparison and scenarios of 0% and 6% discount rates. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status

### Removing the falls-frailty feedback loop

Table F15 shows the 40-year societal CUA outcomes after the falls-frailty feedback loop is removed.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F15** Scenario of no falls-frailty feedback loop for 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Usual care** | **Recommended care** | **Incremental** |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £10,059,133,198 | £9,955,607,722 | -£103,525,475 |
| *(2) Fall-related healthcare costs* | £653,232,465 | £552,870,256 | -£100,362,210 |
| *Public sector intervention costs* | £34,295,528 | £437,094,863 | £402,799,335 |
| QALY | 2,076,511 | 2,083,406 | 6,895 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | -£25,795,971 |
| *Net private expenditure4* |  |  | £58,520,172 |
| *Net informal caregiving cost5* |  |  | £10,880,063 |
| Societal gain, QALY equivalent |  |  | -1,587 QALYs |
| **Societal ICER using (1)6** |  |  | **£56,372 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£56,968 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **-£140,007,651** |
| **Societal INMB using (2)** |  |  | **-£143,170,917** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £43,401 per QALY gained using (1) and £43,860 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | |

### Frailty reduction

Table F16 shows the 40-year societal CUA outcomes under scenarios of 20% reduction in: initial frailty levels at model entry; and the rate of frailty progression during model simulation.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F16** Scenarios of 20% reduction in initial frailty at model entry and in rate of frailty progression for 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Usual care** | **Recommended care** | **Incremental** |
| **Reduction in initial frailty** | | | |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £9,871,409,213 | £9,755,434,731 | -£115,974,482 |
| *(2) Fall-related healthcare costs* | £617,333,093 | £520,669,631 | -£96,663,462 |
| *Public sector intervention costs* | £33,114,114 | £419,420,015 | £386,305,901 |
| QALY | 2,191,155 | 2,209,507 | 18,351 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | £5,473,826 |
| *Net private expenditure4* |  |  | £19,791,980 |
| *Net informal caregiving cost5* |  |  | -£92,339,765 |
| Societal gain, QALY equivalent |  |  | 1,300 QALYs |
| **Societal ICER using (1)6** |  |  | **£13,756 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,739 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **£319,216,233** |
| **Societal INMB using (2)** |  |  | **£299,905,213** |
| **Reduction in rate of frailty progression** | | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs* | £9,919,041,861 | £9,803,335,668 | -£115,706,193 |
| *(2) Fall-related healthcare costs* | £620,064,905 | £523,208,292 | -£96,856,613 |
| *Public sector intervention costs* | £33,261,392 | £422,592,169 | £389,330,777 |
| QALY | 2,173,119 | 2,190,004 | 16,885 |
| Societal outcomes |  |  |  |
| *Net productivity* |  |  | £1,189,219 |
| *Net private expenditure* |  |  | £24,605,080 |
| *Net informal caregiving cost* |  |  | -£82,188,685 |
| Societal gain, QALY equivalent |  |  | 980 QALYs |
| **Societal ICER using (1)8** |  |  | **£15,317 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£16,372 per QALY gained** |
| **Societal INMB using (1)** |  |  | **£262,299,190** |
| **Societal INMB using (2)** |  |  | **£243,449,610** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £14,731 per QALY gained using (1) and £15,783 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  8 The public sector ICERs are £16,206 per QALY gained using (1) and £17,322 using (2). | | | |

Figure F7 compares the societal per-capita INHBs (considering all-cause costs) by SES quartile in base case and in the two frailty reduction scenarios.

**Figure F7** Societal per-capita INHBs for all-cause care costs by SES quartile in base case and scenarios of reduction in initial frailty and rate of frailty progression. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status.

### Higher life expectancy

Table F17 shows the 40-year societal CUA outcomes when other-cause mortality risks were reduced by 20%.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F17** Scenario of higher life expectancy for 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Usual care** | **Recommended care** | **Incremental** |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £10,495,349,038 | £10,358,144,772 | -£137,204,266 |
| *(2) Fall-related healthcare costs* | £719,869,949 | £608,513,741 | -£111,356,208 |
| *Public sector intervention costs* | £37,746,129 | £452,822,016 | £415,075,888 |
| QALY | 2,157,713 | 2,178,420 | 20,707 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | £1,162,561 |
| *Net private expenditure4* |  |  | £20,987,322 |
| *Net informal caregiving cost5* |  |  | -£92,844,303 |
| Societal gain, QALY equivalent |  |  | 1,217 QALYs |
| **Societal ICER using (1)6** |  |  | **£12,674 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£13,853 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **£379,843,298** |
| **Societal INMB using (2)** |  |  | **£353,995,239** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £13,419 per QALY gained using (1) and £14,668 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | |

Figure F8 compares the societal per-capita INHBs (considering all-cause costs) by SES quartile in base case and in the scenario of 20% reduction in other-cause mortality risks.

**Figure F8** Societal per-capita INHBs for all-cause care costs by SES quartile under base case analysis and scenario of 20% reduction in other-cause mortality risks. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status.

### Reduced other-cause mortality risk gap between frailty categories

Table F18 shows the 40-year societal CUA outcomes from scenario with 20% reduction in the hazard ratios across frailty categories (relative to the fit category) for the other-cause mortality risk.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F18** Scenario of 20% reduction in other-cause mortality risk gap between frailty categories for 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Usual care** | **Recommended care** | **Incremental** |
| Public sector costs1 |  |  |  |
| *(1) All-cause public sector costs2* | £10,123,840,949 | £9,996,651,591 | -£127,189,358 |
| *(2) Fall-related healthcare costs* | £666,782,115 | £561,693,429 | -£105,088,686 |
| *Public sector intervention costs* | £35,806,603 | £436,267,582 | £400,460,978 |
| QALY | 2,099,165 | 2,118,457 | 19,292 |
| Societal outcomes |  |  |  |
| *Net productivity3* |  |  | £2,450,997 |
| *Net private expenditure4* |  |  | £21,263,281 |
| *Net informal caregiving cost5* |  |  | -£90,651,111 |
| Societal gain, QALY equivalent |  |  | 1,197 QALYs |
| **Societal ICER using (1)6** |  |  | **£13,337 per QALY gained** |
| **Societal ICER using (2)** |  |  | **£14,416 per QALY gained** |
| **Societal INMB using (1)7** |  |  | **£341,412,108** |
| **Societal INMB using (2)** |  |  | **£319,311,437** |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  3 Includes values of paid and unpaid employment minus intervention time opportunity costs.  4 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  5 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  6 The public sector ICERs are £14,165 per QALY gained using (1) and £15,310 using (2).  7 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | |

Figure F9 compares the societal per-capita INHBs (considering all-cause costs) by initial frailty category in base case and in the scenario of 20% reduction in other-cause mortality hazard ratios across frailty categories.

**Figure F9** Societal per-capita INHBs for all-cause care costs by initial frailty category under base case analysis and scenario of 20% reduction in other-cause mortality hazard ratios delineated by frailty category. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year.

Figure F10 compares the societal per-capita INHBs (considering all-cause costs) by SES quartile in base case and in the scenario of 20% reduction in other-cause mortality hazard ratios across frailty categories.

**Figure F10** Societal per-capita INHBs for all-cause care costs by SES quartile under base case analysis and scenario of 20% reduction in other-cause mortality hazard ratios delineated by frailty category. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status

## Alternative falls prevention strategies

### Pathway contributions

Table F19 shows the cost-effectiveness of the contributions of individual pathways in their RC configurations vs. UC.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F19** Contributions of individual pathways in their recommended care configurations relative to usual care under 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Reactive pathway** | **Proactive pathway** | **Self-referred pathway** |
| Intervention users1,2 |  |  |  |
| *Reactive pathway* | 133,323 | 90,321 | 92,564 |
| *Proactive pathway* | 57,816 | 1,100,236 | 58,519 |
| *Self-referred pathway* | 1,854 | 1,540 | 663,143 |
| *Total* | 192,993 | 1,192,097 | 814,226 |
|  | **Incremental outcomes relative to usual care** | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs3* | -£22,636,387 | -£68,900,350 | -£47,266,327 |
| *(2) Fall-related healthcare costs* | -£19,690,640 | -£59,123,737 | -£35,300,296 |
| *Public sector intervention costs* | £28,105,096 | £301,329,633 | £96,110,389 |
| QALY | 2,482 | 10,873 | 8,849 |
| Societal outcomes |  |  |  |
| *Net productivity4* | £8,466,770 | £2,801,807 | £17,476,565 |
| *Net private expenditure5* | -£212,408 | £21,044,207 | -£120,852 |
| *Net informal caregiving cost6* | -£11,799,227 | -£42,138,370 | -£59,673,772 |
| Societal gain, QALY equivalent | 341 QALYs | 398 QALYs | 1,288 QALYs |
| Societal ICER using (1) | £1,937 per QALY gained7 | £20,622 per QALY gained8 | £4,818 per QALY gained9 |
| Societal ICER using (2) | £2,981 per QALY gained | £21,489 per QALY gained | £5,999 per QALY gained |
| Societal INMB using (1)10 | £79,222,621 | £105,706,657 | £255,262,807 |
| Societal INMB using (2) | £76,276,874 | £95,930,045 | £243,296,776 |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 User counts were 96,588, 60,697, 1,885 and 159,169 for reactive, proactive and self-referred pathways and the total, respectively, under usual care and 121,581, 1,077,117, 511,726 and 1,710,424 under recommended care; see Table F11 for breakdown in user characteristics when all three pathways operate in tandem.  3 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £2,204 per QALY gained using (1) and £3,391 using (2).  8 The public sector ICERs are £21,377 per QALY gained using (1) and £22,276 using (2).  9 The public sector ICERs are £5,520 per QALY gained using (1) and £6,872 using (2).  10 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | |

Table F20 shows the cost-effectiveness of the combinations of two pathways in their RC configurations vs. UC.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table F20** Contributions of combinations of two pathways in their recommended care configurations relative to usual care under 40-year societal cost-utility analysis. | | | |
| N=385,192 | **Reactive and Proactive pathways** | **Reactive and Self-referred pathways** | **Proactive and Self-referred pathways** |
| Intervention users1,2 |  |  |  |
| *Reactive pathway* | 125,867 | 129,034 | 86,337 |
| *Proactive pathway* | 1,082,847 | 55,978 | 1,094,610 |
| *Self-referred pathway* | 1,529 | 656,905 | 514,888 |
| *Total* | 1,210,243 | 841,917 | 1,695,835 |
|  | **Incremental outcomes relative to usual care** | | |
| Public sector costs |  |  |  |
| *(1) All-cause public sector costs3* | -£87,733,012 | -£67,962,229 | -£111,326,360 |
| *(2) Fall-related healthcare costs* | -£74,882,499 | -£53,647,141 | -£91,150,343 |
| *Public sector intervention costs* | £324,216,274 | £122,562,146 | £383,749,688 |
| QALY | 12,888 | 11,330 | 17,389 |
| Societal outcomes |  |  |  |
| *Net productivity4* | £11,178,728 | £16,985,336 | £12,429,033 |
| *Net private expenditure5* | £20,576,159 | -£795,074 | £20,424,804 |
| *Net informal caregiving cost6* | -£46,705,821 | -£69,665,340 | -£88,072,930 |
| Societal gain, QALY equivalent | 622 QALYs | 1,457 QALYs | 1,334 QALYs |
| Societal ICER using (1) | £17,505 per QALY gained7 | £4,270 per QALY gained8 | £14,550 per QALY gained9 |
| Societal ICER using (2) | £18,456 per QALY gained | £5,389 per QALY gained | £15,627 per QALY gained |
| Societal INMB using (1)10 | £168,808,598 | £329,027,507 | £289,283,028 |
| Societal INMB using (2) | £155,958,085 | £314,712,419 | £269,107,011 |
| **Abbreviation:** ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; QALY: quality-adjusted life year.  1 All outcomes were averaged across 20 model trial runs with different random number seeds.  2 User counts were 96,588, 60,697, 1,885 and 159,169 for reactive, proactive and self-referred pathways and the total, respectively, under usual care and 121,581, 1,077,117, 511,726 and 1,710,424 under recommended care; see Table F11 for breakdown in user characteristics when all three pathways operate in tandem.  3 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £18,349 per QALY gained using (1) and £19,346 using (2).  8 The public sector ICERs are £4,819 per QALY gained using (1) and £6,082 using (2).  9 The public sector ICERs are £15,666 per QALY gained using (1) and £16,827 using (2).  10 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | |

Figure F11 shows the societal per-capita INHBs (considering all-cause costs) delineated by SES quartiles for two-pathway combination scenarios.

**Figure F11** Societal per-capita INHBs for all-cause care costs by SES quartile in scenarios of two-pathway combinations relative to usual care. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status

### Capacity constraint and targeting strategies

Figure F12 shows the societal per-capita INHBs (considering all-cause costs) delineated by SES quartiles in the four targeting/allocation scenarios with capacity constraints relative to usual care.

**Figure F12** Societal per-capita INHBs for all-cause care costs in four targeting/allocation scenarios with capacity constraints relative to usual care. **Abbreviation:** INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status

### Economic value of community contributions

Figure F13 shows the societal per-capita INHBs (considering all-cause costs) delineated by SES quartiles in the three community involvement schemes supplementing constrained recommended care with falls risk targeting relative to no supplementation.

**Figure F13** Societal per-capita INHBs for all-cause care costs by SES quartiles in three community involvement scenarios supplementing constrained recommended care with falls risk targeting relative to no supplementation. **Abbreviation:** FRS: falls risk screening; INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status

### Environmental interventions

Table F21 shows the impact of four environmental intervention scenarios: (i) physical activity (PA) promotion that increases the probability of engaging in high physical activity by 5%; (ii) PA promotion with the same efficacy targeting the 3rd and 4th SES quartiles; (iii) falls hazard (FH) removal that reduces the falls risk by 5%; and (iv) FH removal with the same efficacy targeting the 3rd and 4th SES quartiles. The environmental interventions supplemented: (A) UC; and (B) CRC scenario (4). They were then compared to UC alone.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table F21** Environmental intervention scenarios supplementing (A) usual care and (B) constrained recommended care relative to usual care alone for 40-year societal cost-utility analysis. | | | | |
| N=385,192 | **(A) Environmental interventions1 supplementing usual care** | | | |
| **(i) Universal PA promotion** | **(ii) 3rd/4th SES quartile PA promotion** | **(iii) Universal FH removal** | **(iv) 3rd/4th SES quartile FH removal** |
|  | **Incremental outcomes relative to usual care** | | | |
| Public sector costs2 |  |  |  |  |
| *(1) All-cause PS costs3* | -£1,832,130 | -£1,529,176 | -£63,970,348 | -£33,932,023 |
| *(2) Fall-related HC costs* | -£437,177 | -£530,299 | -£53,074,859 | -£26,059,881 |
| *PS intervention costs* | £8,558,078 | £3,913,839 | £188,241,674 | £85,991,191 |
| QALY | 2,321 | 998 | 10,570 | 5,251 |
| Societal outcomes |  |  |  |  |
| *Net productivity4* | £21,818,413 | £12,226,654 | £28,671,801 | £20,367,415 |
| *Net private expenditure5* | -£6,461,122 | -£1,047,018 | -£22,642,149 | -£7,472,711 |
| *Net informal care cost6* | -£23,717,732 | -£11,444,060 | -£76,688,766 | -£36,191,854 |
| Societal gain, QALY equivalent | 867 QALYs | 412 QALYs | 2,133 QALYs | 1,067 QALYs |
| Societal ICER using (1) | £2,110 per QALY7 | £1,692 per QALY9 | £9,783 per QALY9 | £8,240 per QALY10 |
| Societal ICER using (2) | £2,547 per QALY | £2,400 per QALY | £10,640 per QALY | £9,486 per QALY |
| Societal INMB using (1)11 | £88,912,151 | £39,907,265 | £256,830,286 | £137,477,404 |
| Societal INMB using (2) | £87,517,198 | £38,908,388 | £245,934,797 | £129,605,262 |
|  | **(B) Environmental interventions supplementing CRC scenario (4)** | | | |
| **(i) Universal PA promotion** | **(ii) 3rd/4th SES quartile PA promotion** | **(iii) Universal FH removal** | **(iv) 3rd/4th SES quartile FH removal** |
| Public sector costs | **Incremental outcomes relative to usual care** | | | |
| *(1) All-cause PS costs* | -£74,406,904 | -£72,697,285 | -£124,485,786 | -£102,863,368 |
| *(2) Fall-related HC costs* | -£63,822,528 | -£62,937,064 | -£107,316,720 | -£85,661,640 |
| *PS intervention costs* | £155,712,162 | £151,152,025 | £347,232,915 | £232,882,624 |
| QALY | 10,506 | 9,452 | 18,102 | 13,181 |
| Societal outcomes |  |  |  |  |
| *Net productivity* | £34,687,777 | £17,740,679 | £36,793,216 | £25,590,091 |
| *Net private expenditure* | -£5,235,729 | -£555,901 | -£19,149,019 | -£4,209,005 |
| *Net informal care cost* | -£71,573,046 | -£57,987,851 | -£112,785,464 | -£80,342,808 |
| Societal gain, QALY equivalent | 1,858 QALYs | 1,271 QALYs | 2,812 QALYs | 1,836 QALYs |
| Societal ICER using (1) | £6,576 per QALY gained12 | £7,316 per QALY gained13 | £10,651 per QALY gained14 | £9,864 per QALY gained15 |
| Societal ICER using (2) | £7,432 per QALY gained | £8,227 per QALY gained | £11,471 per QALY gained | £11,169 per QALY gained |
| Societal INMB using (1) | £289,618,874 | £243,241,891 | £404,679,723 | £320,475,176 |
| Societal INMB using (2) | £279,034,499 | £233,481,670 | £387,510,656 | £303,273,448 |
| **Abbreviation:** CRC: constrained recommended care; FH: falls hazard; HC: healthcare; ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; PA: physical activity; PS: public sector; QALY: quality-adjusted life year; UC: usual care.  1 PA promotion increased the probability of engaging in high physical activity by 5% at cost of £3 per person. FH removal reduced falls risk by 5% at cost of £66.36 per person. The cost estimates were based on previous models [34, 105].  2 All outcomes were averaged across 20 model trial runs with different random number seeds.  3 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  4 Includes values of paid and unpaid employment minus intervention time opportunity costs.  5 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  6 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  7 The public sector ICERs are £2,897 per QALY gained using (1) and £3,498 using (2).  8 The public sector ICERs are £2,390 per QALY gained using (1) and £3,391 using (2).  9 The public sector ICERs are £11,757 per QALY gained using (1) and £12,788 using (2).  10 The public sector ICERs are £9,915 per QALY gained using (1) and £11,414 using (2).  11 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained.  12 The public sector ICERs are £7,739 per QALY gained using (1) and £8,747 using (2).  13 The public sector ICERs are £8,300 per QALY gained using (1) and £9,333 using (2).  14 The public sector ICERs are £12,305 per QALY gained using (1) and £13,254 using (2).  15 The public sector ICERs are £9,864 per QALY gained using (1) and £11,169 using (2). | | | | |

Table F22 compared the four scenarios vs. UC supplemented with the same respective environmental interventions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table F22** Environmental intervention scenarios under constrained recommended care relative to usual care with same environmental intervention for 40-year societal cost-utility analysis. | | | | |
| N=385,192 | **Environmental intervention scenarios1 under CRC scenario (4)** | | | |
| **(i) Universal PA promotion** | **(ii) 3rd/4th SES quartile PA promotion** | **(iii) Universal FH removal** | **(iv) 3rd/4th SES quartile FH removal** |
| Service annual use2,3 |  |  |  |  |
| *Reactive* | 2,980 | 2,981 | 2,762 | 2,762 |
| *Proactive* | 8,177 | 8,200 | 7,713 | 7,713 |
| *Falls clinic* | 8,951 | 8,976 | 8,377 | 8,669 |
| *Self-referred* | 2,000 | 2,000 | 2,000 | 2,000 |
| Total |  |  |  |  |
|  | **Incremental outcomes relative to UC with same environmental intervention** | | | |
| Public sector costs |  |  |  |  |
| *(1) All-cause PS costs4* | -£72,574,774 | -£71,168,109 | -£60,515,438 | -£68,931,345 |
| *(2) Fall-related HC costs* | -£63,385,352 | -£62,406,765 | -£54,241,861 | -£59,601,759 |
| *PS intervention costs* | £147,154,085 | £147,238,186 | £158,991,241 | £146,891,434 |
| QALY | 8,185 | 8,454 | 7,532 | 7,930 |
| Societal outcomes |  |  |  |  |
| *Net productivity5* | £12,869,364 | £5,514,025 | £8,121,415 | £5,222,676 |
| *Net private expenditure6* | £1,225,392 | £491,117 | £3,493,130 | £3,263,706 |
| *Net informal care cost7* | -£47,855,314 | -£46,543,791 | -£36,096,698 | -£44,150,954 |
| Societal gain, QALY equivalent | 992 QALYs | 859 QALYs | 679 QALYs | 769 QALYs |
| Societal ICER using (1) | £8,127 per QALY gained8 | £8,168 per QALY gained9 | £11,993 per QALY gained10 | £8,962 per QALY gained11 |
| Societal ICER using (2) | £9,129 per QALY gained | £9,108 per QALY gained | £12,757 per QALY gained | £10,035 per QALY gained |
| Societal INMB using (1)12 | £200,706,723 | £203,334,626 | £147,849,437 | £182,997,772 |
| Societal INMB using (2) | £191,517,301 | £194,573,281 | £141,575,860 | £173,668,186 |
| **Abbreviation:** CRC: constrained recommended care; FH: falls hazard; HC: healthcare; ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LTC: long-term care; OOP: out-of-pocket; PA: physical activity; PS: public sector; QALY: quality-adjusted life year; UC: usual care.  1 PA promotion increased the probability of engaging in high physical activity by 5% at cost of £3 per person. FH removal reduced falls risk by 5% at cost of £66.36 per person. The cost estimates were based on previous models [34, 105].  2 All outcomes were averaged across 20 model trial runs with different random number seeds.  3 Service annual uses under CRC scenario (4) are 2,969, 8,198, 8,962 and 2,000 for reactive interventions, proactive interventions, falls clinic, and self-referred interventions, respectively (see Table 6.11).  4 Includes costs of fall-related primary and secondary healthcare, comorbidity primary and secondary healthcare, cost of dying, community healthcare, short-term social care, all-cause long-term care.  5 Includes values of paid and unpaid employment minus intervention time opportunity costs.  6 Includes OOP care expenditure and privately incurred LTC cost minus intervention private co-payments.  7 Includes informal caregiver burden/cost minus intervention caregiver time opportunity costs.  8 The public sector ICERs are £9,112 per QALY gained using (1) and £10,235 using (2).  9 The public sector ICERs are £8,998 per QALY gained using (1) and £10,034 using (2).  10 The public sector ICERs are £13,074 per QALY gained using (1) and £13,907 using (2).  11 The public sector ICERs are £9,831 per QALY gained using (1) and £11,007 using (2).  12 Incremental net monetary benefits are estimated using the cost-effectiveness threshold of £30,000 per QALY gained. | | | | |

Figure F14 shows the societal per-capita INHBs (considering all-cause costs) delineated by SES quartiles of four environmental interventions under usual care relative to usual care alone.

**Figure F14** Societal per-capita INHBs for all-cause care costs by SES quartiles in four environmental interventions under usual care relative to usual care alone. **Abbreviation:** FH: falls hazard; INHB: incremental net health benefit; PA: physical activity; QALY: quality-adjusted life year; SES: socioeconomic status.

Figure F15 shows the societal per-capita INHBs (considering all-cause costs) delineated by SES quartiles of four environmental interventions under constrained recommended care with falls risk targeting relative to usual care alone.

**Figure F15** Societal per-capita INHBs for all-cause care costs by SES quartiles in four environmental interventions under constrained recommended care with falls risk targeting relative to usual care alone. **Abbreviation:** FH: falls hazard; INHB: incremental net health benefit; PA: physical activity; QALY: quality-adjusted life year; SES: socioeconomic status.

### Comparison of intervention strategies

Figure F16 shows the EDE INHBs relative to UC under the range of relative inequality aversion Atkinson index ε from 0 to 30. The EDE INHBs were calculated under the cost-effectiveness threshold of £30,000 per QALY gained.

**Figure F16** EDE INHBs across SES quartiles of intervention strategies relative to UC under relative inequality aversion. **Notes:** See Table 6.18 for strategy numbers; All INHBs estimated using the cost-effectiveness threshold of £30,000 per QALY gained. **Abbreviation:** EDE: equally distributed equivalent; INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status; UC: usual care.

Figure F17 shows the EDE INHBs relative to UC under the range of absolute inequality aversion Kolm index α from 0 to 30. The EDE INHBs were calculated under the cost-effectiveness threshold of £30,000 per QALY gained.

**Figure F17** EDE INHBs across SES quartiles of intervention strategies relative to UC under absolute inequality aversion. **Notes:** See Table 6.18 for strategy numbers; All INHBs estimated using the cost-effectiveness threshold of £30,000 per QALY gained. **Abbreviation:** EDE: equally distributed equivalent; INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status; UC: usual care.

Figure F18 shows the EDE INHBs of capacity constrained, non-environmental intervention strategies relative to UC under the range of relative inequality aversion Atkinson index ε up to 30. The EDE INHBs were calculated under the cost-effectiveness threshold of £30,000 per QALY gained.

**Figure F18** EDE INHBs across SES quartiles of capacity constrained, non-environmental intervention strategies relative to UC under relative inequality aversion. **Notes:** See Table 6.18 for strategy numbers; All INHBs estimated using the cost-effectiveness threshold of £30,000 per QALY gained. **Abbreviation:** EDE: equally distributed equivalent; INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status; UC: usual care.

Figure F19 shows the EDE INHBs of capacity constrained, non-environmental intervention strategies relative to UC under the range of absolute inequality aversion Kolm index α up to 0.5. The EDE INHBs were calculated under the cost-effectiveness threshold of £30,000 per QALY gained.

**Figure F19** EDE INHBs across SES quartiles of capacity constrained, non-environmental intervention strategies relative to UC under absolute inequality aversion. **Notes:** See Table 6.18 for strategy numbers; All INHBs estimated using the cost-effectiveness threshold of £30,000 per QALY gained. **Abbreviation:** EDE: equally distributed equivalent; INHB: incremental net health benefit; QALY: quality-adjusted life year; SES: socioeconomic status; UC: usual care.

## Preliminary, post-analysis feedback from commissioners

Meetings began by presenting the deterministic model results: 40-year CUA; 5-year ROI; impact of social inequities of health under base case; and three intervention scenarios – individual pathway selection, capacity constraint, and environmental interventions. Main points are summarised below.

**Sheffield CCG commissioner**

1. **Concern of over-loading the primary care sector**

The commissioner felt that the additional burden on primary care staff has been underestimated by the model. There may be acute feasibility issue if the proactive pathway relies on primary care staff. It would require significant co-production with primary care if the model is to be implemented successfully. One would need to think about incentivisation model within context of core contract / other priorities.

1. **Current falls prevention in Sheffield**

Significant falls work pre-pandemic. Recent investment commitment to falls prevention strategic approach / practical resources to implement including in care home environment. Recognition of impact of pandemic and de-conditioning on falls risk for key target groups. Also challenge of social distancing on group activities.

1. **General strategic prevention**

Commissioner discussed falls and fracture prevention within the context of broader work on multi-morbidity and frailty prevention and the recognition of how health inequalities and wider determinants impact upon this. Work in Sheffield on Ageing Well part of national AW programme.

1. **Fracture prevention and falls prevention**

Fracture prevention should be seen in conjunction with falls prevention.

**Sheffield City Council commissioner**

1. **Proactive pathway cost-effectiveness**

It would be worth discussing potential reasons for proactive pathway being the least cost-effective pathway. Ideally, ‘proactive’ intervention should target pre-frail persons. Hence, if the high cost of multidisciplinary teams is worsening the cost-effectiveness, could potentially explore a proactive pathway with more cost-effective single-component interventions.

1. **Implication of low ROIs in short time horizon**

The low ROI may still be of interest to Alternative Investments & Social Impact market. Investors there would probably like to see a time series on ROI from five- to 15-year horizon.

1. **Environmental intervention**

The results for environmental intervention were most relevant for public health decision making since it moves from the clinical model to public health modification of wider environmental determinants of health. How the environmental interventions affect the efficiency of falls prevention interventions was also interesting: it shows the diminishing returns on falls prevention; successful early life and/or environmental intervention could motivate potential disinvestment from falls prevention.

1. **Analysis using SES variable**

Should explore how the SES quartiles correspond with IMD variable which is more widely used in decision making (e.g., IMD also contains education and income).

## Methodological checklist score of the current model

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| **Table F23** Methodological quality score for the current falls prevention model from expert-validated checklist for conducting and reporting falls prevention economic evaluations. | | | |
| **#** | **Item1** | **Model score** | **Justification for score** |
| **Define the type of study and the main objective(s)** | | | |
| 1 | State whether a cost-effectiveness, cost-utility, or cost-benefit analysis and state the main outcomes of the analysis | 1 | Described in Section 5.2.1.2. |
| 2 | State whether carried out as part of a clinical trial or a model | 1 | Model overview given in Section 5.2.1.3. |
| 3 | State the aim of the economic evaluation | 1 | Described in Sections 5.2.1.2 and 5.2.1.3. |
| 4 | State the viewpoint [perspective] of the analysis and justify choice of viewpoint. | 1 | Described in Section 5.2.1.2. |
| **Describe competing alternatives** | | | |
| 5 | Describe the intervention(s): (1) who delivered the intervention(s); (2) the components; (3) staff training; (4) how and where it was delivered; (5) frequency and dose; (6) whether sample in intervention study is similar to model population; (7) whether method of recruitment in intervention study is similar to intervention access method in model; (8) whether inclusion and exclusion criteria in intervention study are similar to intervention eligibility criteria in model.2 | 1 | Described (1)-(5) in Section 5.2.4.3. For (6)-(8): Section 5.2.4.2 described the intervention access conditions. Table 5.3 described the target populations of UK-based RCTs considered for the model. Table 5.35 described the characteristics of RCTs used for efficacy parameters. |
| 6 | Classify the intervention(s) as single, multiple or multifactorial | 1 | Described in Section 5.2.4.1. |
| 7 | Include the justification for the intervention(s) and the comparator. | 1 | Described in Section 5.2.4.1. |
| 8 | Justify rationale for either including or excluding a “do-nothing” alternative. | 1 | Described in Section 5.2.4.1. See also Section 3.7. |
| **Describe the method used to establish effectiveness** | | | |
| 9 | State the source of the estimate for the effectiveness used: e.g., randomized controlled trial, systematic review | 1 | Described in Section 5.2.4.4. |
| 10 | State the definition of a fall used | 0 | ELSA did not give a definition of falls recorded in survey; see Section 5.2.1.4. |
| 11 | State the definition of a fall injury used.3 | 0.5 | Section 5.2.5.3 described types of fall injuries representing the acute QALY impact of hospitalised and non-hospitalised MA falls. The model did not define any further fall injury types. |
| 12 | Provide the total number of falls (injuries) in each comparison group | 1 | Figure 6.1 shows the person-years of falls incidence of different types under the base case analysis, though falls data were not presented for further analyses. |
| 13 | [Incorporate] uncertainty surrounding the effectiveness estimate | 1 | Described in Table 5.35. |
| 14 | If effectiveness is measured using a quality of life outcome such as QALYs, describe the method used for estimating QALY values | 1 | Acute QALY loss due to falls described (Section 5.2.5.3). Dynamic secondary impact of falls on EQ-5D estimated (Table 5.50). |
| **Identify all relevant costs and consequences for each alternative and comparator evaluated** | | | |
| 15 | Identify all relevant total health resource utilisation costs for each alternative and comparator evaluated. Use total health resource utilisation costs for base case analysis. | 1 | All-cause care costs presented in all analyses and considered primarily in outcome interpretation. |
| 16 | Identify all relevant fall-related costs and consequences for each alternative and comparator evaluated. Use fall-related costs for sensitivity analysis. | 1 | Fall-related costs presented in all analyses. |
| **Ensure costs and consequences are measured accurately and in appropriate units** | | | |
| 17 | Provide the units used for all cost items and sources for identifying these items | 1 | Intervention cost items described in Tables 5.32 and 5.34. Economic costs of MA falls described in Section 5.2.5.4. Comorbidity care cost items described in Section 5.2.3.4. LTC admission cost described in Section 5.2.6.2. |
| 18 | Define fall-related costs as those incurred directly as a result of the fall. Provide the definition used for defining cost items as fall-related | 1 | Described in Section 5.2.5.4. |
| **Value costs and consequences credibly** | | | |
| 19 | State the year and currency that costs were collected | 1 | £ at 2021/22 price stated and used throughout. |
| 20 | Use actual costs or validated methods to value each cost item if available | 1 | Described valuation methods for productivity values in Section 5.2.3.2 and informal caregiver burden in Section 5.2.3.4. Cost data from previous models used for economic costs of falls in Section 5.2.5.4 and intervention costs in Tables 5.32 and 5.34. Costing methods for comorbidity care and LTC costs described in Sections 5.2.3.4 and 5.2.6.2. |
| 21 | Report total health resource utilisation costs, fall-related healthcare costs, and intervention costs separately. Report these costs both as a total and mean value broken down by group. | 1 | All-cause care costs, fall-related healthcare costs, and public sector intervention costs reported separately for each scenario in results tables. Only the aggregate/total outcomes directly reported by scenario, but the relevant population size reported in each results table from which mean values can be estimated. |
| **Costs and consequences should be adjusted for differential timing** | | | |
| 22 | State and justify the time horizon over which costs and consequences were collected | 1 | Described in Section 5.2.1.2. Alternative horizons explored in Section 6.2.5.1. |
| 23 | If costs were collected over a period of more than 1 year, use the recommended discount rate | 1 | Described in Section 5.2.1.2. Alternative discount rates explored in Section 6.2.5.2. |
| 24 | The effect of the intervention on the number of falls after completion of the trial should not be estimated or modelled as there are not adequate data available to estimate the future risk or cost of falls accurately | 0.5 | This was the case for five of seven RCTs used. The other two RCTs had six-month efficacies which were assumed to last for one year as discussed in Section 5.2.4.4. |
| 25 | If appropriate data permit, model the lifetime costs and consequences using a Markov model or discrete event simulation | 1 | The 40-year horizon was not lifetime duration for incoming cohorts. But 80-year evaluation horizon explored in Section 6.2.5.1; this did not generate major divergence from base case. |
| **Perform an incremental analysis of costs and consequences for all alternatives** | | | |
| 26 | [Where natural unit of falls are used as health outcome under CEA,] report the ICER in three ways: (1) incremental cost per fall prevented; (2) incremental cost per unit decrease in falls per person-year (falls rate); and (3) incremental cost per unit decrease in mean number of falls per person | 0.5 | Not relevant because CEA was not employed in this study. Score of 0.5 given as for previous models. |
| 27 | Report all elements of incremental cost-effectiveness ratios (e.g., incremental costs, QALYs, total number of falls) separately for each group (preferably in a table). Avoid merely stating that one intervention “dominated” an alternative. | 1 | All elements of ICER reported separately for each scenario in results tables. Comparisons of strategies laid out reasons for strong and extended dominance; see Tables 6.18 and 6.23. |
| **Identify key parameters and assumptions that may lead to different conclusions from the incremental analysis** | | | |
| 28 | Estimate uncertainty for costs and consequences using comprehensive one-way sensitivity analyses and probabilistic sensitivity analyses | 0.5 | Conducted PSA and DSA for the base case analysis but not for alternative scenarios. |
| **Present and discuss results from base case and sensitivity analyses** | | | |
| 29 | Report key assumptions and values that substantially affected the estimates for costs and health outcomes | 1 | DSA presented top 20 parameters with the most significant impacts on base case ICERs (Section 6.2.3). Important scenarios were identified in Sections 5.4.1.7 and 5.4.2 and evaluated in Sections 6.2.5 and 6.3 respectively. |
| 30 | Include a discussion of the assumptions and values of cost items and measures of effectiveness incorporated in the point estimates of cost-effectiveness or cost-utility outcomes | 1 | See Section 6.4.4 |
| 31 | Include a discussion of issues related to implementation of the intervention(s) – e.g., generalizability, feasibility, alternative settings, relevant ethical issues | 1 | Sections 6.3.2 and 6.3.3 discussed how commissioning strategy depends on feasibility of, e.g., environmental intervention, ethical issues around age-based targeting and equity. Section 6.4.2 contained initial discussion on generalisability of model results to Sheffield. |
| 32 | Discuss how the economic evaluation will inform health policy. | 1 | Section 6.4.2 contained initial discussion on policy implementation. |
| **Abbreviation:** CEA: cost-effectiveness analysis; DSA: deterministic sensitivity analysis; ELSA: English Longitudinal Study of Ageing; HRQoL: health-related quality of life; ICER: incremental cost-effectiveness ratio; LTC: long-term care; MA fall: fall requiring medical attention; ProFaNE: Prevention of Falls Network Europe; PSA: probabilistic sensitivity analysis; QALY: quality-adjusted life year; RCT: randomised controlled trial.  1 Each study is given a score of 1 for each item if it is deemed to have followed the recommendation sufficiently, 0.5 if followed sub-optimally and 0 if not followed. The maximum potential score is 32. See Table D1 and related commentary in Appendix D for further details.  2 The original checklist recommends that the study describe the components, staff training, how and where it was delivered, frequency and dose, *the sample receiving the intervention, the method of recruitment and inclusion and exclusion criteria*. The latter italicized features are less relevant to decision models that infrequently conduct primary sampling and participant recruitment. They are hence adapted to address the issues of whether the external intervention study evidence suit the model’s population and intervention eligibility and access criteria. Out of 8 components, models that incorporated 6-8 are given a score of 1; those that incorporated 3-5 given 0.5; and those that incorporated 0-2 given 0.  3 The original checklist adds: “The number of radiographically confirmed peripheral fracture events per person-year is included in the dataset recommended by ProFaNE, classified using the ICD-10 classification system [88]. Fractures of the hip, wrist, and spine are the most common consequences of a fall. These should be reported individually. Other injuries as a result of a fall (e.g., traumatic brain injury) should be considered.” Models should incorporate granulated injury types. | | | |

## Critical narrative appraisal of current model

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| **Table F24** Summary of model strengths and limitations in addressing the key methodological recommendations for falls prevention model development. | | |
| **Methodological recommendation1** | **Model strengths – how recommendation was implemented** | **Model limitations, caveats, and areas for further improvement** |
| ***Falls epidemiology features*** | | |
| (1) Clearly state the type and source of data used to characterise the baseline falls risk and discuss the strengths and limitations of choice. | * Described ELSA as the source of falls data and discussed its strengths and limitations.2 * Individual-level granularity in falls risk | * Assumed ELSA data are generalisable to Sheffield. * Could use the most recent ELSA waves. * Significant recall bias in ELSA falls data. * Potential attrition bias in ELSA waves. * Assumptions were required in annuitisation. |
| (2) Use appropriate methods to characterise recurrent falls. | * Incorporated risk of being a recurrent faller given any fall and risk of recurrent MA falls. | * Could parameterise number of falls per recurrent faller. |
| (3) Maximise the range of falls risk factors modelled including those highlighted by NICE CG161.3 | * Incorporated all risk factors highlighted by NICE CG161 except for home hazards. * Incorporated continuous frailty index as risk factor. * Used multivariate falls risk score as a targeting tool under capacity constraint. | * Could include home and external environmental hazards as falls risk factors to model home modification and falls hazard removal. |
| (4) Maximise the range of fall-related health consequences modelled including the long-term impact on risks of mortality and health/functional decline. | * Incorporated secondary effects of falls via frailty index. * Incorporated impacts of non-MA falls on EQ-5D. | * Did not incorporate granulated falls injury types. * Could consider stratifying mortality risk using continuous rather than categorical frailty score. |
| (5) For CUA, distinguish between acute and long-term impacts of fall-related events on health utility. | * Incorporated individual-level EQ-5D values for baseline and dynamic progression. * Distinguished between acute, non-acute and secondary effects of falls on EQ-5D. | * Risk of measurement error in using proxy responses. * Risk that the impact of falls on EQ-5D was double-counted between acute and non-acute parameters. |
| (6) Maximise the range of fall-related economic consequences modelled; incorporate all-cause care costs which capture the full care consequences of falls, while also reporting fall-related care costs. | * Incorporated acute fall-related costs and secondary comorbidity care costs across sectors. * Reported both fall-related and all-cause care costs. | * Could include individual-level comorbidity primary and secondary healthcare costs. * Could distinguish between fall-related and other-cause LTC admissions. * Could capture variation in cost of dying by age. |
| ***Falls prevention intervention features*** | | |
| (7) Clearly describe the comparator(s); where relevant, describe the usual care received. | * UC intervention features were parameterised by pathway. | * Several assumptions were made for UC access patterns (e.g., use of ELSA variables). |
| (8) Clearly state the access pathway for intervention(s) and describe the mechanisms facilitating access. | * Incorporated reactive, proactive and self-referred pathways with distinct access mechanisms. | * Could consider linkages across pathways. |
| (9) Use appropriate methods for modelling the falls risk screening process. Resource-use associated with screening should be appropriately characterised. | * Screening for abnormal gait/balance approximated performance of TUG test under proactive pathway. * Evaluated scenario where multivariate falls risk score used as additional screening/targeting tool. | * 100% screening rate at routine GP contact under RC proactive pathway unrealistic. |
| (10) Maximise the granularity of intervention resources incorporated and costed. Refrain from translating fixed costs into per-participant rates to capture interaction with implementation level. | * Achieved high granularity in costing. * Categorised interventions by resource use structure and characterised fixed cost of falls clinic operation. | * There may be significant sunk cost of falls clinic set-up. * Assumed no time delay in intervention set-up. * Could consider further fixed- or sunk-cost resources: e.g., falls risk screening, environmental modifications. |
| (11) Ensure that the efficacy metric and fall type match the falls incidence metric and type. Refrain from making assumptions on long-term efficacy duration. | * Included efficacies on risk of being a recurrent faller given any fall and risk of experiencing MA fall given any fall to match falls incidence metric and type. * Long-term effectiveness beyond the receipt year driven by sustained access not efficacy duration assumptions. | * Relied on single RCT per intervention subgroup. * Incorporated unbalanced sets of efficacy parameters across interventions. * Could include efficacy data on reduction of fatal falls. * Made efficacy duration assumptions for six-month RCTs. |
| (12) Maximise the range of health effects of interventions modelled beyond falls prevention. | * Increased likelihood of high physical activity was an effect of exercise and environmental intervention. | * Could include other wider health effects: e.g., improving self-efficacy, health benefits for accompanying caregivers. * Could include adverse effects of interventions. * Did not capture efficacy experienced by persons exiting the model via mortality. |
| ***Key challenge for public health economic modelling – capturing non-health outcomes and societal intervention costs*** | | |
| (13) Consult stakeholders on the range of appropriate non-health outcomes and societal intervention costs if the societal perspective is taken. | * Incorporated a wide range of non-health outcomes and societal intervention costs. * Reported individual-level lifetime outcomes. | * Could account for acute impact of falls on social wellbeing. * Could account for process benefits of interventions. * Could account for health and wellbeing impact of providing and/or receiving informal care. * Incorporated informal caregiver TOC only for cognitively impaired intervention participants. |
| (14) Incorporate balanced sets of non-health outcomes and societal intervention costs if relevant. | * Balanced productivity with TOC, OOP care expenditure with private co-payment, and informal caregiving cost with informal caregiver TOC. | * Could consider individual-level granularity in modelling societal intervention costs. |
| (15) Account for sector-specific productive efficiencies if the societal perspective is taken. | * Used dual cost-effectiveness thresholds for public sector and societal outcomes. | * Did not consider productive efficiency differentials within public sector and wider society. |
| ***Key challenge for public health economic modelling – considering heterogeneity and dynamic complexity*** | | |
| (16) Incorporate variable(s) depicting geriatric health variation within the same age and sex groups and serving as subgroup delineating characteristics and markers of dynamic geriatric health trajectory. | * Incorporated SES quartile, 52-variable frailty index, physical activity level, cognitive status, fear of falling and gait/balance status. * Conducted both subgroup and targeting analyses. * Evaluated impacts of complementary interventions affecting underlying geriatric health variables. | * Overlap between frailty components and covariates. * Could estimate baseline and longitudinal values of covariates simultaneously. * Explanatory variables selected by statistical fit rather than conceptual importance. * Limitations in longitudinal analyses: bias from informative dropouts in ELSA; short time horizon; annualisation of two-year interim data. |
| (17) Aggregate outcomes (e.g., total INMB) should be evaluated alongside cost-per-unit ratios (e.g., ICER) if there is significant difference in subgroup sizes. | * Reported both aggregate outcomes and cost-per-unit ratios for all deterministic analyses (except DSA). | * Could evaluate aggregate outcomes under PSA and DSA. |
| (18) Characterise the heterogeneity in intervention efficacy, cost and implementation level. | * Varied intervention features by falls risk, cognitive status, and intervention history. | * Same intervention features across frailty categories. * Same intervention features for all cognitively impaired. * Obtain data on intervention cost at re-receipt. |
| (19) Characterise the interactions between falls risk, intervention need, long-term impacts of falls and falls prevention, and background health. | * Parameterised key causal variables (e.g., cognitive status, frailty, abnormal gait/balance) influencing multiple model components and creating feedback loops. | * Under-represented the causal mechanisms of key variables: e.g., fear of falling, social community.4 |
| (20) Incorporate periodic falls risk screening to allow dynamic variation in the proactive intervention pathway. The reactive pathway should be accessible after serious falls incidence. | * Intervention eligibility and access re-assessed each annual cycle. | * Issue remains over maintenance of proactive falls risk screening at GP contact. * Reactive intervention unable to influence frailty progression after fall incidence before next cycle. |
| (21) Incorporate incoming cohorts of newly eligible persons to characterise the dynamic target population and capacity implications for decision-making. | * Incoming cohorts maintained pressure on capacity and enabled evaluation of capacity constraints. | * Could consider shifts in epidemiological pattern across new cohorts over time. * Could consider population size change via migration. |
| ***Key challenge for public health economic modelling – considering theories of human behaviour and implementation*** | | |
| (22) Incorporate variables that influence health behaviour and intervention supply/demand. Access to self-referred intervention should be determined by dynamic variations in demand. | * Incorporated individual-level variation in self-referred exercise demand at baseline and over time. | * Could consider further psychological and sociological factors affecting self-referred exercise demand. * Only considered group exercise for self-referred pathway; demand profile different for home exercise. * Could incorporate variables influencing demands for reactive and proactive RC interventions. * Could consider variation in professional behaviour. * Could evaluate the impact of protocol compliance. |
| (23) Distinguish between supply- and demand-side implementation factors. Consult stakeholders on whether external implementation data are generalisable. Sustainability level should be based on evidence. | * Distinguished between supply- and demand-side determinants of intervention access. * Sustainability in self-referred exercise demand based on ELSA data. * Sustainability in access to reactive and proactive interventions reassessed each cycle. | * Made assumptions on the maximum number of proactive intervention re-receipts under RC. * Assumed that RCT-level implementations and efficacies are reproducible in routine practice. * Made assumptions using ELSA for UC access rates. * Did not incorporate the impact the Covid-19 pandemic on intervention access from 2021. |
| (24) Conduct value of implementation analyses as alternative scenarios reflecting stakeholder views on important implementation strategies. | * Evaluated scenarios of community involvement in implementation even under capacity constraints and distinguished between different modes of involvement. | * Assumed efficacies of implementation strategies. * Could evaluate implementation strategies involving clinical professionals. |
| (25) Consider capacity and budget implications of intervention and implementation strategies. | * Evaluated the impact of capacity constraints. | * Under binding capacity constraint, willing persons would likely be placed in queues for the next year. * Could evaluate individual pathway contributions under capacity constraints. * Could pre-specify a budget constraint for model analysis. |
| ***Key challenge for public health economic modelling – considering issues of equity*** | | |
| (26) Consult stakeholders to incorporate relevant social and health severity delineating characteristics. | * Incorporated SES variable as social characteristic. * Incorporated frailty category as health severity characteristic. | * Unclear to what extent the SES variable captures the area-level social delineation mentioned by local stakeholders (e.g., LSOA-level multiple deprivation). * Unclear whether ELSA SES is locally generalisable. * Did not include further locally relevant social subgroups: e.g., socially isolated, ethnic/linguistic minorities. |
| (27) Identify causal mechanisms behind vulnerable subgroups’ reduced capacity to benefit and incorporate appropriate model parameters. | * Incorporated individual-level SES gradients to causal mechanisms: e.g., EQ-5D, intervention access by pathway. * Mechanism of LED problem incorporated in frailty-stratified mortality risks. * Mechanism of DJ problem reducing intervention demand for 3rd/4th SES quartiles explored in scenario. | * DJ problem level in scenario based on assumption. * Could account for dynamic change in SES and related causal mechanisms. |
| (28) Formulate strategies that prioritise vulnerable subgroups and/or address causal mechanisms and assess the equity-efficiency trade-off. | * Evaluated scenarios reducing LED and DJ problems and targeting interventions at 3rd/4th SES quartiles. * Conducted DCEA for joint equity-efficiency consideration. * Conducted ECEA, tracking the experience of catastrophic private care expenditure. | * Relatively little attention on severity-based equity issues: i.e., impact delineated by frailty and cognitive status. * DCEA conducted only on deterministic outcomes. * Unclear how the SES-based intervention targeting would be implemented and who bears the opportunity costs. * Used unadjusted outcomes for DCEA. * Could explore alternative SES division (e.g., quintiles). |
| ***Evaluation methods*** | | |
| (29) Assess and report the model’s structural, internal and external validities. | * Conceptual model reduced the structural uncertainty prospectively; scenario analyses for internal validity assessed structural validity retrospectively. * Face, internal, external and cross validities assessed. | * No non-modelling stakeholder conducted face validation. * Access to local routine data would have enabled more robust external validation. |
| (30) Clearly state whether parameter variation represents DSA or scenario analysis. PSA should be conducted to assess the joint parameter uncertainty. | * Clearly distinguished between DSA and scenarios. * Intervention scenarios compared using wide range of outcomes to formulate commissioning recommendations. | * The intervention scenarios did not exhaust possible permutations and did not compare falls incidence. * Could evaluate lifetime outcomes for all incoming cohorts in all scenarios. * PSA only for base case 40-year CUA ICERs. * Could conduct evaluation framework and epidemiological scenarios for alternative intervention scenarios. |
| **Abbreviation:** CE: cost-effectiveness; CG: clinical guideline; CUA: cost-utility analysis; DCEA: distributional cost-effectiveness analysis; DJ: double jeopardy; DSA: deterministic sensitivity analysis; ELSA: English Longitudinal Study of Ageing; ICER: incremental cost-effectiveness ratio; INMB: incremental net monetary benefit; LED: life expectancy differential; LSOA: lower super output area; LTC: long-term care; MA fall: fall requiring medical attention; NICE: National Institute for Health and Care Excellence; OOP: out-of-pocket; PSA: probabilistic sensitivity analysis; RC: recommended care; RCT: randomised controlled trial; SES: socioeconomic status; TOC: time opportunity cost; TUG: timed-up-and-go; UC: usual care.  1 See Section 4.6.1 for the full description of the methodological recommendations.  2 See Section 5.2.1.4 for the description of ELSA and the rationale behind the use of ELSA Waves 4-5; see Section 5.2.5.2 for discussion around recall bias in the ELSA falls data.  3 These risk factors are falls history, fear of falling, home hazards, gait deficit, balance deficit, mobility impairment, visual impairment, cognitive impairment, urinary incontinence [4].  4 Compared to the causal mechanisms of key variables initially conceptualised in Table 3.6. | | |

### Falls epidemiology features

The current model was transparent in describing the data sources for falls risk parameterisation. Specifically, Sections 5.2.1.4 and 5.2.5.2 discussed the strengths and limitations of ELSA as the main data source for falls risk factors and incidence. Its main strength was the individual-level data granularity which helped identify the key associations between falls history/incidence and a wide range of risk factors and outcomes. Only eight of 46 previous models identified by the systematic review characterised falls risk at the individual-level granularity (Table 4.3).

There were, nevertheless, several limitations to falls risk parameterisation. First, the model assumed that: (i) the nationally representative ELSA sample is representative of the local Sheffield population; and (ii) the Waves 4-5 data collected in 2008-10 are generalisable to the period 2021-2060. Second, there was significant recall bias in the ELSA falls data that necessitated assumptions in their use (Section 5.2.5.2). Third, ELSA did not capture falls that occurred to individuals who exited the survey between Waves 4-5; this may have biased the falls risk estimation if attrition rate is associated with covariates (e.g., frailty). Access to higher frequency time-to-event data in further research would enable the modelling of falls, death, and LTC admission as competing events given covariates. Fourth, the two-year survey interim required several assumptions in annualising the data.

The model distinguished between single and recurrent fallers and hence improved upon previous models unable to characterise recurrent falls (Section 4.5.1.2). Moreover, for individuals experiencing recurrent falls with one or more MA falls, the risk of recurrent MA falls was parameterised using external data. Further research could parameterise the exact number of falls, particularly MA falls, to more accurately estimate the health and economic impacts that vary across individuals. Potential approaches include the use of fall frequency distributions [97] or time-to-event data.

A broad range of falls risk factors were considered at both model conceptualisation and parameterisation. All risk factors highlighted by NICE CG161 (p. 47) [4], except for environmental hazards at home, were incorporated as covariates or components of the multivariate frailty index. The latter produced a frailty score on the 0-100 scale and served as explanatory variable for all falls risk estimations except MA fall given single fall (Tables 5.39-42); it thus captured the continuous nature of the falls risk. Only Smith (2016) [108] among previous models estimated a multivariate regression to predict individual-level falls risk. The current model also used multivariate falls risk for targeting and showed that it improved the efficiency of falls prevention even under capacity constraints (Section 6.3.1.2). Unlike the one-year analysis in Smith (2016), the current model also estimated the longitudinal trajectories in the key falls risk factors and hence in the falls risk profile. Further research could incorporate home and external hazards to improve the modelling of HAM and falls hazard removal, respectively.

Regarding the health consequences of falls, the current model used the multivariate frailty index to capture the secondary health effects of falls, including those on mortality, LTC admission, EQ-5D, and comorbidity care costs across sectors. The model also accounted for the impacts of non-MA falls on EQ-5D, which only a few models had done previously (Table D4 in Appendix D). This had a significant bearing on the evaluation: the DSA results in Table 6.5 showed that the QALY losses from non-MA falls had a larger impact on ICERs than MA falls. The model also distinguished between the impacts of single and recurrent non-MA falls, only done by one previous model [32]. The model could have incorporated greater granularity of injury types as recommended by the expert guideline [17]. The base case impact of RC on other-cause mortality was surprisingly modest (0.2% reduction). Further research could stratify the mortality risks by continuous rather than categorical frailty to better estimate the intervention impact on mortality via frailty reduction.

The model incorporated individual-level EQ-5D values estimated from proxy item responses, a method used in previous studies [223, 224]. This method may have introduced some measurement error relative to actual response, although the estimated values closely tracked published EQ-5D central statistics from UK geriatric populations. Their incorporation captured the individual-level heterogeneity in baseline EQ-5D and its dynamic trajectory. By contrast, only one previous model captured the variation in health utility progression by factors additional to age and sex [100], and that was at the subgroup- rather than individual-level (Table 4.13). Tables 5.14 and 5.50 showed that SES quartile and frailty exerted statistically and clinically significant effects on EQ-5D independently of age and sex. Hence, progression by age and sex alone would mischaracterise the EQ-5D and QALY distributions across the SES- and frailty-delineated subgroups that carry priority setting implications. The model also distinguished between acute, non-acute, and secondary effects of falls on EQ-5D, namely: QALY decrements in Table 5.43 for acute effect; coefficients of falls incidence on EQ-5D change in Table 5.50 for non-acute; and coefficient of frailty change (influenced by falls) on EQ-5D in Table 5.50 for secondary. There is, nevertheless, a risk that the impact of falls on EQ-5D has been double-counted between the acute and non-acute/secondary effects.

Regarding the economic consequences of falls, the current model again used the frailty index to cover the fall-related and comorbidity care costs incurred in primary and secondary healthcare, district nursing, short-term social care, LTC, and wider society. Fall-related and comorbidity care costs together constituted the all-cause public sector costs reported in all analyses. As noted, this addressed the most prevalent methodological issues according to the checklist, namely the reporting of all-cause costs (item 15) and the separate reporting of fall-related costs (item 16). Only two previous models (excluding those that used primary RCT data) incorporated all-cause costs [32, 90], and these did not separately report fall-related costs (Table 4.7). Only six incorporated comorbidity care costs [34, 81, 91, 95, 100, 111]; of these, only one allowed the costs to vary by functional status affected by fracture [100].

Further research could incorporate individual-level granularity to the all-cause primary and secondary healthcare costs used to estimate the comorbidity healthcare costs [225]. The cost gradient across the frailty categories was surprisingly modest and may conceal a steep rise near the tail for the frailest individuals within the severely frail category. Understanding the individual-level association between continuous frailty and costs would improve the estimation of secondary effects of falls. Due to data availability in ELSA, the current model did not distinguish between fall-related and other-cause LTC admissions as done in previous models [39, 97]; further research could make this distinction and capture the variation in health and cost implications by admission cause. The 1.1% reduction in LTC admissions in the base case was surprisingly modest, and access to admission data at a higher frequency may improve the admission risk estimation. A future model could also capture the age-related variation in the cost of dying. The literature suggests that this cost decreases with age at death [111, 226]; the model would then capture the cost reductions from interventions that prolong longevity [19].

### Falls prevention intervention features

The current model sought to accurately portray the falls prevention practice in Sheffield. The UC scenario costed three intervention types with efficacy evidence sourced from five RCTs. Indeed, the main difference between UC and RC was in the intervention reach rather than type: e.g., the annual access to multifactorial intervention expanded from 1,519 to 21,131 under the base case. The commissioning decision therefore concerned not only the intervention type(s) but also the feasible supply capacity and demand. As noted, this addressed the third most prevalent checklist issue, namely the interchangeable use of the terms usual care and no intervention (Section 4.7.3). UC parameterisation nevertheless made several assumptions: HAM was the only intervention under the reactive pathway; and ELSA variables were assumed to capture several access rates (Tables 5.26 and 5.27).

The current model was unique in incorporating reactive, proactive, and self-referred pathways operating in tandem; only one previous model had done so, and that was without evaluating the pathway-specific user profiles and contributions [96]. Moreover, the current model parameterised distinct access mechanisms for each pathway, estimating, for example, the likelihood of individuals demanding group exercise under the RC self-referred pathway. Further research could consider incorporating linkages between pathways: for example, participants of reactive/proactive multifactorial interventions being recommended self-referred exercise or high physical activity for sustained therapeutic effect.

For falls risk screening, the current model incorporated the abnormal gait/balance variable which, assuming no measurement error in screening, made the individual eligible for the proactive pathway. This method captured the individual-level granularity in proactive referral and is preferable to other methods such as assigning test efficacies at the subgroup-level (Section 4.5.2.2). Moreover, the gait/balance-based referral had similar sensitivity and specificity to TUG (Section 5.2.2.5), a test recommended by NICE CG161 (p. 53) [4]. Hence, the RC proactive pathway was representative of implementing NICE CG161 widely. The model also evaluated the use of multivariate falls risk as a targeting tool. A limitation was the assumption of 100% falls risk screening rate at GP contact under RC, particularly given the concern over the primary care workload. But in the absence of data on what screening rate would prevail under a concerted falls prevention campaign, any rate would have used assumptions; 100% represented the upper bound of performance used in previous models [96, 108].

For intervention resource and cost features, the modelling in Section 5.2.4.3 achieved a granularity level comparable to the level recommended by the expert guideline [17] or the best levels achieved by previous models (e.g., [46, 97]). Interventions were categorised by resource/cost structure, specifically the proportion of fixed costs involved. The fixed cost of falls clinics impacted the cost-effectiveness of, for example, CRC scenario (2) where no repeated provision of multifactorial interventions resulted in under-utilisation of the clinics and higher per-participant costs (Section 6.3.1.2). That said, a key component of the clinic fixed cost was the capital overheads which was annuitised over 60 years according to the PSSRU practice [219]. But a large proportion of these overheads may be sunk investment costs incurred at clinic set-up, in which case the annuitisation may misrepresent the timing of financial requirements. Another assumption was that interventions could be set up and run without delay; in reality, some time may elapse before they generate efficacies [227]. Two models of vitamin D supplementation, for example, assumed intervention efficacies to materialise six months or three years after initiation [77, 112]. Further research could consider additional fixed/sunk costs beyond the falls clinic. Contract changes and data system set-up to enable citywide falls risk screening, for example, may incur significant sunk costs. Environmental intervention costs could similarly be incorporated at fixed rather than the current per-participant rates.

For intervention efficacy, the model matched the efficacy metric and type with those of fall incidence as far as the RCT data allowed. In Table 5.35, the efficacies included RR of experiencing any fall, RR of experiencing recurrent falls given any fall (RRRF), RR of experiencing MA fall given any fall, and RR of engaging in high physical activity. The derived equation for RRRF used information from both RR and RaR. This would improve the accuracy of the incorporated efficacy data, particularly when falls prevention trials report contrasting RR and RaR in terms of statistical and clinical significance and direction. The Cochrane systematic review, for example, reported pooled RR of 0.96 (95% confidence interval: 0.90-1.03) for multifactorial intervention and pooled RaR of 0.77 (95% CInt: 0.67-0.87) [48].

A limitation to the current efficacy parameterisation was the reliance on single RCTs for each intervention subgroup. But this was preferred over pooling the RCTs of multiple interventions with highly heterogeneous features. The subgroup-specific efficacy improved upon previous models, only one of which considered heterogeneity in efficacy [81] (Section 4.5.3.2). Nevertheless, the approach resulted in unbalanced sets of efficacy parameters across subgroups depending on data availability from RCTs. Four of seven RCTs in Table 5.35, for example, did not report any data on reduction of MA fall given any fall. Their respective interventions were hence assumed to have no impact on MA falls risk and therefore less efficacious than others with better reporting. No RCT reported data on fatal fall reduction, resulting in the modest impact of RC on its incidence (0.4% reduction). As noted, the model assumed that the six-month efficacies of two interventions were durable for the year of receipt. But the long-term effectiveness of interventions beyond the receipt year was modelled to depend on sustained access patterns. This was a key strength that avoided making arbitrary assumptions on efficacy durability as done by several previous models (Section 4.5.2.4).

For wider health effects of falls prevention, the model incorporated RR of engaging in high physical activity for persons of general falls risk who accessed self-referred exercise [176]. Environmental physical activity promotion was also assumed to influence the likelihood of high physical activity. Further research could incorporate yet more wider health effects and do so for all modelled interventions, not just one. As noted in Section 3.7.2, NICE CG161 mentions several wider health effects, including improving self-efficacy and reducing fear of falling. The intervention benefits may also be experienced by caregivers accompanying the older participants: the Tai Chi trial for cognitively impaired older persons, for example, found that intervention group caregivers’ TUG score improved significantly at follow-up relative to control group caregivers [221]. Such caregiver benefits were conceptualised in Table 3.4 but not parameterised. A future model could also incorporate any adverse intervention effects if evidence is available. Finally, the modelling sequence of intervention receipt, mortality risks, and then non-fatal fall incidence meant that deceased individuals would have incurred intervention costs without reaping the benefits of lower non-fatal fall risk. This would have underestimated the cost-effectiveness of interventions.

### Key challenges for public health economic modelling

The model’s strengths and limitations in addressing the key challenges for public health economic modelling are discussed under the four challenge categories.

#### Capturing non-health outcomes and societal intervention costs

This model incorporated a range of non-health outcomes and societal intervention costs wider than that of any previous model (Table 4.11). It also tracked individual-level lifetime outcomes including experiences of fair innings, productive ageing, and excessive private care expenditure. RC had a limited impact on individual-level outcomes relative to UC despite the favourable CUA result using population-level outcomes. Likewise, rankings of intervention strategies varied by whether individual- or population-level outcomes were used (Section 6.3.2.1).

A future model should incorporate any acute impacts of falls on social wellbeing pending data availability; the regressions in Tables 5.17 and E18 only captured the non-acute impacts. Likewise, any data on the impact of LTC admission on social wellbeing should be incorporated. The current model did not assign a QALY decrement to the social impact of LTC admission as done in a previous model [100] since the EQ-5D weighted QALY was perceived as a narrower health measure. The future model could also incorporate the intervention impacts on social wellbeing as recommended in NICE CG161 [4] (Table 3.4). The Tai Chi trial, for example, found that the intervention significantly improved the ICECAP-O measure of older persons’ socially-oriented capability without improving physical status measures such as gait and balance [221]. Such social wellbeing impacts could be parameterised for both older persons and accompanying caregivers if there is a wellbeing measure common to intervention studies and to the main data source for epidemiological parameters.

In addition, further research could account for further health and wellbeing aspects of informal care receipt and provision, beyond the monetised cost of care in the current model. Informal care provision may have adverse health effects on caregivers; care receipt may have positive wellbeing effects on patients [228, 229]. But as noted in Sections 5.2.3.2 and 5.2.3.4, there was limited evidence of these effects in ELSA. The current model incorporated informal caregivers’ TOC (through intervention accompaniment) only for cognitively impaired persons. It is likely that cognitively intact frail persons also require accompaniment, and this should be considered in a future model.

Balanced incorporation of productivity (with TOC), OOP care expenditure (intervention private co-payment) and informal caregiving cost (intervention caregiver TOC) meant that societal ICERs were often close to public sector ICERs. In several cases, societal intervention costs outweighed outcome gains, particularly for private care expenditures, and the number of individuals experiencing catastrophic private care expenditure depended on whether co-payments are included in the measure (Table 6.2). This balancing represents an improvement relative to previous models: of 15 models that reported societal outcomes, only two balanced the outcomes and costs [34, 100]. Obtaining individual-level data on societal intervention costs to match the individual-level non-health outcomes would be a further improvement. For example, there was a SES gradient to OOP care receipt (Table 5.20) but no such gradient for private co-payment. This likely overestimated the co-payment burden for the more deprived SES quartiles who may forego intervention uptake to reduce the burden.

For the societal CUA, the model incorporated dual cost-effectiveness thresholds. The monetary societal outcomes were converted to QALY using the £60,000 per QALY threshold [229]; the ratio between the incremental public sector costs and incremental societal QALYs was compared to the commonly accepted threshold of £30,000 per QALY gained [42]. Although this improved upon the analytic methods of previous models (none of which considered differential thresholds) it assumes uniform productive efficiency within the public sector and across diverse societal sectors. It likewise assumes that national thresholds apply locally. An alternative is to directly estimate the local productive efficiencies across various sectors by engaging stakeholders [229], but this was beyond the scope of this study.

#### Considering heterogeneity and dynamic complexity

The current model incorporated several variables to capture the heterogeneity and dynamic complexity in geriatric health: e.g., SES quartiles, multivariate frailty index, physical activity level, and cognitive status. The frailty index met the established criteria for construction [217] and covered all higher categories of component items covered by previous indices in the literature (Table5.7). The 0-100 index scale captured the continuous nature of geriatric health and improved upon the discrete/binary depiction (if at all) in previous models (Table 4.13). Moreover, the model reported subgroup outcomes for the base case delineated by age, sex, SES quartile, frailty category and further covariates, as well as pathway user profiles delineated by the same variables. It evaluated targeting scenarios by frailty and multivariate falls risk under capacity constraints. This contrasts with previous models, few of which conducted subgroup or targeting analyses delineated by factors other than age and sex (Table 4.12).

The incorporation of key geriatric health variables enabled the model to evaluate the impacts of broader geriatric public health strategies that potentially complement falls prevention. Thus, Sections 6.2.5.4 to 6.2.5.6 explored the potential impacts of additional public health measures that alter the baseline frailty, the contemporaneous frailty progression, life expectancy, and the effects of frailty on mortality. Section 6.3.1.5 explored the potential integration between physical activity promotion and falls prevention.

There were nonetheless caveats in how the geriatric variables were constructed and estimated. First, there were overlaps between several frailty deficit items and covariates incorporated individually, such as cognitive impairment. These may have inflated the strength of associations between the frailty index and these covariates. Yet it was clear that inclusion of a covariate in the frailty index did not exhaust the information content of its individual incorporation: cognitive impairment, for example, was independently associated with several other covariates and outcomes after controlling for frailty (see, e.g., Table 5.46). Second, the covariates were estimated sequentially rather than simultaneously, at baseline and dynamic update. Further research could use simultaneous equations to estimate the joint probabilities of covariate incidence. Third, explanatory variables for the multivariate equations were chosen based on statistical fit rather than their conceptual importance. That said, the conceptual model itself drew on the epidemiological literature that used statistical tests to identify significant associations [230]. Finally, there were several limitations in the use of ELSA data for longitudinal analyses: they would have been affected by informative dropouts between waves; while the two-year wave interim was both too long, requiring annualisation, and too short relative to methods that track the progression of key risk factors over individuals’ lifetimes [231].

Previous models neglected the consideration of aggregate outcomes when comparing interventions that targeted heterogeneous population subgroups (Section 4.5.3.2). By contrast, the current model reported the aggregate outcomes throughout and considered them in strategy comparisons. The self-referred pathway, for example, had a higher ICER than the reactive pathway, but generated a much higher aggregate INMB (Table F18). Likewise, several strategies had very attractive ICERs (e.g., strategies [1]-[3] in Table 6.17) but low aggregate INMBs. These would not be selected as the optimal strategy unless they can be further scaled up while maintaining their cost-effectiveness ratio. The aggregate outcomes could be further investigated under PSA and DSA. ICERs can be insensitive to implementation level changes that affect the intervention reach but not the cost-effectiveness ratio as shown in previous models (Section 4.5.3.3). Hence, the parameter ranking by impact would have differed significantly from Table 6.4 if aggregate outcomes (rather than ICERs) were evaluated in DSA.

The current model varied the intervention features (i.e., type, cost, efficacy, and implementation level) by cognitive status, intervention history, and falls risk to account for heterogeneity (see, e.g., Table 5.35 for efficacy variation). The receipt of reactive HAM under UC was also stratified by frailty category. But future models should further explore how intervention features may differ by frailty; some interventions, for example, may be contraindicated for the severely frail [232]. The model assumed that all cognitively impaired persons would receive the same tailored intervention. But the RCT for tailored Tai Chi, for example, excluded persons with very severe impairment who are unable to give informed consent [221]. Hence, there would be heterogeneity in intervention features *within* the cognitively impaired subgroup which future models should incorporate. The model assumption that persons with intervention history incurred 20% of the costs of outsourced services within multifactorial intervention (Table 5.32) was based on expert opinion but should be further explored using primary service data.

The current model parameterised key causal variables that influenced multiple model components and created dynamic interactions. Cognitive impairment, for example, influenced intervention type (Table 5.25) and comorbidity care costs (e.g., Table 5.19). Likewise, abnormal gait/balance increased falls risk (Table 5.40), initiated proactive referrals (Table 5.27), and reduced self-referred exercise demand (Table 5.49); falls in turn increased the risk of abnormal gait/balance (Table E14). There were hence multiple feedback loops between abnormal gait/balance, falls risk, and falls prevention.

Several causal mechanisms were nonetheless under-represented relative to conceptualisation (Table 3.6). The model did not incorporate further cognitive components of fear of falling which may have had more significant impacts on covariates and outcomes [233, 234]. The ELSA data only captured the physio-behavioural component of fear (whether fear of falling was experienced while walking); its narrow dimension may explain the limited role of the variable in the current model relative to its significant health effects observed in epidemiological studies [116, 122]. NICE CG161 also highlighted self-efficacy and fear of falling as wider outcomes targeted by falls prevention (Figure 3.1) [4]. Another under-represented causal variable was social community of older persons. NICE CG161 highlighted the importance of information provision to informal caregivers to reduce falls risk and facilitate intervention uptake (Figure 3.1). Future models could parameterise the caregiver influence to evaluate an environmental intervention operating via this social mechanism.

The model incorporated cycles through which intervention eligibility and access were re-assessed each year, proactive intervention via falls risk screening and reactive via MA fall incidence. This contrasts with previous models, only two of which incorporated dynamic changes to intervention need (Section 4.5.3.2) [100, 105]. However, the assumption that the falls risk screening can be maintained over time to enable annual re-assessment is less realistic given the concern over primary care workload. Regarding the reactive intervention access, the model sequence placed it at the start of a new cycle and hence after the frailty progression in the previous cycle. But ideally, the reactive intervention would be accessed immediately after fall incidence and *before* frailty progression to reduce its rate. That said, the data required to parameterise this was lacking.

The current model was unique in incorporating incoming cohorts of Sheffield residents aged 60 at every simulated year; only one previous model did so, and that was for only a limited period [105]. This approach enabled the evaluation of capacity constraint scenarios; the absence of incoming cohorts would have made constraints non-binding as the initial cohort members exited. The model also incorporated population size increases predicted by the ONS [235]. Further modelling work could utilise the incoming cohort entries to characterise long-term epidemiological transitions. One epidemiological model, for example, had predicted a rise in multimorbidity among the population aged 65+ in the UK until 2040 [236], and such a trend could have been incorporated in incoming cohorts’ characteristics. It could also incorporate dynamic changes to the target population size through migration as done in previous models [81, 111].

#### Considering theories of human behaviour and implementation

The model parameterised the demand for self-referred exercise at individual-level granularity (Tables 5.30 and 5.49). In Table 5.49, those with exercise history were significantly likelier to self-refer in the next cycle, establishing a positive feedback loop. This pattern captures the outcome of various motives of those who gained the health and non-health benefits of exercise. This improves upon previous models which assigned homogeneous access rates on their (sub-)populations (Table 4.14) and incorporated no behavioural theory that explains individuals’ service demand and access. Yet similar demand equations in future models could incorporate further explanatory variables capturing the health and non-health psychological motives of older persons and the sociological mechanisms influencing demand.

More caveats can be noted in how the current model characterised the behavioural aspects of intervention access. First, the model only incorporated group exercise in the self-referred pathway, but older people may prefer to exercise alone at home [237]. Second, there was no individual- or subgroup-level granularity to the demand for reactive and proactive interventions (Tables 5.26 and 5.27). Third, future models could explore the impacts of variations in professional behaviour and competence. The Simul8 software can parameterise efficiency levels at work activities to characterise such variations. Future models could similarly evaluate the impacts of variations in intervention compliance rates. Several RCTs used for parameterisation reported marked shortfalls in demand-side adherence: e.g., 7.1% of cognitively impaired Tai Chi participants completed the recommended 50 hours of exercise within 20 weeks [221]. The approach used in a previous model [100] of assigning per-protocol efficacy only to those who fully adhered to intervention could capture the impacts of these variations.

The model distinguished between intervention eligibility and supply- and demand-side determinants of intervention access as conceptualised from the qualitative research onwards (Section 2.4.3). Importantly, even under ideal supply conditions of RC, access still depended on demand (Table 5.25). Only one previous model distinguished between supply- and demand-side determinants of access [110]. Previous models also frequently relied on assumptions to characterise long-term sustainability in intervention access (Table 4.14). By contrast, this model parameterised the long-term demand for self-referred exercise using ELSA. Likewise, eligibility for reactive and proactive interventions was re-assessed at each cycle according to dynamic transitions, although a supply-side cap on the maximum number of proactive intervention re-receipts was imposed to limit the client flow to falls clinics.

The current model assumed for all interventions under RC that costing the RCT resource use reproduced the RCT-level efficacy and implementation quality in routine practice. This may not be the case in practice and it may be appropriate to down-adjust the efficacy and/or implementation quality as done in a previous model [79] and/or cost supplementary resources. For interventions under UC, the model used ELSA data to characterise their access rates (Tables 5.26 and 5.27), but this involved making assumptions. The model also did not account for the impact of the Covid-19 pandemic on both demand- and supply-side factors. The pandemic would have changed the range of feasible interventions and the capacity level; such changes would be relevant at least to the early part of the 40-year horizon.

The model evaluated three scenarios of community involvement in falls risk screening and self-referred demand promotion. This accomplished two objectives: (i) to explore the potential contributions of nonclinical community organisations as advocated by Sheffield stakeholders [238] and wider literature [102, 239]; and (ii) conduct value of implementation (VoIM) analysis which has seldom been intentionally used by previous models (Section 4.5.3.3). The VoIM analyses showed that not all community involvement schemes are of equal economic value; self-referred demand increase under capacity constraints, for example, led to efficiency loss. Moreover, universal and targeted community screening generated contrasting equity impacts (Table 6.14). The model hence provides an ideal platform to evaluate all potential schemes before the relevant community assets are mobilised. But the model made assumptions on the efficacies of the evaluated implementation strategies without consulting stakeholders; it may be unrealistic, for example, to expect community organisations (even with extended funding) to reach 50% of older persons who did not see a GP. Future VoIM analyses could also evaluate implementation strategies involving clinical professionals.

Unlike all previous models in Chapter 4, this model incorporated capacity constraints in community-based falls prevention. It did so within a discrete individual simulation rather than a continuous-time discrete event simulation [240]. This approach offers the opportunity for capacity modelling to analysts lacking access to time-to-event data, provided that the simulation software can incorporate incoming cohorts. A caveat to the current approach is that people not accessing an intervention due to a binding constraint were denied the intervention; in practice, they would likely be placed in queues for the subsequent year. An updated model could label eligible, willing but denied participants for receipt in the next cycle. It could also evaluate the contributions of individual pathways under capacity constraints and targeting. The VoIM scenario of community screening in Section 6.3.1.3 suggested that transferring clients from the self-referred to the proactive pathway improved cost-effectiveness relative to UC. If so, this would contrast with the findings for the unconstrained situation in Section 6.3.1.1 where the self-referred pathway generated higher efficiency than the proactive.

The strategy comparison in Section 6.3.2 and the commissioning recommendations in Section 6.3.3 noted the key influence of public sector budget impact on the range of feasible strategies. Future analyses could pre-specify a budget constraint within which the optimal intervention strategy is chosen.

#### Considering issues of equity

The current model incorporated a newly constructed SES variable as the social characteristic of equity relevance. The variable components were subjective measures of financial difficulty – which is important given the likelihood of older persons being asset-rich but cash-poor [241] – and (self-reported) measures of education, income, and wealth. The qualitative research participants indeed mentioned financial barriers to long-term falls prevention uptake (Table 2.2, theme [4-11]). They also identified persons with complex comorbidities as a key vulnerable group (Table 2.3). The model hence incorporated frailty category as the health severity characteristic of equity relevance. This approach improved upon previous modelling practices (Table 4.15): only four models from the same research team incorporated a social characteristic of equity relevance, namely ethnicity in New Zealand [81, 91, 95, 111]; only one model incorporated a health severity characteristic, parameterised the reduced capacity to benefit, and presented the relevant subgroup results [100].

Nevertheless, it was unclear to what extent the above delineating characteristics, particularly the SES variable, captured the equity issues of local relevance. First, as noted by the SCC commissioner, further work is warranted to explore the convergent validity of the SES variable relative to the LSOA-level multiple deprivation measure currently used by local decision-makers [242]. The qualitative research participants likewise mentioned area-level differences in intervention access (Section 2.4.2.5), suggesting that area- rather than individual-level delineation may be more appropriate for decision-making. Second, it is unclear to what extent the SES data in ELSA is generalisable to Sheffield. Studies have noted the significant local variations in socially determined risk factors and behaviour [243]. Third, the qualitative research identified further social characteristics of priority setting relevance, including ethnic/linguistic minority status and social isolation (Table 2.4). Yet there were technical constraints in the number of subgroups that could be incorporated in the Simul8 software. The coding work and the computational burden increased exponentially with further subgroup divisions. A pragmatic approach was taken whereby social isolation was incorporated as a frailty deficit item, while ethnic/linguistic characteristic was excluded.

The current approach nevertheless captured the individual-level SES and frailty gradients to key model components and outcomes. The incorporation of SES and frailty as covariates to EQ-5D progression in Table 5.50, for example, captured the variation in QALY outcome across the SES- and frailty-delineated subgroups with equity implications. The frailty gradient to mortality risks generated the life expectancy differential (LED) problem. Likewise, SES and frailty gradients were identified in productivity level, OOP care expenditure, and informal care receipt. The net societal gains under the base case differed substantially by SES quartile (Table F4) and initial frailty category (Table F5). The dual consideration of SES and frailty gradients was critical: SES was not a significant covariate in falls risk estimations (Tables 5.39 to 5.42) but affected falls risk by shaping the frailty progression (Table 5.45). Thus, frailty was a key medium for the social determinants of falls risk. The SES and frailty gradients to intervention access were also explored by pathway in Section 6.2.4.2. A further scenario of a substantial DJ problem in terms of intervention access was explored in Section 6.3.1.4, although the extent of the DJ problem (50% reduction in demand) was based on assumptions. The model assumed that individuals’ SES is fixed from model entry, whereas it is known that old age deprivation is a dynamic state shaped by risk and protective factors [244]. An updated model should endeavour to capture the dynamic trajectories of SES, particularly for younger subgroups who would undergo greater socioeconomic changes (e.g., formal retirement) during the simulated period.

Having incorporated the causal mechanisms by which SES and frailty affected outcomes, the model evaluated scenarios of policies designed to address them and estimated the equity-efficiency trade-offs. Section 6.2.5.6 evaluated a supplementary initiative that reduced the gap in the frailty-stratified mortality risk and hence the LED problem. Sections 6.3.1.3 and 6.3.1.5 evaluated community falls risk screening and environmental interventions, respectively, that targeted the 3rd and 4th SES quartiles. Section 6.3.1.4 evaluated scenarios of public sector coverage of societal intervention costs that eliminated the DJ problem in the bottom SES quartiles. This contrasts with previous models that incorporated causal mechanisms of equity relevance yet evaluated no scenarios of counteracting policies (Section 4.5.3.4). Three models set in New Zealand, for example, found that exercise and HAM worsened the health inequity delineated by ethnicity and identified the LED problem as the cause [81, 95, 111]. Yet they did not evaluate policies prioritising interventions for the ethnic minority subgroup.

The main analytic framework for evaluating the equity-efficiency trade-offs was the DCEA [23]. This framework was applied for all model scenarios including the base case. The model also conducted a form of ECEA by tracking the number of individuals experiencing catastrophic private care expenditures over their lifetime [245]. These frameworks have not previously been applied in the falls prevention context. They generated important findings in the intervention scenario comparisons. It was found, for example, that the proactive pathway – the main component of NICE CG161 [4] – was the most pro-poor of the three pathways (Table 6.9). Likewise, joint equity-efficiency consideration changed the intervention strategy rankings compared to sole efficiency consideration (Table 6.19).

There were nevertheless several caveats to the current approach of conducting DCEA. First, relatively little attention was given to severity-based analysis; frailty-delineated DCEA was conducted only twice in Sections 6.2.4.1 and 6.2.5.6. The qualitative research participants also identified cognitive impairment as a key severity variable (Table 2.3), but no DCEA was conducted. Second, DCEA was conducted only on deterministic outcomes, while the tutorial recommends it be performed on the average of probabilistic runs [23]. Third, it was unclear who would bear the opportunity cost of strategies prioritising the vulnerable groups and to what extent. These strategies included the public sector coverage of 3rd and 4th SES quartiles’ societal intervention costs in Section 6.3.1.4 and the targeted environmental interventions in Section 6.3.1.5. Under the current approach, it was assumed that the opportunity costs would be borne by the 1st and 2nd SES quartiles, but this may not be the case in practice. If most of the opportunity costs are in fact borne by the 3rd and 4th SES quartiles (e.g., withdrawal of public funding for other public health/welfare initiatives), then the interventions would generate far less equitable, if not regressive, results. This is particularly the case for public sector coverage of societal intervention costs since public sector funding withdrawal to cover the policy expense would incur a higher resource opportunity cost than the societal costs covered (i.e., lower cost-effectiveness threshold for public sector than societal outcomes).

Furthermore, the DCEA tutorial recommends that the analysis use outcomes that are adjusted for the impacts of variables without equity relevance [23]. If, for example, the INHB differential across sex is deemed fair by stakeholders, then the analysis would adjust for the impact of sex on INHB estimated from a multivariate equation. This would allow the DCEA be conducted on sex-standardised INHBs delineated by equity-relevant variables. In the absence of stakeholder consultations to determine which variables do *not* have equity relevance (rather than identify variables of *key* equity relevance), the current model only used unadjusted INHBs in DCEAs. Future work could incorporate such adjustments based on stakeholder views. It could also explore the impact of adopting alternative divisions of the SES and frailty variables (e.g., SES quintiles).

### Evaluation methods

The current model has been validated to improve the credibility of its results. Conceptual modelling in Chapters 2 and 3 prospectively reduced the structural uncertainty. Section 5.3 then conducted post-development model validations: face validation by modelling experts not involved in the development; internal validation by another modeller using line-by-line code verification and scenario analyses; and external validation on key model outcomes. Cross-validation was conducted in Section 6.4.1. This validation approach contrasts with those of previous 46 models, only one of which conducted all four validations above. Nevertheless, involvement of non-modelling stakeholders may have improved face validation. Access to local routine data on falls incidence/cost would have improved external validation.

The current model was transparent about the sensitivity and scenario analyses conducted. This contrasts with previous models which often did not clearly distinguish between DSA to assess parameter uncertainty and scenario analyses to evaluate alternative states of the world (Section 4.5.4.2). Future evaluations could ensure that lifetime outcomes are tracked for all incoming cohorts in all scenarios, rather than in just one scenario under the current model in Section 6.2.5.1.

For the 23 alternative intervention scenarios, these were compared in Section 6.3.2 using a wide range of outcomes, including cost-effectiveness, equity, individual-level lifetime outcomes, budget impact, capacity implication, and feasibility. Several caveats should still be noted. First, the 23 scenarios did not exhaust the range of possible permutations: individual pathways, for example, could be evaluated under capacity constraints, while environmental interventions and community involvement could supplement a CRC scenario other than scenario (4). Second, given the wide range of outcomes, multi-criteria decision analysis could be used [246]. Finally, further work could conduct PSA and alternative evaluation frameworks and epidemiological scenarios on the key intervention scenarios that emerge as commissioning candidates.

# Appendix References

1. Pfadenhauer L, Rohwer A, Burns J, Booth A, Lysdahl KB, Hofmann B, et al. Guidance for the assessment of context and implementation in health technology assessments (HTA) and systematic reviews of complex interventions: the context and implementation of complex interventions (CICI) framework. Available from: <http://www.integrate-hta.eu/downloads/>: European Union, 2016.

2. Norheim OF, Baltussen R, Johri M, Chisholm D, Nord E, Brock D, et al. Guidance on priority setting in health care (GPS-Health): the inclusion of equity criteria not captured by cost-effectiveness analysis. Cost Effectiveness and Resource Allocation. 2014;12(1):18.

3. Stevens A, Gabbay J. Needs assessment needs assessment. Health trends. 1991;23(1):20-3.

4. National Institute for Health and Care Excellence. Falls in older people: assessing risk and prevention. National Institute for Health and Care Excellence. 2013;Clinical Guideline 161(nice.org.uk/guidance/cg161).

5. Schüz B, Wurm S, Warner LM, Wolff JK, Schwarzer R. Health motives and health behaviour self-regulation in older adults. Journal of behavioral medicine. 2014;37(3):491-500.

6. Ory M, Hoffman MK, Hawkins M, Sanner B, Mockenhaupt R. Challenging aging stereotypes: Strategies for creating a more active society. American journal of preventive medicine. 2003;25(3):164-71.

7. French DP, Olander EK, Chisholm A, Mc Sharry J. Which behaviour change techniques are most effective at increasing older adults’ self-efficacy and physical activity behaviour? A systematic review. Annals of Behavioral Medicine. 2014;48(2):225-34.

8. National Institute for Health and Care Excellence. 2019 surveillance of falls in older people: assessing risk and prevention (NICE guideline CG161). National Institute for Health and Care Excellence. 2019;Published: 23 May 2019.

9. Public Health England. Falls and fracture consensus statement: Supporting commissioning for prevention. London: Public Health England. 2017.

10. Foster C, Reilly J, Jago R, Murphy M, Skelton D, Cooper A, et al. UK Chief Medical Officers' Physical Activity Guidelines. Department of Health and Social Care. 2019.

11. Kwon J, Lee Y, Squires H, Franklin M, Young T. Economic evaluation of community-based falls prevention interventions for older populations: a systematic methodological overview of systematic reviews. BMC Health Serv Res. 2022;22. doi: <https://doi.org/10.1186/s12913-022-07764-2>.

12. Pollock M, Fernandes RM, Becker LA, Pieper D, Hartling L. Chapter V: Overviews of Reviews. In: In: Higgins JPT TJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors), editor. Cochrane Handbook for Systematic Reviews of Interventions version 62 (updated February 2021)2018.

13. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Bmj. 2021;372.

14. Royal College of Nursing. Clinical practice guideline for the assessment and prevention of falls in older people. Clinical Practice Guidelines. 2005;London: Royal College of Nursing.

15. Drummond MF, Sculpher MJ, Claxton K, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes: Oxford university press; 2015.

16. Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. bmj. 2017;358.

17. Davis J, Robertson MC, Comans T, Scuffham P. Guidelines for conducting and reporting economic evaluation of fall prevention strategies. Osteoporosis international. 2011;22(9):2449-59.

18. Philips Z, Ginnelly L, Sculpher M, Claxton K, Golder S, Riemsma R, et al. Review of guidelines for good practice in decision-analytic modelling in health technology assessment. 2004.

19. Huter K, Kocot E, Kissimova-Skarbek K, Dubas-Jakóbczyk K, Rothgang H. Economic evaluation of health promotion for older people-methodological problems and challenges. BMC health services research. 2016;16(5):328.

20. Squires H, Chilcott J, Akehurst R, Burr J, Kelly MP. A systematic literature review of the key challenges for developing the structure of public health economic models. International journal of public health. 2016;61(3):289-98.

21. Squires H, Chilcott J, Akehurst R, Burr J, Kelly MP. A framework for developing the structure of public health economic models. Value in Health. 2016;19(5):588-601.

22. Fenwick E, Claxton K, Sculpher M. The value of implementation and the value of information: combined and uneven development. Medical Decision Making. 2008;28(1):21-32.

23. Asaria M, Griffin S, Cookson R. Distributional Cost-Effectiveness Analysis: A Tutorial. Medical decision making. 2016;36(1):8-19. doi: 10.1177/0272989X15583266.

24. Brennan A, Akehurst R. Modelling in health economic evaluation. Pharmacoeconomics. 2000;17(5):445-59.

25. Davis JC, Robertson MC, Ashe MC, Liu-Ambrose T, Khan KM, Marra CA. Does a home-based strength and balance programme in people aged > or =80 years provide the best value for money to prevent falls? A systematic review of economic evaluations of falls prevention interventions. Br J Sports Med. 2010;44(2):80-9. doi: 10.1136/bjsm.2008.060988. PubMed PMID: 20154094.

26. Public Health England. A structured literature review to identify cost-effective interventions to prevent falls in older people living in the community. Public Health England. 2018.

27. Olij BF, Ophuis RH, Polinder S, Van Beeck EF, Burdorf A, Panneman MJ, et al. Economic evaluations of falls prevention programs for older adults: a systematic review. Journal of the American Geriatrics Society. 2018;66(11):2197-204.

28. Winser SJ, Chan HTF, Ho L, Chung LS, Ching LT, Felix TKL, et al. Dosage for cost-effective exercise-based falls prevention programs for older people: a systematic review of economic evaluations. Annals of physical and rehabilitation medicine. 2020;63(1):69-80.

29. Dubas-Jakóbczyk K, Kocot E, Kissimova-Skarbek K, Huter K, Rothgang H. Economic evaluation of health promotion and primary prevention actions for older people—a systematic review. The European Journal of Public Health. 2017;27(4):670-9.

30. Huter K, Dubas-Jakóbczyk K, Kocot E, Kissimova-Skarbek K, Rothgang H. Economic evaluation of health promotion interventions for older people: do applied economic studies meet the methodological challenges? Cost Effectiveness and Resource Allocation. 2018;16(1):14.

31. Robertson MC, Gardner MM, Devlin N, McGee R, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 2: Controlled trial in multiple centres. BMJ. 2001;322(7288):701-4. PubMed PMID: 11264207; PubMed Central PMCID: PMCPMC30095.

32. Albert SM, Raviotta J, Lin CJ, Edelstein O, Smith KJ. Cost-effectiveness of a statewide falls prevention program in Pennsylvania: Healthy Steps for Older Adults. The American journal of managed care. 2016;22(10):638-44.

33. Beard J, Rowell D, Scott D, van Beurden E, Barnett L, Hughes K, et al. Economic analysis of a community-based falls prevention program. Public Health. 2006;120(8):742-51. doi: 10.1016/j.puhe.2006.04.011. PubMed PMID: 16824563.

34. Johansson P, Sadigh S, Tillgren P, Rehnberg C. Non-pharmaceutical prevention of hip fractures - a cost-effectiveness analysis of a community-based elderly safety promotion program in Sweden. Cost effectiveness and resource allocation : C/E. 2008;6:11. doi: <https://dx.doi.org/10.1186/1478-7547-6-11>.

35. van der Velde N, Meerding WJ, Looman CW, Pols HA, van der Cammen TJ. Cost effectiveness of withdrawal of fall-risk-increasing drugs in geriatric outpatients. Drugs & aging. 2008;25(6):521-9.

36. Farag I, Howard K, Ferreira ML, Sherrington C. Economic modelling of a public health programme for fall prevention. Age Ageing. 2015;44(3):409-14. Epub 2014/12/20. doi: 10.1093/ageing/afu195. PubMed PMID: 25523025.

37. Smith RD, Widiatmoko D. The cost-effectiveness of home assessment and modification to reduce falls in the elderly. Australian and New Zealand journal of public health. 1998;22(4):436-40.

38. McLean K, Day L, Dalton A. Economic evaluation of a group-based exercise program for falls prevention among the older community-dwelling population. BMC Geriatr. 2015;15:33. Epub 2015/04/17. doi: 10.1186/s12877-015-0028-x. PubMed PMID: 25879871; PubMed Central PMCID: PMCPMC4404560.

39. Public Health England. A Return on Investment Tool for the Assessment of Falls Prevention Programmes for Older People Living in the Community. Public Health England. 2018.

40. Robertson MC, Devlin N, Gardner MM, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomised controlled trial. BMJ. 2001;322(7288):697-701. PubMed PMID: 11264206; PubMed Central PMCID: PMCPMC30094.

41. Costa S, Cary M, Helling DK, Pereira J, Mateus C. An overview of systematic reviews of economic evaluations of pharmacy-based public health interventions: addressing methodological challenges. Systematic reviews. 2019;8(1):1-20.

42. National Institute for Health and Care Excellence. Guide to the methods of technology appraisal 2013. 2013.

43. Campbell AJ, Robertson MC. Fall prevention: single or multiple interventions? Single interventions for fall prevention. Journal of the American Geriatrics Society. 2013;61(2):281-4.

44. Day LM. Fall prevention programs for community‐dwelling older people should primarily target a multifactorial intervention rather than exercise as a single intervention. Journal of the American Geriatrics Society. 2013;61(2):284-5.

45. National Institute for Health and Care Excellence. Supporting investment in public health: Review of methods for assessing cost effectiveness, cost impact and return on investment. London: NICE. 2011.

46. Day L, Hoareau E, Finch C, Harrison JE, Segal L, Bolton TG, et al. Modelling the impact, cost and benefits of falls prevention measures to support policy-makers and program planners. 2009.

47. Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, et al. Interventions for preventing falls in older people living in the community. Cochrane database of systematic reviews. 2012;(9).

48. Hopewell S, Adedire O, Copsey BJ, Boniface GJ, Sherrington C, Clemson L, et al. Multifactorial and multiple component interventions for preventing falls in older people living in the community. Cochrane database of systematic reviews. 2018;(7).

49. Sherrington C, Fairhall NJ, Wallbank GK, Tiedemann A, Michaleff ZA, Howard K, et al. Exercise for preventing falls in older people living in the community. Cochrane database of systematic reviews. 2019;(1).

50. Winser S, Lee SH, Law HS, Leung HY, Bello UM, Kannan P. Economic evaluations of physiotherapy interventions for neurological disorders: A systematic review. Disability and Rehabilitation: An International, Multidisciplinary Journal. 2020;42(7):892-901. doi: <http://dx.doi.org/10.1080/09638288.2018.1510993>.

51. Campbell AJ, Robertson MC, La Grow SJ, Kerse NM, Sanderson GF, Jacobs RJ, et al. Randomised controlled trial of prevention of falls in people aged > or =75 with severe visual impairment: the VIP trial. BMJ. 2005;331(7520):817. doi: 10.1136/bmj.38601.447731.55. PubMed PMID: 16183652; PubMed Central PMCID: PMCPMC1246082.

52. Cockayne S, Rodgers S, Green L, Fairhurst C, Adamson J, Scantlebury A, et al. Clinical effectiveness and cost-effectiveness of a multifaceted podiatry intervention for falls prevention in older people: a multicentre cohort randomised controlled trial (the REducing Falls with ORthoses and a Multifaceted podiatry intervention trial). Health technology assessment (Winchester, England). 2017;21(24):1-198. doi: <https://dx.doi.org/10.3310/hta21240>.

53. Davis JC, Marra CA, Robertson MC, Khan KM, Najafzadeh M, Ashe MC, et al. Economic evaluation of dose-response resistance training in older women: a cost-effectiveness and cost-utility analysis. Osteoporos International. 2011;22(5):1355-66. doi: 10.1007/s00198-010-1356-5. PubMed PMID: 20683707; PubMed Central PMCID: PMCPMC4508130.

54. Davis JC, Marra CA, Robertson MC, Najafzadeh M, Liu‐Ambrose T. Sustained economic benefits of resistance training in community‐dwelling senior women. Journal of the American Geriatrics Society. 2011;59(7):1232-7.

55. Farag I, Howard K, Hayes AJ, Ferreira ML, Lord SR, Close JT, et al. Cost-effectiveness of a Home-Exercise Program Among Older People After Hospitalization. Journal of the American Medical Directors Association. 2015;16(6):490-6. doi: <https://dx.doi.org/10.1016/j.jamda.2015.01.075>.

56. Farag I, Sherrington C, Hayes A, Canning CG, Lord SR, Close JCT, et al. Economic evaluation of a falls prevention exercise program among people With Parkinson's disease. Movement disorders. 2016;31(1):53-61. doi: <https://dx.doi.org/10.1002/mds.26420>.

57. Fletcher E, Goodwin VA, Richards SH, Campbell JL, Taylor RS. An exercise intervention to prevent falls in Parkinson's: an economic evaluation. BMC Health Serv Res. 2012;12:426. doi: 10.1186/1472-6963-12-426. PubMed PMID: 23176532; PubMed Central PMCID: PMCPMC3560229.

58. Hendriks MR, Evers SM, Bleijlevens MH, van Haastregt JC, Crebolder HF, van Eijk JTM. Cost-effectiveness of a multidisciplinary fall prevention program in community-dwelling elderly people: a randomized controlled trial (ISRCTN 64716113). International journal of technology assessment in health care. 2008;24(2):193-202.

59. Irvine L, Conroy SP, Sach T, Gladman JRF, Harwood RH, Kendrick D, et al. Cost-effectiveness of a day hospital falls prevention programme for screened community-dwelling older people at high risk of falls. Age and Ageing. 2010;39(6):710-6. doi: 10.1093/ageing/afq108. PubMed PMID: WOS:000283659700011.

60. Isaranuwatchai W, Perdrizet J, Markle-Reid M, Hoch JS. Cost-effectiveness analysis of a multifactorial fall prevention intervention in older home care clients at risk for falling. BMC geriatrics. 2017;17(1):199. doi: <https://dx.doi.org/10.1186/s12877-017-0599-9>.

61. Jenkyn KB, Hoch JS, Speechley M. How much are we willing to pay to prevent a fall? Cost-effectiveness of a multifactorial falls prevention program for community-dwelling older adults. Canadian Journal on Aging/La Revue canadienne du vieillissement. 2012;31(2):121-37.

62. Kenkre JE, Allan TF, Tobias RS, Parry DJ, Bryan S, Carter YH. Breaking bones, breaking budgets: a clinical and economic evaluation of a prospective, randomized, practice controlled, intervention study in the prevention of accidents in primary care. Family practice. 2002;19(6):675-81.

63. Li F, Harmer P. Economic Evaluation of a Tai Ji Quan Intervention to Reduce Falls in People With Parkinson Disease, Oregon, 2008-2011. Prev Chronic Dis. 2015;12:E120. doi: 10.5888/pcd12.140413. PubMed PMID: 26226067; PubMed Central PMCID: PMCPMC4523116.

64. Patil R, Kolu P, Raitanen J, Valvanne J, Kannus P, Karinkanta S, et al. Cost-effectiveness of vitamin D supplementation and exercise in preventing injurious falls among older home-dwelling women: findings from an RCT. Osteoporosis International. 2016;27(1):193-201. doi: 10.1007/s00198-015-3240-9. PubMed PMID: WOS:000369525500022.

65. Peeters GMEE, Heymans MW, de Vries OJ, Bouter LM, Lips P, van Tulder MW. Multifactorial evaluation and treatment of persons with a high risk of recurrent falling was not cost-effective. Osteoporosis International. 2011;22(7):2187-96. doi: 10.1007/s00198-010-1438-4. PubMed PMID: WOS:000291227700015.

66. Polinder S, Boye ND, Mattace-Raso FU, Van der Velde N, Hartholt KA, De Vries OJ, et al. Cost-utility of medication withdrawal in older fallers: results from the improving medication prescribing to reduce risk of FALLs (IMPROveFALL) trial. BMC Geriatr. 2016;16(1):179. doi: 10.1186/s12877-016-0354-7. PubMed PMID: 27809792; PubMed Central PMCID: PMCPMC5096283.

67. Rizzo JA, Baker DI, McAvay G, Tinetti ME. The cost-effectiveness of a multifactorial targeted prevention program for falls among community elderly persons. Medical care. 1996:954-69.

68. Robertson MC, Devlin N, Scuffham P, Gardner MM, Buchner DM, Campbell AJ. Economic evaluation of a community based exercise programme to prevent falls. J Epidemiol Community Health. 2001;55(8):600-6. PubMed PMID: 11449021; PubMed Central PMCID: PMCPMC1731948.

69. Sach TH, Logan PA, Coupland CA, Gladman JR, Sahota O, Stoner-Hobbs V, et al. Community falls prevention for people who call an emergency ambulance after a fall: an economic evaluation alongside a randomised controlled trial. Age Ageing. 2012;41(5):635-41. doi: 10.1093/ageing/afs071. PubMed PMID: 22695789; PubMed Central PMCID: PMCPMC3424053.

70. Salkeld G, Cumming RG, O'Neill E, Thomas M, Szonyi G, Westbury C. The cost effectiveness of a home hazard reduction program to reduce falls among older persons. Australian and New Zealand journal of public health. 2000;24(3):265-71.

71. Timonen L, Rantanen T, Mäkinen E, Timonen T, Törmäkangas T, Sulkava R. Cost analysis of an exercise program for older women with respect to social welfare and healthcare costs: a pilot study. Scandinavian journal of medicine & science in sports. 2008;18(6):783-9.

72. Carande-Kulis V, Stevens JA, Florence CS, Beattie BL, Arias I. A cost-benefit analysis of three older adult fall prevention interventions. J Safety Res. 2015;52:65-70. doi: 10.1016/j.jsr.2014.12.007. PubMed PMID: 25662884.

73. Church J, Goodall S, Norman R, Haas M. An economic evaluation of community and residential aged care falls prevention strategies in NSW. New South Wales public health bulletin. 2011;22(3-4):60-8. doi: <https://dx.doi.org/10.1071/NB10051>.

74. Church J, Goodall S, Norman R, Haas M. The cost-effectiveness of falls prevention interventions for older community-dwelling Australians. Aust N Z J Public Health. 2012;36(3):241-8. doi: 10.1111/j.1753-6405.2011.00811.x. PubMed PMID: 22672030.

75. Frick KD, Kung JY, Parrish JM, Narrett MJ. Evaluating the cost-effectiveness of fall prevention programs that reduce fall-related hip fractures in older adults. J Am Geriatr Soc. 2010;58(1):136-41. doi: 10.1111/j.1532-5415.2009.02575.x. PubMed PMID: 20122044.

76. Hektoen LF, Aas E, Luras H. Cost-effectiveness in fall prevention for older women. Scand J Public Health. 2009;37(6):584-9. doi: 10.1177/1403494809341093. PubMed PMID: 19666674.

77. Lee RH, Weber T, Colon-Emeric C. Comparison of cost-effectiveness of vitamin D screening with that of universal supplementation in preventing falls in community-dwelling older adults. Journal of the American Geriatrics Society. 2013;61(5):707-14. doi: <https://dx.doi.org/10.1111/jgs.12213>.

78. Ling C, Henderson S, Henderson R, Henderson M, Pedro T, Pang L. Cost benefit considerations of preventing elderly falls through environmental modifications to homes in Hana, Maui. Hawaii medical journal. 2008;67(3):65.

79. Mori T, Crandall C, Ganz DA. Cost-effectiveness of combined oral bisphosphonate therapy and falls prevention exercise for fracture prevention in the USA. Osteoporosis international. 2017;28(2):585-95.

80. Ontario Medical Advisory Secretariat. The Falls/fractures Economic Model in Ontario Residents aged 65 years and over (FEMOR). Ontario health technology assessment series. 2008;8(6):1.

81. Pega F, Kvizhinadze G, Blakely T, Atkinson J, Wilson N. Home safety assessment and modification to reduce injurious falls in community-dwelling older adults: cost-utility and equity analysis. Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention. 2016;22(6):420-6. doi: <https://dx.doi.org/10.1136/injuryprev-2016-041999>.

82. Poole CD, Smith J, Davies JS. Cost-effectiveness and budget impact of Empirical vitamin D therapy on unintentional falls in older adults in the UK. BMJ open. 2015;5(9):e007910. doi: <https://dx.doi.org/10.1136/bmjopen-2015-007910>.

83. Sach TH, Foss AJ, Gregson RM, Zaman A, Osborn F, Masud T, et al. Falls and health status in elderly women following first eye cataract surgery: an economic evaluation conducted alongside a randomised controlled trial. Br J Ophthalmol. 2007;91(12):1675-9. doi: 10.1136/bjo.2007.118687. PubMed PMID: 17585002; PubMed Central PMCID: PMCPMC2095519.

84. Wu S, Keeler EB, Rubenstein LZ, Maglione MA, Shekelle PG. A cost-effectiveness analysis of a proposed national falls prevention program. Clinics in geriatric medicine. 2010;26(4):751-66. doi: <https://dx.doi.org/10.1016/j.cger.2010.07.005>.

85. Ofman JJ, Sullivan SD, Neumann PJ, Chiou C-F, Henning JM, Wade SW, et al. Examining the value and quality of health economic analyses: implications of utilizing the QHES. Journal of Managed Care Pharmacy. 2003;9(1):53-61.

86. National Institute for Health and Care Excellence. Developing NICE guidelines: the manual Appendix H. London: NICE. 2014.

87. Evers S, Goossens M, de Vet H, van Tulder M, Ament A. Criteria list for assessment of methodological quality of economic evaluations: Consensus on Health Economic Criteria. Int J Technol Assess Health Care. 2005;21(2):240-5. doi: 10.1017/S0266462305050324.

88. Lamb SE, Jørstad‐Stein EC, Hauer K, Becker C, Europe PoFN, Group OC. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. Journal of the American Geriatrics Society. 2005;53(9):1618-22.

89. Agartioglu Kundakci G, Yilmaz M, Sozmen MK. Determination of the costs of falls in the older people according to the decision tree model. Archives of Gerontology and Geriatrics. 2020;87:104007. doi: <https://dx.doi.org/10.1016/j.archger.2019.104007>.

90. Alhambra-Borrás T, Durá-Ferrandis E, Ferrando-García M. Effectiveness and estimation of cost-effectiveness of a group-based multicomponent physical exercise programme on risk of falling and frailty in community-dwelling older adults. International journal of environmental research and public health. 2019;16(12):2086.

91. Boyd M, Kvizhinadze G, Kho A, Wilson G, Wilson N. Cataract surgery for falls prevention and improving vision: modelling the health gain, health system costs and cost-effectiveness in a high-income country. Injury prevention. 2020;26(4):302-9.

92. Chartered Society of Physiotherapy. The falls prevention economic model: Physiotherapy commissioning support tool. In: (WSYBCSU) WaSYaBCSU, editor. 2016.

93. Comans T, Brauer S, Haines T. A break-even analysis of a community rehabilitation falls prevention service. Australian and New Zealand journal of public health. 2009;33(3):240-5. doi: <https://dx.doi.org/10.1111/j.1753-6405.2009.00382.x>.

94. Day L, Finch CF, Harrison JE, Hoareau E, Segal L, Ullah S. Modelling the population-level impact of tai-chi on falls and fall-related injury among community-dwelling older people. Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention. 2010;16(5):321-6. doi: <https://dx.doi.org/10.1136/ip.2009.025452>.

95. Deverall E, Kvizhinadze G, Pega F, Blakely T, Wilson N. Exercise programmes to prevent falls among older adults: modelling health gain, cost-utility and equity impacts. Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention. 2018. doi: <https://dx.doi.org/10.1136/injuryprev-2016-042309>.

96. Eldridge S, Spencer A, Cryer C, Parsons S, Underwood M, Feder G. Why modelling a complex intervention is an important precursor to trial design: lessons from studying an intervention to reduce falls-related injuries in older people. Journal of health services research & policy. 2005;10(3):133-42.

97. Franklin M, Hunter RM. A modelling-based economic evaluation of primary-care-based fall-risk screening followed by fall-prevention intervention: a cohort-based Markov model stratified by older age groups. Age and ageing. 2019.

98. Hiligsmann M, Ben Sedrine W, Bruyère O, Evers SM, Rabenda V, Reginster J-Y. Cost-effectiveness of vitamin D and calcium supplementation in the treatment of elderly women and men with osteoporosis. The European Journal of Public Health. 2014;25(1):20-5.

99. Hirst A, Knight C, Hirst M, Dunlop W, Akehurst R. Tramadol and the risk of fracture in an elderly female population: a cost utility assessment with comparison to transdermal buprenorphine. The European journal of health economics : HEPAC : health economics in prevention and care. 2016;17(2):217-27. doi: <https://dx.doi.org/10.1007/s10198-015-0673-1>.

100. Honkanen LA, Mushlin AI, Lachs M, Schackman BR. Can Hip Protector Use Cost‐Effectively Prevent Fractures in Community‐Dwelling Geriatric Populations? Journal of the American Geriatrics Society. 2006;54(11):1658-65.

101. Howland J, Shankar KN, Peterson EW, Taylor AA. Savings in acute care costs if all older adults treated for fall-related injuries completed matter of balance. Injury Epidemiology. 2015;2(1):25. doi: <http://dx.doi.org/10.1186/s40621-015-0058-z>.

102. Ippoliti R, Allievi I, Falavigna G, Giuliano P, Montani F, Obbia P, et al. The sustainability of a community nurses programme aimed at supporting active ageing in mountain areas. The International Journal of Health Planning & Management. 2018;33(4):e1100-e11. doi: <http://dx.doi.org/10.1002/hpm.2591>. PubMed PMID: 2151287056.

103. Miller TR, Dickerson JB, Smith ML, Ory MG. Assessing costs and potential returns of evidence-based programs for seniors. Evaluation & the health professions. 2011;34(2):201-25.

104. Moriarty F, Cahir C, Bennett K, Fahey T. Economic impact of potentially inappropriate prescribing and related adverse events in older people: A cost-utility analysis using Markov models. BMJ Open. 2019;9(1):e021832. doi: <http://dx.doi.org/10.1136/bmjopen-2018-021832>.

105. Nshimyumukiza L, Durand A, Gagnon M, Douville X, Morin S, Lindsay C, et al. An economic evaluation: Simulation of the cost‐effectiveness and cost‐utility of universal prevention strategies against osteoporosis‐related fractures. Journal of Bone and Mineral Research. 2013;28(2):383-94.

106. Poole CD, Smith JC, Davies JS. The short-term impact of vitamin D-based hip fracture prevention in older adults in the United Kingdom. Journal of endocrinological investigation. 2014;37(9):811-7.

107. Sach T, Foss A, Gregson R, Zaman A, Osborn F, Masud T, et al. Second-eye cataract surgery in elderly women: a cost-utility analysis conducted alongside a randomized controlled trial. Eye. 2010;24(2):276.

108. Smith MI, de Lusignan S, Mullett D, Correa A, Tickner J, Jones S. Predicting Falls and When to Intervene in Older People: A Multilevel Logistical Regression Model and Cost Analysis. PloS one. 2016;11(7):e0159365. doi: <https://dx.doi.org/10.1371/journal.pone.0159365>.

109. Tannenbaum C, Diaby V, Singh D, Perreault S, Luc M, Vasiliadis H-M. Sedative-hypnotic medicines and falls in community-dwelling older adults: a cost-effectiveness (decision-tree) analysis from a US Medicare perspective. Drugs & aging. 2015;32(4):305-14. doi: <https://dx.doi.org/10.1007/s40266-015-0251-3>.

110. Turner JP, Sanyal C, Martin P, Tannenbaum C. Economic Evaluation of Sedative Deprescribing in Older Adults by Community Pharmacists. The journals of gerontology Series A, Biological sciences and medical sciences. 2020. doi: <http://dx.doi.org/10.1093/gerona/glaa180>.

111. Wilson N, Kvizhinadze G, Pega F, Nair N, Blakely T. Home modification to reduce falls at a health district level: Modeling health gain, health inequalities and health costs. PloS one. 2017;12(9):e0184538.

112. Zarca K, Durand-Zaleski I, Roux C, Souberbielle J, Schott A, Thomas T, et al. Cost-effectiveness analysis of hip fracture prevention with vitamin D supplementation: a Markov micro-simulation model applied to the French population over 65 years old without previous hip fracture. Osteoporosis International. 2014;25(6):1797-806.

113. Salomon JA, Vos T, Hogan DR, Gagnon M, Naghavi M, Mokdad A, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. The Lancet. 2012;380(9859):2129-43.

114. Brazier J, Green C, Kanis J. A systematic review of health state utility values for osteoporosis-related conditions. Osteoporosis International. 2002;13(10):768-76.

115. Ström O, Borgström F, Sen S, Boonen S, Haentjens P, Johnell O, et al. Cost-effectiveness of alendronate in the treatment of postmenopausal women in 9 European countries-an economic evaluation based on the fracture intervention trial. Osteoporosis international. 2007;18(8):1047-61.

116. Iglesias CP, Manca A, Torgerson DJ. The health-related quality of life and cost implications of falls in elderly women. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA. 2009;20(6):869-78. doi: 10.1007/s00198-008-0753-5. PubMed PMID: 18846400.

117. Salkeld G, Ameratunga SN, Cameron I, Cumming R, Easter S, Seymour J, et al. Quality of life related to fear of falling and hip fracture in older women: a time trade off study. BMJ. 2000;320(7231):341-6.

118. Peasgood T, Herrmann K, Kanis JA, Brazier JE. An updated systematic review of Health State Utility Values for osteoporosis related conditions. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA. 2009;20(6):853-68. doi: 10.1007/s00198-009-0844-y. PubMed PMID: 19271098.

119. Giles LC, Hawthorne G, Crotty M. Health-related quality of life among hospitalized older people awaiting residential aged care. Health and Quality of Life Outcomes. 2009;7(1):71.

120. Kind P, Hardman G, Macran S. UK population norms for EQ-5D. 1999.

121. Ara R, Brazier JE. Populating an economic model with health state utility values: moving toward better practice. Value in Health. 2010;13(5):509-18.

122. Thiem U, Klaaßen-Mielke R, Trampisch U, Moschny A, Pientka L, Hinrichs T. Falls and EQ-5D rated quality of life in community-dwelling seniors with concurrent chronic diseases: a cross-sectional study. Health and quality of life outcomes. 2014;12(1):2.

123. Jonsson B, Kanis J, Dawson A, Oden A, Johnell O. Effect and offset of effect of treatments for hip fracture on health outcomes. Osteoporosis international. 1999;10(3):193-9.

124. Hiligsmann M, Ethgen O, Richy F, Reginster J-Y. Utility values associated with osteoporotic fracture: a systematic review of the literature. Calcified tissue international. 2008;82(4):288-92.

125. Kind P, Dolan P, Gudex C, Williams A. Variations in population health status: Results from a United Kingdom national questionnaire survey. British Medical Journal. 1998;316(7133):736-41.

126. Amgen UK Ltd. Single technology appraisal (STA) to NICE denosumab for the prevention of osteoporotic fractures in postmenopausal women. 2010.

127. Fryback DG, Dasbach EJ, Klein R, Klein BE, Dorn N, Peterson K, et al. The Beaver Dam Health Outcomes Study: initial catalog of health-state quality factors. Medical Decision Making. 1993;13(2):89-102.

128. Gabriel SE, Kneeland TS, Melton LJ, Moncur MM, Ettinger B, Tosteson AN. Health-related quality of life in economic evaluations for osteoporosis: whose values should we use? Medical Decision Making. 1999;19(2):141-8.

129. Neumann PJ, Hermann R, Kuntz K, Araki S, Duff S, Leon J, et al. Cost-effectiveness of donepezil in the treatment of mild or moderate Alzheimer’s disease. Neurology. 1999;52(6):1138-.

130. Segui-Gomez M, Keuffel E, Frick KD. Cost and effectiveness of hip protectors among the elderly. International journal of technology assessment in health care. 2002;18(1):55-66.

131. Burström K, Johannesson M, Diderichsen F. Health-related quality of life by disease and socio-economic group in the general population in Sweden. Health policy. 2001;55(1):51-69.

132. Borgström F, Zethraeus N, Johnell O, Lidgren L, Ponzer S, Svensson O, et al. Costs and quality of life associated with osteoporosis-related fractures in Sweden. Osteoporosis International. 2006;17(5):637-50.

133. Hanmer J, Lawrence WF, Anderson JP, Kaplan RM, Fryback DG. Report of nationally representative values for the noninstitutionalized US adult population for 7 health-related quality-of-life scores. Medical Decision Making. 2006;26(4):391-400.

134. Friedman SM, Munoz B, West SK, Rubin GS, Fried LP. Falls and fear of falling: which comes first? A longitudinal prediction model suggests strategies for primary and secondary prevention. J Am Geriatr Soc. 2002;50(8):1329-35. PubMed PMID: 12164987.

135. Murphy SL, Williams CS, Gill TM. Characteristics associated with fear of falling and activity restriction in community-living older persons. J Am Geriatr Soc. 2002;50(3):516-20. PubMed PMID: 11943049; PubMed Central PMCID: PMCPMC3046411.

136. National Osteoporosis Foundation. Osteoporosis: review of the evidence for prevention, diagnosis and treatment and cost-effective analysis. Osteoporosis International. 1998;8:S7-S80.

137. Si L, Winzenberg T, de Graaff B, Palmer A. A systematic review and meta-analysis of utility-based quality of life for osteoporosis-related conditions. Osteoporosis international. 2014;25(8):1987-97.

138. Si L, Winzenberg T, Jiang Q, Palmer A. Screening for and treatment of osteoporosis: construction and validation of a state-transition microsimulation cost-effectiveness model. Osteoporosis International. 2015;26(5):1477-89.

139. Cranney AB, Coyle D, Hopman WM, Hum V, Power B, Tugwell PS. Prospective evaluation of preferences and quality of life in women with hip fractures. The Journal of rheumatology. 2005;32(12):2393-9.

140. Cranney A, Coyle D, Pham B, Tetroe J, Wells G, Jolly E, et al. The psychometric properties of patient preferences in osteoporosis. The Journal of rheumatology. 2001;28(1):132-7.

141. Papaioannou A, Kennedy CC, Ioannidis G, Sawka A, Hopman WM, Pickard L, et al. The impact of incident fractures on health-related quality of life: 5 years of data from the Canadian Multicentre Osteoporosis Study. Osteoporosis International. 2009;20(5):703-14.

142. Couzner L, Crotty M, Norman R, Ratcliffe J. A comparison of the EQ-5D-3L and ICECAP-O in an older post-acute patient population relative to the general population. Applied health economics and health policy. 2013;11(4):415-25.

143. Léger D, Morin CM, Uchiyama M, Hakimi Z, Cure S, Walsh JK. Chronic insomnia, quality-of-life, and utility scores: comparison with good sleepers in a cross-sectional international survey. Sleep medicine. 2012;13(1):43-51.

144. Borgström F, Sobocki P, Ström O, Jönsson B. The societal burden of osteoporosis in Sweden. Bone. 2007;40(6):1602-9.

145. Kanis J, Johnell O, Odén A, Borgstrom F, Zethraeus N, De Laet C, et al. The risk and burden of vertebral fractures in Sweden. Osteoporosis international. 2004;15(1):20-6.

146. Jönsson B, Christiansen C, Johnell O, Hedbrandt J. Cost-effectiveness of fracture prevention in established osteoporosis. Osteoporosis international. 1995;5(2):136-42.

147. Harwood RH, Foss A, Osborn F, Gregson R, Zaman A, Masud T. Falls and health status in elderly women following first eye cataract surgery: a randomised controlled trial. British Journal of Ophthalmology. 2005;89(1):53-9.

148. Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Falls prevention over 2 years: a randomized controlled trial in women 80 years and older. Age and ageing. 1999;28(6):513-8.

149. Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E, et al. Tai Chi and fall reductions in older adults: a randomized controlled trial. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2005;60(2):187-94.

150. Clemson L, Cumming RG, Kendig H, Swann M, Heard R, Taylor K. The effectiveness of a community‐based program for reducing the incidence of falls in the elderly: A randomized trial. Journal of the American Geriatrics Society. 2004;52(9):1487-94.

151. Wolf SL, Barnhart HX, Kutner NG, McNeely E, Coogler C, Xu T, et al. Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. Journal of the American Geriatrics Society. 1996;44(5):489-97.

152. Cumming RG, Thomas M, Szonyi G, Salkeld G, O'neill E, Westbury C, et al. Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. Journal of the American geriatrics society. 1999;47(12):1397-402.

153. Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet. 1999;353(9147):93-7. doi: 10.1016/S0140-6736(98)06119-4. PubMed PMID: 10023893.

154. Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home‐based exercise program to prevent falls: a randomized, controlled trial. Journal of the American geriatrics society. 1999;47(7):850-3.

155. Kenny RAM, Richardson DA, Steen N, Bexton RS, Shaw FE, Bond J. Carotid sinus syndrome: a modifiable risk factor for nonaccidental falls in older adults (SAFE PACE). Journal of the American College of Cardiology. 2001;38(5):1491-6.

156. Barry E, Galvin R, Keogh C, Horgan F, Fahey T. Is the Timed Up and Go test a useful predictor of risk of falls in community dwelling older adults: a systematic review and meta-analysis. BMC geriatrics. 2014;14(1):14.

157. Greene BR, Redmond SJ, Caulfield B. Fall risk assessment through automatic combination of clinical fall risk factors and body-worn sensor data. IEEE journal of biomedical and health informatics. 2017;21(3):725-31.

158. Boonen S, Lips P, Bouillon R, Bischoff-Ferrari HA, Vanderschueren D, Haentjens P. Need for additional calcium to reduce the risk of hip fracture with vitamin D supplementation: evidence from a comparative metaanalysis of randomized controlled trials. The Journal of Clinical Endocrinology & Metabolism. 2007;92(4):1415-23.

159. Tang BM, Eslick GD, Nowson C, Smith C, Bensoussan A. Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a meta-analysis. The Lancet. 2007;370(9588):657-66.

160. Bischoff-Ferrari HA, Willett WC, Wong JB, Stuck AE, Staehelin HB, Orav EJ, et al. Prevention of nonvertebral fractures with oral vitamin D and dose dependency: a meta-analysis of randomized controlled trials. Archives of internal medicine. 2009;169(6):551-61.

161. Li L, Setoguchi S, Cabral H, Jick S. Opioid Use for Noncancer Pain and Risk of Fracture in Adults: A Nested Case-Control Study Using the General Practice Research Database. American Journal of Epidemiology. 2013;178(4):559-69. doi: 10.1093/aje/kwt013.

162. Gallagher AM, Leighton-Scott J, van Staa TP. Utilization characteristics and treatment persistence in patients prescribed low-dose buprenorphine patches in primary care in the United Kingdom: a retrospective cohort study. Clinical therapeutics. 2009;31(8):1707-15.

163. Patel S, Ogunremi L, Chinappen U. Acceptability and compliance with hip protectors in community‐dwelling women at high risk of hip fracture. Rheumatology. 2003;42(6):769-72.

164. Kannus P, Parkkari J, Niemi S, Pasanen M, Palvanen M, Järvinen M, et al. Prevention of hip fracture in elderly people with use of a hip protector. New England journal of medicine. 2000;343(21):1506-13.

165. Woo J, Sum C, Yiu H, Ip K, Chung L, Ho L. Efficacy of a specially designed hip protector for hip fracture prevention and compliance with use in elderly Hong Kong Chinese. Clinical rehabilitation. 2003;17(2):203-5.

166. Zijlstra GR, Van Haastregt JC, Ambergen T, Van Rossum E, Van Eijk JTM, Tennstedt SL, et al. Effects of a multicomponent cognitive behavioral group intervention on fear of falling and activity avoidance in community‐dwelling older adults: Results of a randomized controlled trial. Journal of the American Geriatrics Society. 2009;57(11):2020-8.

167. Kalyani RR, Stein B, Valiyil R, Manno R, Maynard JW, Crews DC. Vitamin D treatment for the prevention of falls in older adults: systematic review and meta‐analysis. Journal of the American Geriatrics Society. 2010;58(7):1299-310.

168. Murad MH, Elamin KB, Abu Elnour NO, Elamin MB, Alkatib AA, Fatourechi MM, et al. The effect of vitamin D on falls: a systematic review and meta-analysis. The Journal of Clinical Endocrinology & Metabolism. 2011;96(10):2997-3006.

169. Fitzharris MP, Day L, Lord SR, Gordon I, Fildes B. The Whitehorse NoFalls trial: effects on fall rates and injurious fall rates. Age and ageing. 2010;39(6):728-33.

170. Robertson MC, Campbell AJ, Gardner MM, Devlin N. Preventing injuries in older people by preventing falls: A meta‐analysis of individual‐level data. Journal of the American geriatrics society. 2002;50(5):905-11.

171. Tannenbaum C, Martin P, Tamblyn R, Benedetti A, Ahmed S. Reduction of inappropriate benzodiazepine prescriptions among older adults through direct patient education: the EMPOWER cluster randomized trial. JAMA internal medicine. 2014;174(6):890-8.

172. Clyne B, Smith SM, Hughes CM, Boland F, Bradley MC, Cooper JA, et al. Effectiveness of a multifaceted intervention for potentially inappropriate prescribing in older patients in primary care: a cluster-randomized controlled trial (OPTI-SCRIPT Study). The Annals of Family Medicine. 2015;13(6):545-53.

173. Moayyeri A. The association between physical activity and osteoporotic fractures: a review of the evidence and implications for future research. Annals of epidemiology. 2008;18(11):827-35.

174. Bischoff-Ferrari HA, Willett WC, Orav EJ, Lips P, Meunier PJ, Lyons RA, et al. A pooled analysis of vitamin D dose requirements for fracture prevention. New England Journal of Medicine. 2012;367(1):40-9.

175. Bischoff-Ferrari HA, Dawson-Hughes B, Staehelin HB, Orav JE, Stuck A, Theiler R, et al. Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials. Bmj. 2009;339:b3692.

176. Iliffe S, Kendrick D, Morris R, Masud T, Gage H, Skelton D, et al. Multicentre cluster randomised trial comparing a community group exercise programme and home-based exercise with usual care for people aged 65 years and over in primary care. Health technology assessment (Winchester, England). 2014;18(49):vii-105. doi: <https://dx.doi.org/10.3310/hta18490>.

177. Woolcott JC, Richardson KJ, Wiens MO, Patel B, Marin J, Khan KM, et al. Meta-analysis of the impact of 9 medication classes on falls in elderly persons. Archives of internal medicine. 2009;169(21):1952-60.

178. Stone KL, Ancoli-Israel S, Blackwell T, Ensrud KE, Cauley JA, Redline S, et al. Actigraphy-measured sleep characteristics and risk of falls in older women. Archives of internal medicine. 2008;168(16):1768-75.

179. Martin P, Tamblyn R, Benedetti A, Ahmed S, Tannenbaum C. Effect of a pharmacist-led educational intervention on inappropriate medication prescriptions in older adults: the D-PRESCRIBE randomized clinical trial. Jama. 2018;320(18):1889-98.

180. Chang JT, Morton SC, Rubenstein LZ, Mojica WA, Maglione M, Suttorp MJ, et al. Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomised clinical trials. Bmj. 2004;328(7441):680.

181. Heaney RP, Davies KM, Chen TC, Holick MF, Barger-Lux MJ. Human serum 25-hydroxycholecalciferol response to extended oral dosing with cholecalciferol. The American journal of clinical nutrition. 2003;77(1):204-10.

182. World Bank. Inflation, consumer prices (annual %) 2021. Available from: <https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG>.

183. OECD Data. Purchasing power parities (PPP) 2021. Available from: <https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm#indicator-chart>.

184. Age UK. Later Life in the United Kingdom 2019. Age UK. 2019.

185. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS medicine. 2009;6(7):e1000097.

186. Dhesi JK, Jackson SH, Bearne LM, Moniz C, Hurley MV, Swift CG, et al. Vitamin D supplementation improves neuromuscular function in older people who fall. Age and ageing. 2004;33(6):589-95.

187. RECORD Trial Group. Oral vitamin D3 and calcium for secondary prevention of low-trauma fractures in elderly people (Randomised Evaluation of Calcium Or vitamin D, RECORD): a randomised placebo-controlled trial. The Lancet. 2005;365(9471):1621-8.

188. Harwood RH, Sahota O, Gaynor K, Masud T, Hosking DJ. A randomised, controlled comparison of different calcium and vitamin D supplementation regimens in elderly women after hip fracture: The Nottingham Neck of Femur (NONOF) Study. Age and ageing. 2004;33(1):45-51.

189. Porthouse J, Cockayne S, King C, Saxon L, Steele E, Aspray T, et al. Randomised controlled trial of calcium and supplementation with cholecalciferol (vitamin D3) for prevention of fractures in primary care. Bmj. 2005;330(7498):1003.

190. Smith H, Anderson F, Raphael H, Maslin P, Crozier S, Cooper C. Effect of annual intramuscular vitamin D on fracture risk in elderly men and women—a population-based, randomized, double-blind, placebo-controlled trial. Rheumatology. 2007;46(12):1852-7.

191. Trivedi DP, Doll R, Khaw KT. Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. Bmj. 2003;326(7387):469.

192. Witham MD, Price RJ, Band MM, Hannah MS, Fulton RL, Clarke CL, et al. Effect of vitamin K2 on postural sway in older people who fall: A randomized controlled trial. Journal of the American Geriatrics Society. 2019;67(10):2102-7.

193. Wood A, Secombes K, Thies F, Aucott L, Black A, Reid D, et al. A parallel group double-blind RCT of vitamin D 3 assessing physical function: is the biochemical response to treatment affected by overweight and obesity? Osteoporosis International. 2014;25(1):305-15.

194. Carpenter G, Demopoulos G. Screening the elderly in the community: controlled trial of dependency surveillance using a questionnaire administered by volunteers. British Medical Journal. 1990;300(6734):1253-6.

195. Franse CB, Van Grieken A, Alhambra-Borrás T, Valía-Cotanda E, Van Staveren R, Rentoumis T, et al. The effectiveness of a coordinated preventive care approach for healthy ageing (UHCE) among older persons in five European cities: a pre-post controlled trial. International journal of nursing studies. 2018;88:153-62.

196. Kingston P, Jones M, Lally F, Crome P. Older people and falls: A randomized controlled trial of a health visitor (HV) intervention. Reviews in Clinical Gerontology. 2001;11(3):209-14.

197. Lightbody E, Watkins C, Leathley M, Sharma A, Lye M. Evaluation of a nurse‐led falls prevention programme versus usual care: a randomized controlled trial. Age and ageing. 2002;31(3):203-10.

198. Vetter NJ, Lewis PA, Ford D. Can health visitors prevent fractures in elderly people? British Medical Journal. 1992;304(6831):888-90.

199. Parry SW, Steen N, Bexton R, Tynan M, Kenny RA. Pacing in elderly recurrent fallers with carotid sinus hypersensitivity: a randomised, double-blind, placebo controlled crossover trial. Heart. 2009;95(5):405-9.

200. Ryan DJ, Nick S, Colette SM, Roseanne K. Carotid sinus syndrome, should we pace? A multicentre, randomised control trial (Safepace 2). Heart. 2010;96(5):347-51.

201. Hill S, Mossman J, Stockdale P, Crome P. A randomised controlled trial of a nurse-led falls prevention clinic. Age Ageing. 2000;29(Suppl 2):20.

202. Waterman H, Ballinger C, Brundle C, Chastin S, Gage H, Harper R, et al. A feasibility study to prevent falls in older people who are sight impaired: the VIP2UK randomised controlled trial. Trials. 2016;17(1):1-14.

203. Foss AJ, Harwood RH, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following second eye cataract surgery: a randomised controlled trial. Age and ageing. 2006;35(1):66-71.

204. Pighills AC, Torgerson DJ, Sheldon TA, Drummond AE, Bland JM. Environmental assessment and modification to prevent falls in older people. Journal of the American Geriatrics Society. 2011;59(1):26-33.

205. Whitehead PJ, Golding-Day MR, Belshaw S, Dawson T, James M, Walker MF. Bathing adaptations in the homes of older adults (BATH-OUT): results of a feasibility randomised controlled trial (RCT). BMC public health. 2018;18(1):1-11.

206. Ebrahim S, Thompson PW, Baskaran V, Evans K. Randomized placebo-controlled trial of brisk walking in the prevention of postmenopausal osteoporosis. Age and ageing. 1997;26(4):253-60.

207. Parry SW, Bamford C, Deary V, Finch TL, Gray J, MacDonald C, et al. Cognitive-behavioural therapy-based intervention to reduce fear of falling in older people: therapy development and randomised controlled trial-the Strategies for Increasing Independence, Confidence and Energy (STRIDE) study. Health Technology Assessment (Winchester, England). 2016;20(56):1-206.

208. Sumukadas D, Price R, McMurdo ME, Rauchhaus P, Struthers A, McSwiggan S, et al. The effect of perindopril on postural instability in older people with a history of falls—a randomised controlled trial. Age and ageing. 2018;47(1):75-81.

209. McMurdo ME, Price RJ, Shields M, Potter J, Stott DJ. Should oral nutritional supplementation be given to undernourished older people upon hospital discharge? A controlled trial. Journal of the American Geriatrics Society. 2009;57(12):2239-45.

210. Whitehead PJ, Walker MF, Parry RH, Latif Z, McGeorge ID, Drummond AE. Occupational Therapy in HomEcare Re-ablement Services (OTHERS): results of a feasibility randomised controlled trial. BMJ open. 2016;6(8):e011868.

211. Logan PA, Coupland CA, Gladman JR, Sahota O, Stoner-Hobbs V, Robertson K, et al. Community falls prevention for people who call an emergency ambulance after a fall: randomised controlled trial. Bmj. 2010;340.

212. Liston MB, Alushi L, Bamiou D-E, Martin FC, Hopper A, Pavlou M. Feasibility and effect of supplementing a modified OTAGO intervention with multisensory balance exercises in older people who fall: a pilot randomized controlled trial. Clinical rehabilitation. 2014;28(8):784-93.

213. McMurdo ME, Mole PA, Paterson CR. Controlled trial of weight bearing exercise in older women in relation to bone density and falls. BMJ. 1997;314(7080):569.

214. Mirelman A, Rochester L, Maidan I, Del Din S, Alcock L, Nieuwhof F, et al. Addition of a non-immersive virtual reality component to treadmill training to reduce fall risk in older adults (V-TIME): a randomised controlled trial. The Lancet. 2016;388(10050):1170-82.

215. Steadman J, Donaldson N, Kalra L. A randomized controlled trial of an enhanced balance training program to improve mobility and reduce falls in elderly patients. Journal of the American Geriatrics Society. 2003;51(6):847-52.

216. Suman S, Myint PK, Clark A, Das P, Ring L, Trepte NJ. Community-based fall assessment compared with hospital-based assessment in community-dwelling older people over 65 at high risk of falling: A randomized study. Aging clinical and experimental research. 2011;23(1):35-41.

217. Searle SD, Mitnitski A, Gahbauer EA, Gill TM, Rockwood K. A standard procedure for creating a frailty index. BMC geriatrics. 2008;8(1):24.

218. Clegg A, Bates C, Young J, Ryan R, Nichols L, Ann Teale E, et al. Development and validation of an electronic frailty index using routine primary care electronic health record data. Age Ageing. 2016;45(3):353-60. doi: 10.1093/ageing/afw039. PubMed PMID: 26944937; PubMed Central PMCID: PMCPMC4846793.

219. Curtis LA, Burns A. Unit costs of health and social care 2019. PSSRU K, UK, editor2019.

220. Shaw FE, Bond J, Richardson DA, Dawson P, Steen IN, McKeith IG, et al. Multifactorial intervention after a fall in older people with cognitive impairment and dementia presenting to the accident and emergency department: randomised controlled trial. BMJ: British medical journal. 2003;326(7380):73.

221. Nyman SR, Ingram W, Sanders J, Thomas PW, Thomas S, Vassallo M, et al. Randomised controlled trial of the effect of Tai Chi on postural balance of people with dementia. Clinical interventions in aging. 2019;14:2017.

222. Skelton D, Dinan S, Campbell M, Rutherford O. Tailored group exercise (Falls Management Exercise—FaME) reduces falls in community-dwelling older frequent fallers (an RCT). Age and ageing. 2005;34(6):636-9.

223. Beusterien KM, Yeung J-E, Pang F, Brazier J. Development of the multi-attribute adolescent health utility measure (AHUM). Health and Quality of life outcomes. 2012;10(1):1-9.

224. Xiong X, Dalziel K, Huang L, Mulhern B, Carvalho N. PIH33 How Do Different Health Conditions IMPACT Dimensions of Pediatric Preference-Based Health-Related Quality of Life Measures? Value in Health. 2021;24:S104.

225. Han L, Clegg A, Doran T, Fraser L. The impact of frailty on healthcare resource use: a longitudinal analysis using the Clinical Practice Research Datalink in England. Age and Ageing. 2019;48(5):665-71.

226. Polder JJ, Barendregt JJ, van Oers H. Health care costs in the last year of life—the Dutch experience. Social science & medicine. 2006;63(7):1720-31.

227. Kumpunen S, Edwards N, Georghiou T, Hughes G. Why do evaluations of integrated care not produce the results we expect? International Journal of Care Coordination. 2020:2053434520909089.

228. Koopmanschap MA, van Exel NJA, van den Berg B, Brouwer WB. An overview of methods and applications to value informal care in economic evaluations of healthcare. Pharmacoeconomics. 2008;26(4):269-80.

229. Tong T. Broadening the perspective of economic evaluation in health care - A case study in dementia care in the UK: University of Sheffield; 2017.

230. Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E. Risk factors for falls in community-dwelling older people: a systematic review and meta-analysis. Epidemiology. 2010;21(5):658-68. doi: 10.1097/EDE.0b013e3181e89905. PubMed PMID: 20585256.

231. Breeze P, Squires H, Chilcott J, Stride C, Diggle PJ, Brunner E, et al. A statistical model to describe longitudinal and correlated metabolic risk factors: the Whitehall II prospective study. Journal of Public Health. 2016;38(4):679-87.

232. Clegg A, Barber S, Young J, Iliffe S, Forster A. The Home-based Older People's Exercise (HOPE) trial: a pilot randomised controlled trial of a home-based exercise intervention for older people with frailty. Age and Ageing. 2014;43(5):687-95.

233. Hadjistavropoulos T, Delbaere K, Fitzgerald TD. Reconceptualizing the role of fear of falling and balance confidence in fall risk. Journal of aging and Health. 2011;23(1):3-23.

234. Delbaere K, Close JC, Mikolaizak AS, Sachdev PS, Brodaty H, Lord SR. The falls efficacy scale international (FES-I). A comprehensive longitudinal validation study. Age and ageing. 2010;39(2):210-6.

235. Office for National Statistics. 2018-based subnational principal population projections for local authorities and higher administrative areas in England. 2020.

236. Kingston A, Robinson L, Booth H, Knapp M, Jagger C, project M. Projections of multi-morbidity in the older population in England to 2035: estimates from the Population Ageing and Care Simulation (PACSim) model. Age and ageing. 2018;47(3):374-80.

237. Barmentloo LM, Olij BF, Erasmus V, Smilde D, Schoon Y, Polinder S. Personal preferences of participation in fall prevention programmes: a descriptive study. BMC geriatrics. 2020;20(1):1-12.

238. Sheffield Teaching Hospitals. Perfect Patient Pathway Test Bed Overview Report. Sheffield Teaching Hospitals NHS Foundation Trust, 2019.

239. Markle-Reid MF, Dykeman CS, Reimer HD, Boratto LJ, Goodall CE, McGugan JL. Engaging community organizations in falls prevention for older adults: moving from research to action. Can J Public Health. 2015;106(4):189-96.

240. Brennan A, Chick SE, Davies R. A taxonomy of model structures for economic evaluation of health technologies. Health Econ. 2006;15(12):1295-310. Epub 2006/08/31. doi: 10.1002/hec.1148. PubMed PMID: 16941543.

241. Kutty NK. The scope for poverty alleviation among elderly home-owners in the United States through reverse mortgages. Urban studies. 1998;35(1):113-29.

242. McLennan D, Noble S, Noble M, Plunkett E, Wright G, Gutacker N. The English indices of deprivation 2019: Technical report. 2019.

243. Yang F, Angus C, Duarte A, Gillespie D, Walker S, Griffin S. Impact of socioeconomic differences on distributional cost-effectiveness analysis. Medical Decision Making. 2020;40(5):606-18.

244. Kwan C, Walsh CA. Old age poverty: A scoping review of the literature. Cogent Social Sciences. 2018;4(1):1478479.

245. Verguet S, Kim JJ, Jamison DT. Extended cost-effectiveness analysis for health policy assessment: a tutorial. Pharmacoeconomics. 2016;34(9):913-23.

246. van den Bogaart EH, Kroese ME, Spreeuwenberg MD, Ruwaard D, Tsiachristas A. Economic Evaluation of New Models of Care: Does the Decision Change Between Cost-Utility Analysis and Multi-Criteria Decision Analysis? Value in Health. 2021.