Implementation lessons learnt when evaluating palliative care interventions in the intensive care unit: relationships between implementation determinants, strategies, and models of delivery

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ABSTRACT

Background

Palliative and end-of-life care have important roles in intensive care units (ICUs) given symptom burden and rate of mortality in ICUs. However, we do not know how ICU-based palliative care interventions should be implemented. This systematic review aims to identify and synthesise knowledge on how ICU-based palliative care interventions have been implemented and provide critical recommendations for successful implementation.

Methods

Systematic review methods following PRISMA reporting guidelines. Search strategy combined palliative care, intensive care, and implementation terms. Searches up to December 2022 of MEDLINE, Embase, Cochrane, CINAHL, and PsycINFO. Components from an adapted Smith's Implementation Research Logic Model were used to develop themes for reporting intervention characteristics, implementation determinants (barriers and facilitators), implementation strategies, mechanisms, and outcomes, and to synthesise relationships between these components.

Results

79 included studies: 8 process evaluations, and 71 effectiveness studies. Published evidence on ICU-based palliative care interventions is wide-reaching, but reporting on implementation factors (determinants, strategies, mechanisms) is variable and often lacking. In particular, patient and family-related determinants, and any mechanisms, were not reported. Main facilitators are adequate resources and a symbiotic relationship between palliative care and ICU teams. Main barriers are ICU team reluctance toward palliative care involvement, lack of skills and familiarity, and high ICU acuity. Main implementation strategies were utilising champions, providing education and resources, involving stakeholders, creating adaptable interventions, and building relationships between palliative care and ICU teams. Mechanisms most commonly worked by facilitating collaborative working.

Conclusion

Most research into ICU-based palliative care interventions does not report on how the intervention is implemented into practice. Patient and family perspectives on implementation are rarely sought. Even with strong effectiveness evidence for an intervention, improvements in care will not be achieved without consideration of context-specific implementation strategies. We provide actionable recommendations to address this and identify the relevant research gaps.

ABBREVIATIONS

ACP: Advance Care Planning; BFS-PM: Bereaved Family Survey-Performance Measure; BFS: Bereaved Family Survey; CFIR: Consolidated Framework for Implementation Research; EHR: Electronic Health Record; EMR: Electronic Medical Record; EOLC: End-of-life care; ERIC: Expert Recommendations for Implementing Change; FS-ICU: Family Satisfaction in the ICU; SUDS: Subjective Units of Distress Score; PG: Prolonged Grief; FSS: Family Support Specialist; GICU: General Intensive Care Unit; GRADE-CERQual: Grading of Recommendations Assessment, Development, and Evaluation - Confidence in the Evidence from Reviews of Qualitative research; HCPs: Health Care Professionals; ICU: Intensive care unit; IRLM: Implementation Research Logic Model; MeSH: Medical Subject Headings; MICU: Medical Intensive Care Unit; MMAT: Mixed Methods Appraisal Tool; MTFC: Multidisciplinary Team and Family Conference; NEST: Needs of Social nature, Existential concerns, Symptoms, and Therapeutic interaction; PACE: Psychosocial Assessment and Communication Evaluation; PARTNER: Pairing Re-engineered ICU Teams with Nurse-Driven Emotional Support and Relationship-Building; PC: Palliative Care; PCCS: Patient-Centeredness of Care Scale; PCL-C: Civilian Post-Traumatic Stress Disorder Checklist; PCR: Palliative Care Rounds; PHQ: Patient Health Questionnaire; PRISMA: Preferred Reporting Items of Systematic Reviews and Meta-Analyses; PSS: Perceived Stress Scale; PTSD: Posttraumatic Stress Disorder; QES: Qualitative evidence synthesis; QOC: Quality of Communication; QODD: Quality of Dying and Death; RWJ: Robert Wood Johnson; SICU: Surgical Intensive Care Unit; SOFA: Sequential Organ Failure Assessment; TIDieR: Template for Intervention Description and Replication

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DEDICATION

This Thesis is dedicated to Dr. Randy Curtis. Dr Curtis passed away February 6th, 2023, after a lifetime of dedication to work around end-of-life and palliative care. Dr Curtis' work focused on improving the care for people with terminal conditions by improving the patient clinician communication about end-of-life care and the integration of palliative care in the ICU setting. This field of research would not be where it is today without Dr Curtis.

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PUBLICATIONS AND CONFERENCES

Publications

Meddick-Dyson SA, Boland JW, Pearson M, Greenley S, Gambe R, Budding JR, Murtagh FEM: Implementation lessons learnt when trialling palliative care interventions in the intensive care unit: relationships between determinants, implementation strategies, and models of delivery-a systematic review protocol. Syst Rev 2022, 11(1):186.

Conferences

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1 INTRODUCTION

Intensive Care Units (ICUs) deliver specialised care to critically ill patients. There are high rates of uncertainty and mortality is quoted to be 13-16% despite technological advances [1, 2]. Of patients at high risk of dying, up to 75% experience distressing symptoms [3]. In addition, survivors, and families of those admitted to the ICU are at risk of post-ICU syndrome, experiencing anxiety, depression, and post-traumatic stress disorder [4-8]. Palliative care interventions have been shown to benefit patients, families, and the healthcare professionals who care for them [9, 10]. However, there are barriers to providing this care, and a recent systematic review of ICU palliative care interventions found over 40 heterogenous interventions [9], highlighting that at present, there is no "one size fits all". Model of integration of palliative care into ICU varies from mainly consultative, integrative, or mixed [11]. The "consultative model" involves consultation with specialist palliative care teams, while the "integrative model" supports the intensive care teams to provide primary palliative care as part of their daily practice [11]. In reality these models represent two ends of a heterogenous spectrum rather than mutual exclusivity [11]. There are also varying types of ICU, for example cardiac, or surgical. These differences mean that context must be considered when implementing an ICU palliative care intervention [12].

Despite evidence and best practice guidance, there are variations in practice [12, 13], and reports suggest needs are not being met. For example, inadequate symptom control, unsatisfactory support for families, and delayed identification of dying [3, 14, 15], suggesting an evidence-to-practice gap. This may be explained by the fact that healthcare research historically focuses on conducting intervention studies, rather than researching whether and how the findings translate into health impact [16].

Implementation science is defined as "the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services" [16, 17]. It places an emphasis on understanding actions of stakeholders and the healthcare context in facilitating or hindering intervention integration [17]. Implementation science can therefore provide methods to promote the systematic uptake of palliative care interventions into routine ICU practice, to provide the benefits they have been shown to offer. Implementation science methods include use of models, frameworks, and theories. This systematic review uses a combination of these methods to identify and synthesise knowledge on how models of integrating palliative care into the ICU have been implemented and provide critical recommendations for successful implementation.

This thesis will describe the background to this work, methodologies, and methods, with details on the aforementioned implementation structures, synthesised results, and discuss how findings can be translated into actionable points for palliative and intensive care teams, and foci for future work.

2 BACKGROUND

2.1 PALLIATIVE CARE IN ICU

Time in the ICU can be fraught with burdensome symptoms, difficult discussions, and emotionally demanding decisions for patients and their families. [3] Palliative care is an approach that can help in these situations to improve the quality of life of at-risk-of-dying patients and their families. Palliative care reduces suffering through the recognition and treatment of pain and other problems, whether physical, emotional, social, or spiritual. [18] For these patients with life-threatening illness, palliative care encompasses complex symptom control, communication surrounding care and treatments, addressing patient values, transitional planning, and support for those around them. [18] Palliative care is therefore accepted as a crucial component of comprehensive care for patients who are critically ill, irrespective of prognosis or diagnosis [19]. A view supported by bodies representing critical care professionals [20-22] and the World Health Organisation [23]. An international consensus conference held in Belgium identified a number of concerns with end-of-life care in the ICU, including terminology used, variability, communication issues, and determining preferences [22]. The jury strongly recommended that research be conducted to improve end-of-life care [24]. In 2001, an expert group convened to develop a research agenda for end-of-life care in the ICU and amongst their priorities were: addressing the cultural chasm between clinicians in the ICU, educating the public and providers, developing innovative strategies to improve quality of care, and structural and organizational changes [25]. The James Lind Alliance's top 10 palliative and end-of-life care priorities include research addressing the questions: “How can it be ensured that staff, including healthcare assistants, are adequately trained to deliver palliative care, no matter where the care is being delivered?” and “what are the best ways to determine a person’s palliative care needs, then initiate and deliver this care for patients with non-cancer diseases” [26]. A top 20 priority reads, “What are the best models of palliative care in an acute setting?” [26]. The Faculty states that end-of-life care remains a necessary core skill set for critical care teams: strengthening inter-personal relationships between patients and those close to them by providing a sense of control, minimising distress, alleviating both psychological and physical burdens, meeting spiritual needs, and understanding legal and ethical principles, amongst other benefits [20].

2.1.1 MODELS OF PALLIATIVE CARE DELIVERY IN THE INTENSIVE CARE UNIT

Clinicians cannot reliably predict which patients will die on the ICU, who will survive, and of those, who will live with the symptoms of their critical illness chronically. By nature of admission to the intensive care unit, the intent will be curative. If mortality was predicted, admission would be prevented. Once admitted, both disease-modifying and palliative care may be needed. An abrupt shift from one to the other is difficult for clinicians, patients, and their families. A situation where both are available in tandem enables mutual enhancement of strengths and increased range of needs to be met.

Two models of care are commonly used to exemplify how palliative care can be integrated into the ICU. [11] The "consultative model" promotes involvement of and consultation with specialist palliative care teams, especially for patients at high risk of a poor outcome, while the "integrative model" aims to support intensive care teams to incorporate palliative care into their daily practice. [11] These two models denote each end of a spectrum rather than being mutually exclusive, and practice may see interventions favouring one approach over the other, or a hybrid of the two. Despite this spectrum, a dichotomy is useful for comparative research and so will be used for the purpose of this review. For consistency, the dichotomy used by Metaxa et al will be used, and mixed interventions or those involving consultations with palliative care-trained specialists or ethicists, will be classified as consultative [9]. There are advantages and disadvantages for each model, shown in

Table 1. Consultation with the palliative care service taps into an expertise that already exists. It can provide continuity of care before, during, and after ICU as well as facilitating transfer out of ICU for end-of-life care if appropriate. However, it does depend on the palliative care service having adequate resources and staff to provide such a service. [11] There is also the possibility that the palliative care clinicians are seen as 'outsiders' with the potential to compound fragmented care or cause conflict. This may be heightened by a lack of familiarity, knowledge and skill of palliative clinicians in the biomedical and nursing aspects of critical care. [11] Involvement could also lead to less of an incentive for the ICU team to develop their own palliative care knowledge and skills. Conversely, regular involvement could help facilitate the learning of the ICU team. [11] The integrative approach means that the palliative care service resource is not required and makes palliative care, delivered by the ICU staff, available to all ICU patients. It may be easier to co-ordinate care within one team. However, to reach this point, extra training is needed for ICU teams, thus adding to their already heavy workload, and the service would be dependent on their commitment and engagement. [11] Integration also removes continuity of care before and after ICU, as patient care would need to be transferred between teams at these points. [11] For these reasons, the most appropriate model will vary depending on local resources and processes, and centers should look

to identify these to determine how they may be most successful in integrating and implementing palliative care withing their ICU.

Table 1: Advantages and disadvantages for models of palliative care delivery in the ICU

	Advantages	**Disadvantages**
Consultative	Uses existing expertise	Depends on palliative care service resources
	Can provide continuity of care	Can be seen as ‘outsiders’ leading to fragmented care
	Can aid in facilitating transfer out of ICU for end-of-life care if appropriate	Lack of familiarity, knowledge, and skill of palliative clinicians in the biomedical and nursing aspects of critical care
	Regular involvement could help facilitate the learning of the ICU team, and the palliative care team	Less incentive for the ICU team to develop their own palliative care knowledge and skills
Integrative	Extra palliative care service resource is not required	Extra training is needed for ICU teams, adding to their already heavy workload
	Palliative care, delivered by the ICU staff, available to all ICU patients	service would be dependent on the ICU team’s commitment and engagement
	Easier to co-ordinate care within on team	Removes continuity of care before and after ICU

2.1.2 INTENDED BENEFITS OF PALLIATIVE CARE IN THE INTENSIVE CARE UNIT

Research has highlighted both areas for improvement when delivering palliative care in the ICU and how interventions focused on this have helped. In keeping with the definition of palliative care introduced previously, a palliative care intervention can be defined as one that was aimed at improving the quality of life of at-risk-of-dying patients and/or their families [9]. In 2003, Interventions to provide palliative care in the ICU were initially categorised into domains by the Robert Wood Johnson (RWJ) Foundation’s End-of-Life Care Project [24]. These were (i) patient- and family-centred decision-making, (ii) communication, (iii) continuity of care, (iv) emotional and practical support for patients and families, (v) symptom management and comfort care, (vi) spiritual support, and (vii) emotional and organizational support for ICU clinicians. A recent systematic review of randomised clinical trials and observational studies reported palliative care interventions within the ICU setting, assessed their potential impact on ICU practice and evaluated differences in palliative care approaches between different countries [9]. They found overlap with some of these domains, and that some were unused and created a new classification system to serve a more practical description of the practices delivered in each study [9]: (i) communication interventions, (ii) ethics consultations, (iii) educational interventions, (iv) palliative care team involvement, and (v) advance care planning [9].

Palliative care interventions have been shown to increase advance care planning conversations within ICU [27-36]. While not increasing mortality, they can reduce conflict over goals of care and reduce nonbeneficial treatments, with timely implementation of care plans aligning with patients' preferences [37-40]. They positively impact symptoms [41-44] and reduce ICU [28, 29, 31, 38, 45-52] and hospital [36, 47-49, 51-54] length of stay. This is important in the highly medicalised environment of ICU that may sometimes be at odds with patients' wishes. Unnecessary investigations, treatments, and days on ICU can not only negatively impact patients and families but have cost [39, 40, 53-55] and environmental implications too [56]. Families of patients admitted to ICU are at risk of post-ICU syndrome, experiencing anxiety, depression, and post-traumatic stress disorder [4, 5]. 13-56% of family members experience clinically relevant PTSD symptoms [57]. ICU palliative care interventions increase frequency of family meetings [29, 58-62], increase family satisfaction [43, 48, 49, 63-68] and reduce psychological distress [47, 48, 54, 69]. Systematic review and meta-analysis of 25 studies including over 20,000 HCPs from adult ICUs found prevalence of high-level burnout for ICU physicians and nurses to be similar at 42 and 45% respectively [70]. Severity of patient illness is a risk factor [70]. Burnout can reduce quality of care and patient outcomes [71]. Structured ICU palliative care interventions increased staff satisfaction [34, 37, 42, 49, 64, 72-76] and reduced their psychological distress and burnout [72, 73]. This has ramifications for staff recruitment, retention, and development; workforce implications that are high priority for the NHS to address [77].

2.1.3 PALLIATIVE CARE OUTCOMES IN THE INTENSIVE CARE UNIT

Although interventions to improve palliative care in the ICU have been trialled, heterogeneity and relevance of reported outcomes has challenged evaluation of these interventions. The previously mentioned systematic review of interventions found more than 40 different validated and unvalidated outcomes were reported [78]. Many of these were only reported in one or two studies and this heterogeneity made comparison of the studies challenging and inhibited meta-analysis [79].

Aslakson et al reviewed palliative care outcomes in the ICU and conceptualized a framework with four groups [10]. System-related, content-related, clinician-related, and patient/family-related [10]. System-related outcomes are those that refer to a percentage or group of delivered care rather than a single unit of observation such as a patient or clinician [10]. Examples include mortality rates, proportion of patients with documented escalation of care decisions, or frequency of interventions such as mechanical ventilation. Content-related outcomes describe the actual care provided [10]. These include ICU or hospital length of stay, duration of mechanical ventilation, goals-of-care discussions, and consensus between family and clinicians amongst others. Clinician-related outcomes encompass an intervention's impact on clinician well-being or satisfaction, or their perception of the intervention's impact on others [10]. For example, a score measuring nurses' perception of the quality of death. Family-related outcomes refer to family perceptions of the care provided and their wellbeing [10]. These include family satisfaction, and scores of family distress. Aslakson et al recognised that although not reported in the intervention trials they reviewed, patient-centred outcomes must be included when trialling palliative care interventions in the ICU [10]. Measurement of such outcomes is challenged by the fact that patients are often too unwell to communicate and for patients who die on the ICU, quality assessment of their care may be reliant on family-related metrics [10]. However, for those who are alert enough, measurement should be sought or by collecting retrospective reports from survivors [10].

From the Metaxa et al systematic review [9], the four most frequently reported outcomes were ICU length of stay, hospital length of stay, mortality, and family satisfaction. As this suggests, historically outcome measures utilised in critical care tend to be system-related. These system focused measures, although important, cannot fully examine the impact of, or define, high quality end of life care in isolation. One must also consider outcomes that are important to patients and families. These findings, particularly the lack of patient-centred outcomes, prompted further work. Research has been funded to develop a core outcome set for person-centred outcomes in end-of-life care in critical care [80]. The research team are currently undertaking a mixed methods systematic review to identify person-centred outcomes and measures reported in studies evaluating End-of-Life care in critical care [81]. They then plan to conduct an in-depth longitudinal exploration of what patients and their families feel are important outcomes measures in end-of-life care in critical care through semi-structured qualitative interviews and/or focus groups with bereaved families [80]. Delphi process and a consensus meeting will then be used to identify and determine a final outcome set [80].

2.1.4 BARRIERS TO PALLIATIVE CARE IN THE INTENSIVE CARE UNIT

Alshehri et al conducted a systematic mixed methods review and thematic synthesis of studies highlighting health care professionals' experiences or perceptions of the integration or implementation of palliative care in ICUs [82]. Their aim was to identify barriers and facilitators influencing a palliative approach in intensive care settings, as perceived by health care professionals (HCPs) [82]. They reviewed 24 studies including 2545 allied health professionals' perspectives across ten countries [82]. Results suggested that both organisational factors, including resource and time constraints, and individual factors such as HCP, patient, and family attitudes, communication, skills and knowledge, can hinder ICU palliative care [82].

A recent scoping review of 2005-2021 papers (14 included covering 9 countries) described the provision of palliative care in the ICU in terms of barriers and facilitators as perceived by HCPs [83]. They summarised barriers to include lack of skills, family boundaries, cultural differences, and practical issues [83]. Facilitating factors included family acceptance, collaboration, adequate communication, and experience in providing palliative care [83].

Between the two reviews, only one paper was included in both, yet findings agree when synthesising healthcare professional perceived barriers and facilitators to palliative care in the ICU.

2.2 IMPLEMENTATION SCIENCE

The term implementation science is used interchangeably within the literature with terms such as research utilisation and knowledge transfer [84]. It has a broader scope than traditional clinical research, looking past patient level to organisations and policies and how these impact patient outcomes [16]. Implementation science takes evidence-based-practice and works to address delivery gaps at varying levels from patient to healthcare system [16]. The field aims to develop generalisable knowledge that can be applied beyond that of the study focus [16]. The World Health Organisation explain how rather than conducting research to develop new interventions, we should explore how existing research findings can be translated into practice across cultures and contexts

[85]. This is where implementation research closes the gap by providing methods to guide intervention design to context, inform pragmatic thinking, and structure interpretation and evaluation of findings [86]. Table 2 defines some important terms within implementation science.

Table 2: Implementation science important terms

Term	Definition
Theory	A set of analytical principles or statements designed to structure our observation, understanding and explanation of the world [87].
Model	A visual simplification of a phenomenon or aspect of a phenomenon [87]. Models can be described as theories with a more narrowly defined scope of explanation; a model is descriptive, whereas a theory is explanatory as well as descriptive [88].
Framework	An outline or system consisting of descriptive categories, and the relations between them that are presumed to account for a phenomenon [87]. Frameworks are purely descriptive and do not provide explanations [88].
Implementation strategies	"Methods or techniques used to enhance the adoption, implementation, and sustainability" of an evidence-based intervention [89, 90].
Determinants	The modifiable factors that the implementation strategy aims to change to influence implementation of evidence-based interventions [90, 91], in other words, factors that facilitate or constrain implementation
Mechanisms of action	Processes through which an implementation strategy affects implementation outcomes [92].

2.2.1 IMPLEMENTATION FRAMEWORKS, MODELS AND THEORIES

Implementation science methods use models, frameworks, and theories, and the toolkit is extensive. Literature tends to refer to these using the umbrella term "frameworks" [86]. To avoid confusion with duplication of the term as both an umbrella term and the name for one of the constituents within the umbrella, I will use the term "structures" as a hypernym encompassing models, frameworks, theories, and taxonomies. They provide a common language for researchers, stakeholders and those who are executing the implementation efforts [86]. As such, they can be valuable at multiple stages of implementation research from design to evaluation, and should ideally be used prior to and throughout any implementation research or real-word project [86].

Systematic reviews are widely used to synthesise research, reducing bias of single studies, to inform decisions in policy and practice [93]. Reviews such as this one of complex interventions within complex systems, require methods that allow examination of interlacing factors and causal pathways. The use of frameworks, models and theory in systematic reviews of complex issues is an evolving field addressing this complexity [94]. However, if these methods are used sub optimally, this can lead to research and resource waste [86]. The critical thinking behind the choice and use of structures within this review is detailed in the methodology.

2.2.2 IMPLEMENTATION OUTCOMES

Proctor et al define implementation outcomes as "the effects of deliberate and purposive actions to implement new treatments, practices, and services." Developing and measuring implementation outcomes enables understanding of implementation processes and analysis of implementation strategy effectiveness. Alongside outcomes that measure the effectiveness of an intervention, in this case, system, content, clinician or patient/family-related palliative care outcomes, implementation outcomes provide holistic and transparent information around how and why an intervention has or has not has the desired effect. Proctor et al developed a taxonomy for implementation outcomes, summarised in Table 3. This taxonomy will be used to characterise implementation outcomes within this review.

Table 3: Taxonomy of implementation outcomes (Proctor et al 2011)

Implementation outcome	**Definition**
Acceptability	Perception among stakeholders that an intervention (practice, service, innovation, or treatment) is agreeable, palatable, or satisfactory

Adoption	The uptake and utilization of the intervention, the intention to try
Appropriateness	Perceived fit, relevance or compatibility of the intervention for a given context
Feasibility	The degree to which a new intervention can be successfully used or carried out in a given context
Fidelity	The extent to which a new intervention has been implemented as it was prescribed and intended
Implementation cost	The costs of delivering an intervention
Penetration	The integration of an intervention into a setting and its systems
Sustainability	The degree to which an intervention is maintained or institutionalised within a service setting’s ongoing, stable operations

2.3 GAPS OR LIMITATIONS IN THE EXISTING LITERATURE

Implementation of ICU palliative care interventions has not been systematically reviewed. Metaxa et al concluded that the field of ICU-based palliative care would benefit from well-designed, targeted interventions [9]. Implementation research can help achieve this. Studies of the experiences and perceptions of health care professionals in adopting palliative care interventions in ICUs have been reviewed via systematic [82] and scoping methodologies [83]. However, these reviews did not include effectiveness studies and so did not establish barriers or facilitators to implementation or report any implementation strategies used by researchers. Alsheheri et al’s systematic review concluded that we need explicit knowledge translation research demonstrating valid implementation strategies [82]. Reviewing effectiveness studies alongside process evaluations for palliative care interventions within intensive care will give valuable insights into implementation barriers or constraints identified and demonstrate the implementation strategies that have been found to complement or overcome them. Moreover, it will help gain insight into implementation strategies that have been tried and found to be ineffective. Thus far validated implementation science structures have not been used when synthesising evidence around implementation of palliative care in ICU. Utilising these structures to synthesise and present review findings will allow clear communication and knowledge translation, as well as contribution to the field of implementation science research.

3 AIM AND OBJECTIVES

AIM

Using a logic model as a framework for synthesis, this review will aim to identify and synthesise knowledge on how models of integrating palliative care into the ICU have been implemented and provide critical recommendations for successful future development and implementation of complex interventions in this field.

OBJECTIVES

1. To identify and describe evidence on facilitators of, or constraints on, implementation of palliative care interventions within the ICU.
2. To identify and describe any specific implementation strategies reported, that have been used to address facilitators or constraints, when employing palliative care interventions within the ICU.
3. To explore evidence on the effect of these strategies on implementation and outcomes.
4. To identify and describe any reported differences in implementation when looking at palliative care interventions that are characterised as integrative or consultative.

4 METHODOLOGY

4.1 IMPLEMENTATION STRUCTURES AND TAXONOMIES

As implementation science has developed, so have a large number of models, frameworks and theories to support evaluation, reporting, and knowledge transfer of research [87]. Selections therefore need to be made when conducting implementation research as to which of these compliments the aims and objectives of the study most and therefore should be used. For this study the aims and objectives required identification and description of determinants to implementing palliative care interventions, implementation strategies, intervention characteristics, and outcomes. They also required exploration of causal pathways between determinants, implementation strategies, mechanisms, and outcomes. Therefore, multiple implementation structures and taxonomies were needed to address these requirements.

There are resources, such as review articles and websites, that outline potential structures to give researchers a list of options to choose from [87, 95, 96]. When selecting which structure(s) should be used, Moullin et al stated that the process should consider: i) the purpose of the structure, ii) the levels covered, iii) the degree of inclusion and analysis of concepts, and iv) the orientation/setting/type of intervention it was originally designed for [86]. As in this case, they suggested that it may be beneficial or necessary for researchers to use multiple structures. Before exploring the reasoning for each structure used, Table 4 outlines their role in this study, as related to the requirements above to address the aims and objectives.

Table 4: Role of Implementation Structures/Taxonomies for this study

Implementation Structure/Taxonomy	Role in this study
Implementation Research Logic Model (IRLM) [97]	Explore causal pathways between determinants, implementation strategies, mechanisms, and outcomes.
Consolidated Framework for Implementation Research (CFIR) [98]	Identification and description of determinants
Expert Recommendations for Change (ERIC) implementation strategies compilation [89]	Identification and description of implementation strategies

Template for Intervention Description and Replication (TIDieR) taxonomy [99]	Identification and description of intervention characteristics
Proctor et al implementation outcomes taxonomy [100]	Identification and description of implementation outcomes
Aslakson et al palliative care outcomes taxonomy [10]	Identification and description of palliative care outcomes

4.1.1 IMPLEMENTATION RESEARCH LOGIC MODEL

Although frameworks and taxonomies can help to clearly describe individual components, it is the relationships among variables that is critical when attempting to understand the success or failure of an implementation innovation. For this, causal modelling is needed [92]. As mentioned, the aim and objectives of this study required exploration of causal pathways. A logic model can act as a conceptually grounded organisation tool to facilitate this [97]. The choice of framework synthesis is explained within this methodology section, and the five steps described. Following familiarisation with the literature, framework selection was required. Logic models can help conceptualise and manage complexity and can provide a framework for systematic reviews [94]. They can provide scaffolding to integrate the findings of varying evidence [101, 102]. A priori logic models are being increasingly used in systematic reviews [103]. They can be deconstructed for data extraction and then reconstructed to show relationships between components [102].

The Implementation Research Logic Model is a process-orientated model encompassing validated implementation science frameworks and taxonomies [97]. The generalised theory of the IRLM postulates that:

1. Implementation strategies selected for an evidence-based intervention are related to implementation determinants (context-specific barriers and facilitators)
2. Strategies work via mechanisms of action to alter the context or behaviours of individuals and organisations within the context.
3. Strategies and their mechanisms impact implementation outcomes that then relate to the clinical outcomes of the intervention [97].

It allows clear visualisation and examination of relationships between the components that this review is aimed to explore; implementation determinants, implementation strategies, mechanisms, palliative care interventions, and implementation and clinical outcomes (Figure 1) [97]. These components are described below.

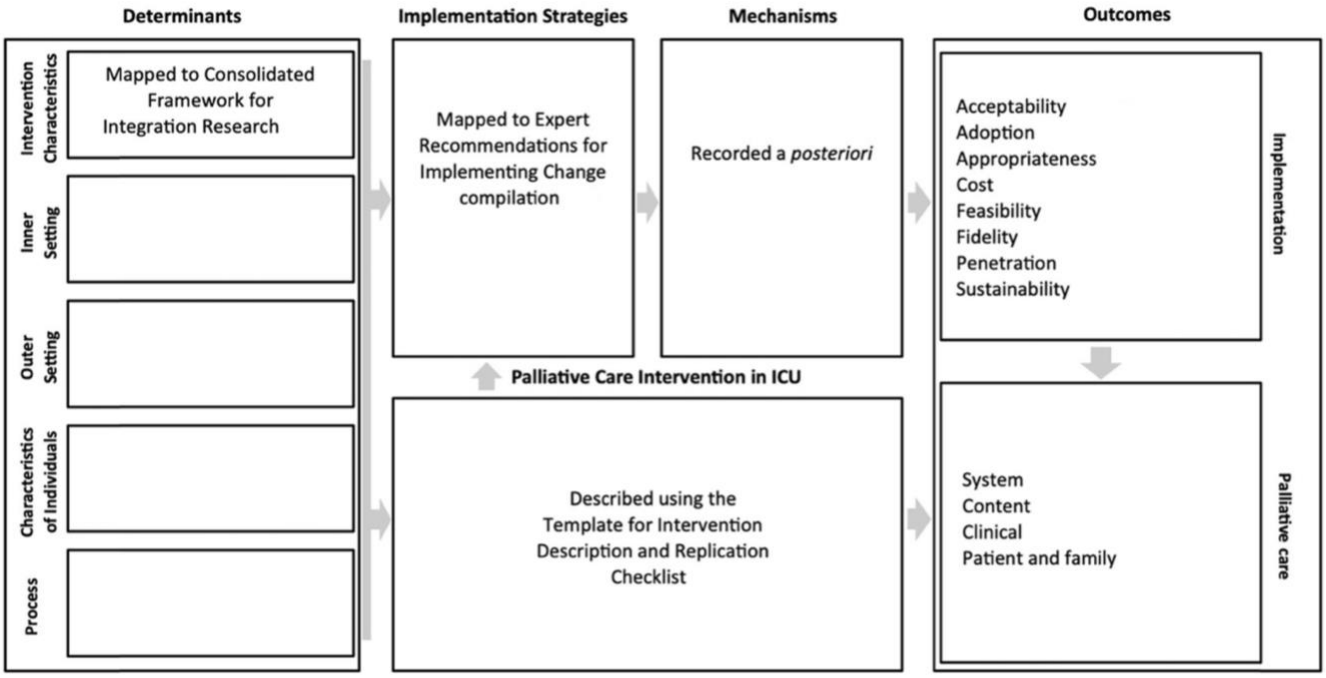


Figure 1: Implementation Research Logic Model (adapted from Smith et al)

4.1.2 DETERMINANTS: CONSOLIDATED FRAMEWORK FOR IMPLEMENTATION RESEARCH

The model draws the domain names for determinants from the Consolidated Framework for Implementation Research (CFIR); process, characteristics of individuals, outer setting, inner setting, intervention characteristics [98].

Nilsen et al termed frameworks that help to “Specify types (also known as classes or domains) of determinants and individual determinants, which act as barriers and enablers (independent variables) that influence implementation outcomes (dependent variables)” as determinant frameworks [87]. Their overarching aim being to understand the determinants’ influence on implementation outcomes, however they do not offer any causal mechanisms, separating them from theories [87]. As integrative frameworks, they do nevertheless help to identify and place the determinants within the multiple layers of implementation, and without them, findings will be limited to the context in which they are found. A 2019 scoping review found 11 determinant frameworks [104]. Of these, CFIR is a pragmatic meta-theoretical framework comprising 39 implementation related constructs across five domains, providing a standardised repository applicable within a continuum of implementation research and settings [98]. In 2009, Damschroder et al developed the Consolidated Framework for Implementation Research, to not replace, but streamline previous significant contributions to implementation science [98]. They had reported that when examining published implementation frameworks, many of the proposed constructs overlapped, but it appeared that on comparison, individually each framework tended to be missing important constructs from others [98]. They also found variation in terms and definitions within frameworks [98]. CFIR provides researchers with a guide to identify variables that are salient to a particular innovation whilst offering a common taxonomy [105]. CFIR was proposed for use at multiple stages within implementation research [98] , and has since been utilised as such [105]. Unlike other frameworks, CFIR presents system-level constructs as a comprehensive operationally-defined taxonomy, whilst acknowledging constructs are inextricably linked to individual beliefs, action and behaviour [98].

4.1.3 Implementation Strategies: Expert Recommendations for Implementing Change Compilation

During the Expert Recommendations for Implementing Change (ERIC) study, self-identified implementation experts selected implementation strategies most likely to address each CFIR barrier [89]. 73 ERIC strategies were identified and categorised into 9 subheadings: engage consumers, use evaluative and iterative strategies, change infrastructure, adapt and tailor to the context, develop stakeholder interrelationships, utilize financial strategies, support clinicians, provide interactive assistance, train and educate stakeholders [89, 106]. Implementation Research Logic Model developers suggests use of this taxonomy for implementation strategies [97].

4.1.4 Mechanisms

Mechanisms are described as the processes or events through which implementation outcomes are affected by implementation strategies [92]. Current literature describes a lack of work around mechanisms for the ERIC strategies [107]. No predefined list of mechanisms exists for use, therefore any mechanisms identified were recorded a posteriori.

4.1.5 Palliative Care Interventions: Template for Intervention Description and Replication

The Template for Intervention Description and Replication (TIDieR) is a comprehensive framework developed to improve comprehensive reporting of interventions and has been recommended for use in systematic reviews [99, 108].

4.1.6 OUTCOME FRAMEWORKS

The logic model used for this systematic review separates outcomes into implementation outcomes, service outcomes, and clinical/patient outcomes. For the purpose of this review, service and clinical/patient are grouped under the umbrella term of palliative care outcomes. As no palliative care in the ICU specific outcome framework exists at present, reported palliative care outcomes are categorised as system-related, content-related, clinician-related, and patient/family-related, following findings from Aslakson et al [10].

Implementation outcomes are categorised as acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, and sustainability, following Proctor et al's framework in their seminal paper [100]. This is the standard implementation outcome framework within implementation science.

4.2 QUALITATIVE EVIDENCE SYNTHESIS

Qualitative evidence synthesis (QES) has a key role in addressing questions related to complex interventions and systems, and guideline development [109]. QES is a process and product of systematically reviewing, and integrating findings of, completed qualitative studies [110]. It is an umbrella term for numerous methodologies [109]. The purpose of QES is to bring together findings from primary studies to establish a greater understanding of the topic of interest [109]. The synthesis can offer multiple perspectives as well as compare contradictory viewpoints that may be overlooked when studies are taken in isolation [111]. QES therefore produces more than the simple sum of the research, but rather deepens understanding. It can pool data across different contexts, generate new conceptual or theoretical models, identify research gaps, and provide evidence for development, implementation and evaluation of health interventions [112]. Flemming et al describe how QES may help address elements of complexity and encourage the consideration of using QES for reviews and guidelines on complex interventions implemented in complex systems, such as this review [109].

There are over 30 methods for conducting a qualitative evidence synthesis [113]. They vary in their stage of development and sophistication [109]. QES methodologies sit on a spectrum between integrative and interpretive approaches [109]. Integrative synthesis aggregates or summarises data. As a more deductive approach, it is best used when there are clear themes and concepts defined in the primary research [109]. This is also referred to as translation of findings at the descriptive level [114]. Reviews using this approach can be termed aggregative reviews [115]. In contrast, using interpretive synthesis, themes can be developed inductively. It therefore allows for new or advanced concepts and theories grounded in the primary data to be presented [109]. This development of new relationships is also termed transformation [114]. Configurative reviews use this approach [115]. Due to number of methodologies to choose from, it is important to choose an appropriate synthesis method to answer the research question within scope of the review [109, 113]. Cochrane Qualitative and Implementation Methods Group states that a synthesis method should only be determined once the pool of evidence for the review is known [116].

The aim of this review was to identify and synthesise knowledge on how models of integrating palliative care into the ICU have been implemented. Objectives within this aim included identification and description of determinants and strategies. These objectives require aggregation of information and would therefore benefit from an integrative synthesis approach (translation). However, additional objectives to explore relationships between strategies and outcomes, and differences when comparing interventions require some interpretive synthesis (transformation). Once the pool of evidence for the review was known, it was clear that both translation and transformation would be possible and required to address the research objectives. The three qualitative synthesis methods that allow for both translation and transformation are framework synthesis, thematic synthesis, and meta-ethnography [114, 117]. If there is a pre-existing theory or framework, then framework synthesis is recommended, including best fit synthesis as a branch of this [118]. If there is no theory or framework then thematic synthesis is better suited, or if the aim is to develop a theory and evidence allows, meta-ethnography [118]. For this review, The Implementation Research Logic Model was identified as an already published framework illustrating how the concepts (to be translated/aggregated) of interest may be related (relationships to be transformed/configured). Framework synthesis is a method used to examine complexity in systematic reviews [119]. It is deemed a good choice of method when the research question relates to health system considerations for this reason [109]. It can provide a more transparent way to present findings [119]. Framework synthesis is a configurative method that includes some components where data are aggregated [115]. Therefore, framework synthesis is the most appropriate method for this review to facilitate aggregation of descriptive data as well as configurative review.

In addition to ensuring the QES method chosen is appropriate for the research question, a further consideration is the development and validation of the method [113]. Some synthesis methods are better developed and tested than others [113]. Thematic synthesis [120], framework synthesis [121], and meta-ethnography [122] are some of the most developed QES methods [123].

4.3 FRAMEWORK SYNTHESIS

Framework synthesis is a method used to examine complexity in systematic reviews [119]. It is deemed a good choice of method when the research question relates to health system considerations for this reason [109]. It can provide a more transparent way to present findings [119]. Framework synthesis is a configurative method that includes some components where data are aggregated [115]. It is derived from framework analysis, where a framework derived from literature and theoretical background provides an iterative scaffold for primary findings to be organised against [124, 125]. When this method is used to synthesise findings of prior research, it is termed framework synthesis [119]. Framework synthesis involves five stages [119]. Familiarisation, in which the reviewer(s) become familiar with the research topic gaps and ideas [119]. Framework selection, this framework can be developed with stakeholders or, as in this review's case, from literature [109]. They can be derived from an existing review output, a policy framework, or a conceptual or logic model. For this review, a logic model is used as the overarching framework, with secondary frameworks from existing reviews as its constituents. Indexing, identification, screening, and data extraction of studies using the conceptual framework. Charting, data extracted from studies are categorised, deriving themes. Finally, mapping and interpretation is where the themes are considered in light of the original research questions. It is distinct from other methods in that it uses an a priori framework to both extract and synthesise findings [126].

The framework on which the synthesis is structured, in this case, the Implementation Research Logic Model, presents to the reader clearly the original concepts, the origins and basis of the themes identified, and how these are translated back to the framework to develop the thinking [119]. This transparency can be helpful when engaging stakeholders, including the public, with the findings [119]. It is suggested to be one of the methods directly relevant to policy makers and intervention designers compared to one of the more constructivist methods such as critical interpretive synthesis [117].

Due to the ability to conceptualise and configure multiple components, framework synthesis can be termed a pluralist method [119]. It is therefore helpful when synthesising a variety of study types in a systematic review of complex interventions such as this one. Synthesising these multiple data sources through framework synthesis enables analysis of not just what works but why it works and in what context [127]. For example, for this review, it is not enough to know what the implementation strategies are, but also the mechanisms by which they work. It is also a method recommended where there are a large number of studies [118], such as in this case of n=79.

The use of an a priori framework to guide the framework synthesis can mean that the review process is timelier, however the time taken to develop or identify a framework can be underestimated [109]. It is also possible that it would not become apparent that the framework is not suitable until late in the review process, requiring steps backwards to be taken [109]. In some cases, there will be a risk of simplistically forcing data into the framework and researchers must consider data external to the a priori framework and how it should be presented [127]. In these cases, best fit synthesis may be more appropriate whereby reviewers test, reinforce and build on an existing model [128]. This was not the aim for this review, and after data extraction, it was clear that framework synthesis with the Implementation Research Logic Model was suitable.

5 METHODS

The protocol for this systematic review was registered prospectively before searches, with PROSPERO (registration: CRD42022311052) and published in a peer reviewed journal [129]. The study followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) checklist when reporting results [130].

5.1 SEARCH STRATEGY

A Boolean search strategy was developed with an information specialist. MEDLINE, EMBASE and PsycINFO via OVID, CINAHL via EbscoHost, CENTRAL and Cochrane Database of Systematic Reviews via The Cochrane Library, databases were used. Date and language restrictions did not apply. Search strategies used database appropriate Subject Headings terms (e.g. MeSH) and free text terms, combining adaptations of the searches from Metaxa et al [9] and novel strategies (See Appendix 1 for example search strategy for MEDLINE). The results from combining the following three concepts:
Terms related to palliative and end of life services (adapted existing)
AND
Terms related to intensive and critical care (adapted existing)
AND
Terms related to implementation science (developed for this review)
Were pooled using the 'OR' syntax with the following three concepts:
Terms related to palliative and end of life services
AND
Terms related to intensive and critical care
AND
Terms to identify controlled studies (developed for this review)

Reference lists of all included papers and any relevant reviews were hand searched. Forwards and backwards citation searching using Citation Indexes was conducted on included papers describing controlled trials to identify linked process evaluations and search filters related to process evaluations were added to the implementation science search concept (shown in search strategy).

The initial search was completed 25th February 2022 and was repeated to include publications up to 4th December 2022.

5.2 ELIGIBILITY FOR INCLUSION IN SYSTEMATIC REVIEW

Population: Adult patients (aged ≥18 years) admitted to the ICU or High Dependency unit and/or their families and/or palliative care professionals or teams. Families are defined as individuals who provide support and with whom the patient has a significant relationship [19].

Interventions: Palliative care interventions, defined as those that were aimed at improving the quality of life of at-risk-of-dying patients and/or their families [9].

Comparators: No intervention or alternative palliative care intervention(s).

Outcomes: System/content/clinical/patient and family related palliative care outcomes [10] defined individually a posteriori, or the following implementation outcomes; acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, sustainability [100].

Studies: Controlled trials (randomised and non-randomised including observational studies) and process evaluations (quantitative, qualitative, or mixed methods) conducted either alongside a comparative study or stand-alone. Case reports or series, editorials, commentaries, opinion papers, publications only as abstracts, review papers and studies with no reported outcomes and/or no reported information of implementation were excluded.

5.3 STUDY SELECTION

Initial search results were managed in EndNote and duplicate references removed before screening. Remaining references were managed in Covidence online systematic review software. Two reviewers independently performed title and abstract screening followed by full text screening of each study. Any conflicts were resolved by discussion between screening reviewers or consultation with a third reviewer if consensus was not reached If full texts were not available after contacting the author, the study was not included in the review. Google translate was used to aid the screening of papers not written in English. Manual translation of full texts not written in English was planned for but not required.

5.4 DATA EXTRACTION

Data were extracted using a predefined and piloted data extraction form (Appendix 2), using Covidence. Headings were derived from the components of the IRLM. Study, participant, intervention, and outcome data were extracted by JRB and checked by SMD. Implementation data were extracted by SMD and checked by JRB. Conflicts were resolved via discussion between SMD and JRB or consultation with a third reviewer if no consensus was reached.

5.5 QUALITY ASSESSMENT

The methodological quality of included studies and process evaluations was assessed independently by SMD and JRB during data extraction, using the Mixed Methods Appraisal Tool [131] (Appendix 3). Papers were included regardless of their quality, but quality has been considered when interpreting findings. The strength of the body of evidence was assessed using the Grading of Recommendations Assessment, Development, and Evaluation-Confidence in the Evidence from Reviews of Qualitative research (GRADE-CERQual) [132].

5.6 DATA SYNTHESIS AND ANALYSIS

Study characteristics have been described descriptively. The Implementation Research Logic Model was used as a framework for synthesis [97]. Extracted data were managed in NVivo and codes were created mapped to: Intervention domains as previously proposed by Metaxa et al [9] and the RWJ Foundation's End-of-Life Care Project [24], model of palliative care provision, ICU type, palliative care outcome category [10], implementation outcomes [100], CFIR determinants [98] and ERIC implementation strategies [89, 106]. A new intervention domain, bereavement, was also added to capture this specific topic. Models of integrating palliative care into the ICU are ends of a spectrum, however a dichotomy is useful for comparative research. Mixed interventions or those involving consultations with palliative care-trained specialists or ethicists, have previously been classified as consultative to provide this dichotomy of external specialist involvement or none [9]. To maintain common taxonomy, this review used the same dichotomy. Data were then coded to facilitate a framework synthesis. Evidence not captured by the framework was analysed using the principles of thematic analysis to generate themes to incorporate back into the framework. Study characteristics were summarised (Appendix 4). The outcome category was stated for each study and a comprehensive list of the outcomes compiled (Table 10). Intervention characteristics not reported elsewhere are summarised using the TIDieR [99] in Appendix 5.

6 RESULTS

6.1 IDENTIFICATION OF STUDIES

The search (until December 2022) identified 8716 citations. 3500 duplicates were removed, title and abstract screening excluded 5011 records, and 3 full texts were not able to be retrieved. 214 articles were full text screened and 79 met the inclusion criteria (Figure 2).

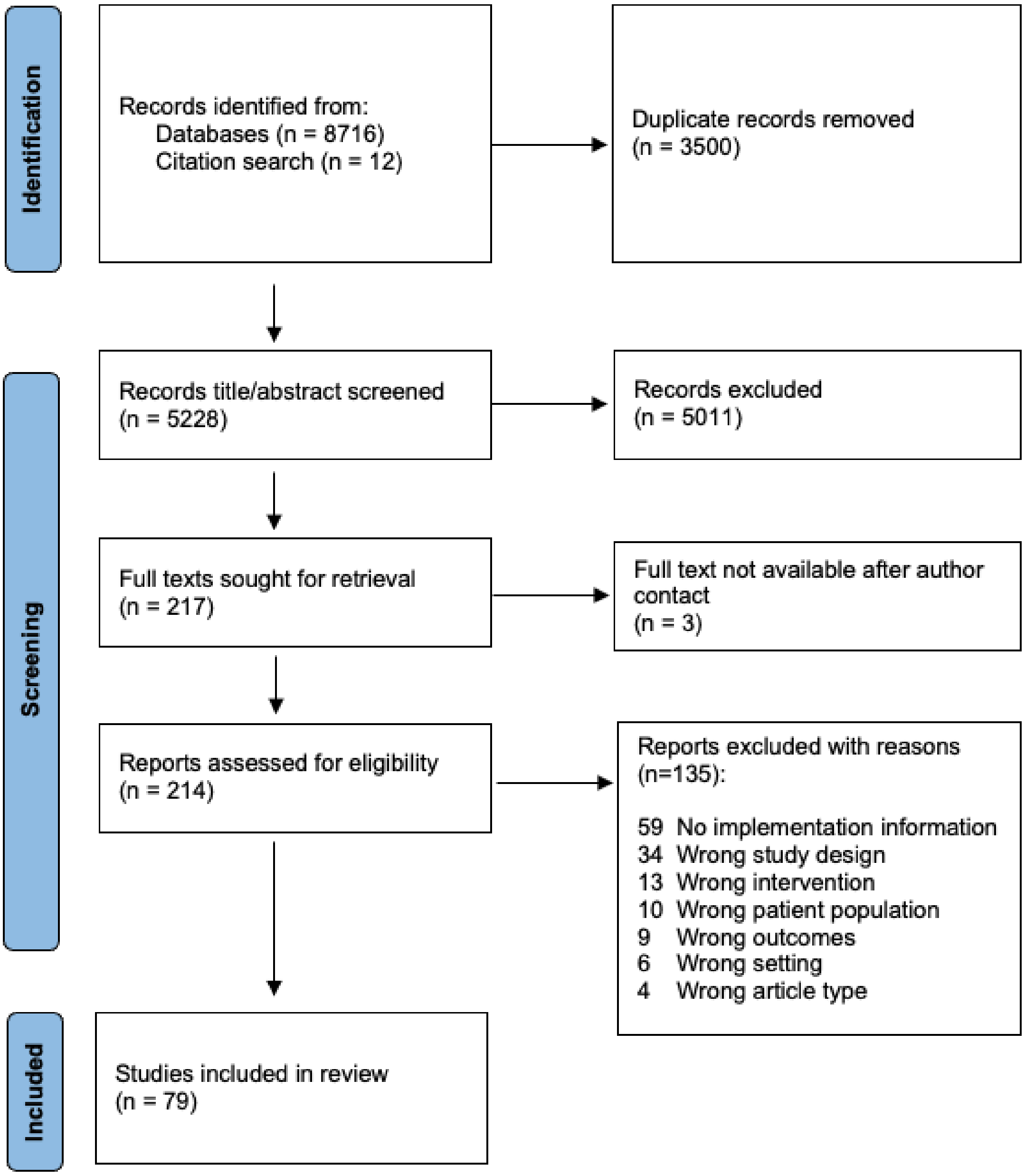


Figure 2: PRISMA flow diagram of article inclusion

6.2 CHARACTERISTICS OF INCLUDED STUDIES

Of the 79 included studies, 71 were effectiveness and/or feasibility studies, and 8 were process evaluations. Together, they referenced 66 interventions. Study characteristics are shown in Appendix 4. 47% (n=37) studies used a consultative model and 53% (n=42) used an integrative model. 49 studies focused on one ICU type (transplant, cardiothoracic, and trauma were classed as surgical) whereas the remaining 30 either did not specify (n=6) or involved more than one ICU type but did not distinguish between them when reporting results (n=24). Frequencies for each ICU type and intervention domain shown in **Error! Reference source not found.**. 75% (n=59) studies were conducted in America. 33% (n=26) studies used pre-post intervention (quality improvement) study design, which was the most common design used.

Table 5: Frequency of ICU type and intervention domain

ICU type	No. of studies involving*
ICU type not specified	6
Medical	36
General	29
Surgical	20
Neuro	16
Cardiology or thoracic	15
Trauma	10
Transplant	4
Burns	1
Nephrology	1
Respiratory	1
Vascular surgery	1
Intervention domain	No. of studies involving*
A Communication interventions	40
B: Educational interventions	35

C: Palliative care team involvement	30
D: Advance care planning	20
E: Ethics consultations	3
F: Emotional and organizational support for ICU clinicians	58
G: Patient or family centred decision making	24
H: Emotional and practical support (family or patient)	13
I: Symptom management and comfort care	5
J: Spiritual support	1
K: Communication within the team and with patients and families	40
L: Continuity of care	0
M: Bereavement	6

*Sum is greater than 79 as some studies involved multiple ICU types

6.3 INTERVENTION CHARACTERISTICS

Reason for the intervention, description of intervention materials and procedures, who delivered the intervention and mode of delivery were reported for all interventions. Timing and dosing (when and how much), for example length of teaching intervention or number of times patients were screened, of interventions was not always reported. Full intervention characteristics using TiDieR taxonomy is shown in Appendix 5.

6.4 OUTCOMES REPORTED

Frequency of implementation outcomes [100] and palliative care outcome categories are shown in Table 6.

Table 6: Frequency of outcomes reported

Palliative Care outcome category	No. reported
System-related	97
Content-related	59
Patient/family-related	40

Clinician-related	33
Implementation outcome	No. times reported
Feasibility	14
Acceptability	12
Adoption	12
Appropriateness	6
Adherence	4
Sustainability	4
Fidelity	2
Costs	2
Penetration	2

84 different outcomes were identified across the four palliative care outcome domains and Appendix 6 lists each reported outcome in each category.

7 OBJECTIVE 1: DETERMINANTS

As previously described, determinants are "the modifiable factors that the implementation strategy aims to change to influence implementation of evidence-based interventions" [90, 91], in other words, factors that facilitate or constrain implementation. Addressing objective 1; to identify and describe evidence on facilitators of, or constraints on, implementation of palliative care interventions within the ICU, reported determinants are described here using CFIR headings [98].

7.1.1 INNER SETTING:

Components of the inner setting were the most discussed determinants to implementation.

Available resources

"The level of resources dedicated for implementation and on-going operations, including money, training, education, physical space, and time" [98].

It was recognised that intensive care units are busy, with high acuity patients and so staff numbers and their lack of available time hindered implementation in many cases [27, 32, 64, 76, 133-155]. This included time for implementation strategy development [156] and ongoing engagement to sustain the intervention [139]. In contrast in a larger centre, high staff numbers were reported as a barrier due to issues communicating to all of the staff [138]. It was recognised that interventions involving ethics consultation or specialist palliative care teams may be limited if a centre does not have this service or capacity [29, 35, 40, 134, 154, 157, 158], but where there is an existing team, appropriate use of this resource is a facilitator [29, 40, 58, 134, 140, 159, 160]. In general, having the personnel required for the intervention frequently present and available enabled implementation [40, 42, 150, 160-162], and lack of availability hindered implementation [29, 139, 163-165]. Lack of efforts made to increase workforce were noted as a hinderance [141, 142]. Availability outside of normal hours both helped [40, 163, 164], and reduced engagement as there was understandable reluctance for more work outside of working hours [143, 166]. The unpredictability of break times was a barrier to an intervention scheduled for breaktimes [150]. In centres where leaders allowed time for implementation, this was seen as a facilitating factor [138, 139, 151, 167, 168] ICU nurses were discussed as a valuable resource when implementing palliative care in the ICU due to the caring nature of their role, and their consistent presence and availability on the intensive care units [134, 161]. Availability of physical [138, 169-172] and electronic resources [150, 152, 160, 168, 173] were also mentioned as barriers to overcome. For example, one initiative had only one comfort care cart and this made it difficult to provide care for multiple families [169], and in on case, the end-of-life care app was designed for Android systems and so could not be implemented in iOS devices like iPhones [173]. The lack of standardised assessment tool for symptoms where patients are sedated, as often in ICU, was noted [27, 155]. In some cases, funding prevented adequate resources for implementation [143, 164, 174].

Compatibility

"The degree of tangible fit between meaning and values attached to the intervention by involved individuals, how those align with individuals' own norms, values, and perceived risks and needs, and how the intervention fits with existing workflows and systems" [98].

Interventions that were embedded into usual care facilitated implementation [27, 34, 58, 60, 62, 138, 155, 158, 161, 175, 176]. However, the incompatibility with the acute nature of the ICU acted as a barrier [139, 142, 154, 155, 177]. Some interventions are incompatible for sedated and ventilated patients [27, 155]. It was helpful for the intervention to be applicable to all patients [60, 65, 159, 177]. Timing demands and conflicts, as well as access to resources limited compatibility, as previously discussed under available resources, and addressing these issues promoted implementation. These two constructs are closely linked. Interventions that were administered by ICU nurses fit well into existing workflows for conceptual and pragmatic reasons [134, 169, 178]. Reluctance of ICU teams was linked to the incompatibility with their own beliefs around palliative care and its place in ICU. This will be discussed under knowledge and beliefs around the intervention. Implementation was supported where the intervention aligned with perceived need, and this is discussed under relative advantage.

Networks and communications

"The nature and quality of webs of social networks and the nature and quality of formal and informal communications within an organization" [98].

It was recognised that in order to improve end-of-life care, interprofessional approaches were beneficial [62, 75, 149, 151, 155, 165, 168, 177]. Nurses valued the presence of other healthcare professionals for building cohesiveness and learning [147]. Physicians and bedside nurses working together was favourable [134, 147]. A symbiotic relationship between the palliative care and ICU team was advantageous [29, 58, 65, 158, 160, 171, 178-180]. Where ICUs were able to provide primary palliative care, this freed up the specialist palliative care team for complex cases [58, 181].

Palliative care professionals [135, 162, 177] or researchers [146] having prior familiarity with the ICU team helps and authentic connections between ICU individuals were used [138]. Reluctance of the ICU team to delegate their patient care to palliative care [136, 179] and a lack of relationship between treating physicians and palliative care hindered implementation [159]. Communication about the intervention outside of ICU but within the organisation was described in one case [138].

Culture

“Norms, values, and basic assumptions of a given organization” [98].

The fact that clinical team structures and role expectations are deeply ingrained in hospital cultures was highlighted as a challenge to implementation [134]. Culture is closely linked to individuals’ knowledge and beliefs. Many studies spoke about individual familiarity, acceptance, preference, or comfort related to palliative care rather than the organisation as a whole. These are discussed under individuals’ knowledge and beliefs about the intervention. However, some studies directly referenced culture. ICU staffs’ training focusing on restoring health was seen to provide conflict [40, 142, 166, 174, 177]. A culture that emphasised the importance of palliative care was described as beneficial [138, 182], as was promoting a culture of change to improve patient access to palliative care [148]. A culture shift towards automatically engaging with an intervention aided success [160]. It was acknowledged that ICU culture can find it hard to make time for new interventions [139], and that surgical culture, in general, views death as a professional failure [27, 180]. Variation in culture between units around professional roles impacted implementation [75]. Establishment of new norms, and normalisation of interventions were described as important factors [149, 165, 175]. Nurse ethic of caring and family-centredness enabled implementation of a family support intervention [134]. Research tradition in academic centres facilitated intervention initiation and spread [138]. Differences in fundamental approaches to palliative care [168, 182], and stigma around palliative care negatively impacted success [148].

Structural characteristics

“The social architecture, age, maturity, and size of an organization” [98].

Addressing structural barriers such as workforce size was identified as necessary for success [158]. There was reference to the composition of palliative care teams and how this varied by hospital [32]. As previously mentioned, the presence of a well-staffed palliative care team was seen as a facilitator [29, 35, 40, 134, 154, 157, 158]. Where researchers were integrated into the ICU team, implementation was helped [41]. The shift-based nature of ICU, high patient volume, and high staff turnover were felt to pose barriers [27, 29, 134, 136, 151, 155, 177, 182]. As did the stress of being a specialist centre ICU, such as those that provide Extracorporeal Membrane Oxygenation [139]. One unit had a protocol to transfer post-operative patients out of the surgical ICU as soon as possible, and this did not provide time for implementation [27]. Low turnover of staff [149], and having a closed unit ICU model (where intensivists are the admitting clinicians and specialty teams collaborate [183]), enhanced the ability to make change [155]. Open, nonteaching, and mixed ICUs were described to have had less robust compliance with the intervention [158]. Having multiple physicians involved in a patients care made it more complicated to make changes [155]. Units with lower numbers of deaths had less opportunity for repetition and reinforcement of a death related intervention and this hindered implementation [139]. Smaller centres found implementation more challenging due to competing clinical demands [138], fewer resources and the fact that they often house open, nonteaching, mixed ICUs [158]. However, larger centres found dissemination of information for implementation more difficult [138, 156]. Where target ICUs were across sites [156], or where ICUs underwent organisational changes during the implementation process, this hindered progress [156, 158]. If an intervention required staff to leave the immediate area of the ICU, there was reluctance seen [140]. Within the social architecture, leadership buy-in facilitated implementation, this is discussed under leadership engagement.

Leadership engagement

"Commitment, involvement, and accountability of leaders and managers with the implementation."

Studies discussed the importance of involving hospital and ICU leaders [59, 75, 76, 134, 140, 141, 148, 156, 169, 178], as well as palliative care, nursing, and social work leaders [148, 157, 178], and senior clinicians [75, 135, 168]. It was seen as a key to success [151, 180]. They had the ability to create the time and space for implementation [138, 139], help gain access to professionals under their lead, and provide guidance [168]. Leadership challenging implementation [138], or not valuing the intervention [140] hindered progression.

Access to knowledge

"Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks" [98].

Stakeholders having information on how to use/carry out the intervention facilitated implementation [34, 42, 59, 75, 137, 139, 140, 144, 150, 159, 164, 167, 169, 173]. Specific strategies are discussed in Chapter 5.6. Ease of access to this information was recognised as important [28, 159, 184]. Access to personnel supporting implementation was a facilitating factor [139, 140, 143, 144, 147, 150, 155, 175, 184]. It was helpful when it was ICU staff trained to share this information [42] Lack of understanding of the intervention inhibited progress [138, 139, 174]. Absence of standardised procedure and/or ongoing follow up contributed to this [139]. Educational time being limited within ICU made providing this knowledge challenging [140, 143]. Where information was generalised, it was felt that more individualised and targeted training may be more beneficial [66].

Implementation climate

"The absorptive capacity for change, shared receptivity of involved individuals to an intervention, and the extent to which use of that intervention will be rewarded, supported, and expected within their organization" [98].

Organisational resistance was highlighted as a reason for implementation challenge [76] and it was recognised that interventions should be implemented in units with strong institutional support [64, 75, 178]. Many of the concepts discussed here have been covered in detail within other constructs but contribute to overall implementation climate. Clinical team structures and role expectations may be deeply ingrained and hard to change [134]. Some ICU teams showed reluctance or discomfort to palliative care involvement [32, 40, 134, 144, 156, 179]. The high pressure and pace of ICU hindered change [40, 139, 143, 177] and emotional exhaustion was felt to hinder teamwork required for team based interventions [143]. If an intervention required investing personal time it was not well received [143]. Management lack of understanding challenged implementation until they understood the value of the intervention [138]. Where organisational changes were occurring, the capacity to change was less [156]. This was also seen with high staff turnover [155]. It was felt that younger and more ethnically diverse workers may be more amenable to palliative care interventions compared to experienced workers who would have to change old behavioural patterns [182]. Academic centres' research tradition supported change [138]. Some interventions transitioned to be expected within usual care [149, 154, 165, 175, 181]. Implementation climate closely links to readiness for implementation.

Readiness for implementation

“Tangible and immediate indicators of organizational commitment to its decision to implement an intervention” [98].

The difference being these are clear examples of commitment. Formal leadership endorsement aided implementation [47, 141]. Inadequate recruitment of extra staffing for the work generated by an intervention evidenced lack of commitment [142]. Where this readiness was not seen, an intervention had to take place outside of working hours which, as previously mentioned, hindered its use [143].

Relative priority

“Individuals’ shared perception of the importance of the implementation within the organization” [98].

This is again closely linked but prioritisation was referred to in several cases. Change was facilitated where the intervention aligned with palliative care being recognised as an organisational priority [76], or with the overall health system goals [28]. Some sites had an institutional mission statement focusing on high quality end-of-life care [138]. A reflection intervention was mandated where the institution was determined to prioritise resident emotional wellness [135]. In ICUs where the intervention was perceived as part of a prioritised quality improvement initiative, there was more enthusiasm [140]. Prioritisation of life saving treatment over palliative care was seen as a barrier [142, 143, 165]. Again, in busy units, patient care will take priority over implementation efforts [40, 139, 140, 143, 154].

Organisational incentive and rewards

“Extrinsic incentives such as goal-sharing awards, performance reviews, promotions, and raises in salary, and less tangible incentives such as increased stature or respect” [98].

Monetary or educational incentives facilitated engagement [75, 185].

Tension for change

“The degree to which stakeholders perceive the current situation as intolerable or needing change” [98].

There were cases where ICU teams did not perceive a need for change [40, 144, 148, 154, 160, 166, 172, 177, 179, 186]. In other instances, nurses were interested to see if there was an improvement in family experience [169], and wanted a standardised way of providing end-of-life care [156]. Other nurses were eager to integrate palliative care into their practice due to worries over the current end-of-life care [168]. Medical staff were motivated by their concerns that patient care planning could be improved [34]. Burnout was described as a driving force for change [148], as was the potential for improving care and lowering cost [76]. Awareness of a knowledge gaps also stimulated change [136, 142, 155].

Learning climate

“A climate in which: a) leaders express their own fallibility and need for team members’ assistance and input; b) team members feel that they are essential, valued, and knowledgeable partners in the change process; c) individuals feel psychologically safe to try new methods; and d) there is sufficient time and space for reflective thinking and evaluation” [98].

Feelings of ownership and empowerment developed and aided progress [138, 149, 175, 186]. Support from the intervention team on the ICU to address questions [140, 143] or in times of distress [147, 158, 162], was described. Open, friendly and non-judgmental support was valued [147]. Chances to discuss the impact of the research project were helpful [175]. The impacts of opportunities for reflection and feedback are discussed in future sections. Where there was emotional exhaustion [143], concerns and discomfort [40], or over formality [147], engagement was limited. As previously discussed, time pressures also hindered learning and change.

Goals and feedback

“The degree to which goals are clearly communicated, acted upon, and fed back to staff, and alignment of that feedback with goals” [98].

This relates closely to reflecting and evaluating. Establishment of goals and providing feedback tended to be discussed separately rather than direct feedback on the goals themselves being referenced. Development of clearly defined goals was described [178]. Baseline performance was assessed and used to plan these goals [59]. Studies discussed the importance of feedback to ICUs following implementation [27, 41, 59, 138, 140, 167, 175, 177, 178, 180].

7.1.2 INTERVENTION CHARACTERISTICS:

Adaptability and complexity were the two most common determinants under the intervention characteristics heading.

Adaptability

"The degree to which an intervention can be adapted, tailored, refined, or reinvented to meet local needs" [98].

Having an intervention that was adaptable, in terms of who can deliver them [32, 163, 170-172], the mode of delivery [134, 163, 187], where [163, 169], and when they are delivered [29, 48, 134, 147, 150, 161, 166, 187], and their content [48, 62, 147, 152, 163, 176, 182, 184], was a facilitator for implementation. It was recognised that strategies would need adapting depending on ICU type [174]. Curtis et al described adaptability as a barrier in that for their multi-disciplinary intervention, it was difficult to "transcend the silos of clinical disciplines" [64].

Complexity

"The perceived difficulty of implementation, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps required to implement" [98].

Intervention brevity [60, 76, 149, 166, 176, 179, 188, 189] and ease of use [65, 76, 137, 158, 166, 187-190] were reported amongst facilitating factors. Standardised paperwork and guidance [145, 177] and minimal required preparation [135] contributed to this ease of use. Mobile apps [173] and online resources [76, 150, 158] facilitated use [152]. Although multifaceted interventions were described as a facilitator of sustained change [148], the complexity that came with individualised and meaningful interventions [133], and co-ordination within ICU teams [155, 174] and between ICU teams and families [164] was found to be limiting. Even when a clear systematic process was provided, Santiago et al found steps dependent on family members limited implementation [170]. Some interventions' complexity meant that completion was difficult when intended consumers were busy [137, 150, 154]. Schwarzkopf et al reflected that additional system resources are needed when intervention is complex [143].

Relative advantage

"Stakeholders' perception of the advantage of implementing the intervention versus an alternative solution" [98].

Demonstrable or perceived benefit were seen as facilitating factors [76, 133, 137, 143, 144, 150, 162, 179]. Some groups found that intensive care staff not perceiving the need for or benefit from palliative care input as a hindering factor [40, 134, 136, 159, 179]. It was recognised that in these cases, an integrative model may be helpful [159, 179].

Evidence strength and quality

"Stakeholders' perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes" [98].

Authors described awareness of an intervention's evidence base, in theory or previously published materials, as a facilitating factor to implementation. [28, 42, 47, 48, 60, 140, 148, 154, 160, 163, 168, 180, 187, 189].

Intervention source

"Perception of key stakeholders about whether the intervention is externally or internally developed" [98].

Intervention source as a facilitator was reflected in stakeholders' involvement developing the intervention in multiple studies [28, 60, 65, 75, 137, 148, 149, 151, 152, 158, 160, 168, 177, 178, 180].

Intervention costs

"Costs of the intervention and costs associated with implementing the intervention including investment, supply, and opportunity costs" [98].

Low cost was a facilitator [47, 154, 165, 172, 187, 189], and if costs were a concern this was a barrier [76]. However, cost, particularly as a barrier, was not mentioned often.

7.1.3 OUTER SETTING:

Outer setting components were less referenced.

Patient needs and resources

"The extent to which patient needs, as well as barriers and facilitators to meet those needs, are accurately known and prioritized by the organization" [98].

Studies highlighted the importance of interventions targeting patients and family rather than only clinicians [61], and interventions that were applicable to all patients helped [27, 41, 60, 65, 75, 152]. The need to ensure multiple patients could benefit [169] and advocate for patient needs [141] was discussed. The importance of education to ensure knowledge of patient needs was considered [137]. As previously mentioned, it was acknowledged that critically ill patients may be sedated and so where interventions involved symptom assessment, implementation was hindered [27, 155].

External policy & incentives

"A broad construct that includes external strategies to spread interventions, including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting" [98].

This was seen most in cases where interventions worked to implement existing external policies and guidelines [29, 58, 141, 142, 148].

Few studies discussed contributions from the community (cosmopolitan) [40, 138] and one described interaction with those outside of the ICU about the intervention [138]. No studies discussed peer pressure.

7.1.4 CHARACTERISTICS OF INDIVIDUALS:

Individual's knowledge and belief about the intervention

"Individuals' attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention" [98].

This was the most recorded determinant. Drawing some similarity with relative advantage, reluctance was seen from ICU teams to consult palliative care within interventions due to perceptions of the meaning and consequence of palliative care [40, 75, 137, 144, 148, 166, 177], lack of familiarity, or trust [32, 134, 137, 169, 179, 186], the belief that involvement was not needed [40, 136, 144, 148, 154, 160, 172, 179], and the challenge to physician autonomy [144, 148]. There was a concern that an intervention during the dying process may be too invasive [187]. It was suggested that newer professionals who did not have to "change old behaviours" may be more amenable to the palliative care perspective [182]. Equally, palliative care physicians "outsider status" was referenced, and their lack of familiarity with the intensive care unit's biomedical and nursing aspects was seen as a hinderance [168]. Knowledge gaps preventing delivery of an intervention were noted amongst both palliative care and intensive care professionals, including when self-perceived [29, 134, 136, 139, 142, 143, 147, 169, 174, 186]. It was acknowledged that the inherent difficulties in precisely predicting clinical outcomes are magnified in the critically ill [40]. In contrast, if professionals could use transferable skills from their job role to perform the intervention, this was a facilitator [134, 135]. Familiarity of ICU staff with intensive care, and palliative medicine staff with palliative care [40], meant that their involvement was helpful. The intervention being seen as of value to staff and/or patients and families was a facilitating factor to implementation [76, 133, 138, 139, 143, 144, 147, 150, 155, 156, 160, 166, 169, 175, 181, 188]. For interventions that required family member participation, the acute situation and foreign environment was felt to hinder engagement with the process [134]. Interventions designed for all ICU patients were misconstrued as only for use at the end of life [177].

Self-efficacy

"Individual belief in their own capabilities to execute courses of action to achieve implementation goals" [98].

This can be seen as a factor for implementation. Intensive care teams' own level of comfort and preparedness in providing palliative care was suggested as a barrier to implementation [29, 40, 139, 142, 156, 166, 169, 179]. When this comfort improved, as did implementation [139, 166]. Opportunity to practice [182], and the presence of a palliative care team with more comfort in this area aided implementation [40]. A sense of ownership and feeling empowered was described to support success [138, 149, 175, 186]. It was noted that nurses felt that they had autonomy to implement an intervention that did not require a prescription from a physician [169]. As with comfort, as empowerment increased and stakeholders moved from needing instruction and conformation from project catalysts to implementing independently, this was a facilitating factor. Where nurses did not feel sure of what they were being asked to do, this hindered implementation [137]. There were some intervention specific barriers. Nurse discomfort with vulnerability when taking part in an intervention that supported them held some back from participation [147]. Where surrogate involvement was required for implementation, as for where the environment was previously mentioned as a hinderance, their own feeling of overwhelm was also noted to prevent participation [163].

Individual stage of change

“Characterization of the phase an individual is in, as he or she progresses toward skilled, enthusiastic, and sustained use of the intervention” [98].

The self-efficacy determinants felt by stakeholders described above could also be linked to their stage of change. Studies specifically mentioned progression through stages as facilitators to implementation. Rate of spread of the 3-wishes intervention was influenced by clinicians progressing through learning a new skill set [133]. Transition for stakeholders into engraining interventions into usual work was described [138, 139, 149, 175], and with experience, initial hesitancy was reported to dissipate [138]. Building capacity and skills of staff increased comfort with implementation [34, 160, 175] and as skill developed this led to assurance of personal value and further development [166]. Involving stakeholders in development discussions promoted engagement and enthusiasm [149, 169] and colleague enthusiasm was mentioned as a motivating factor [156]. In contract, lack of repetition and re-enforcement of implementation hindered the development progress and was seen as a barrier [139]. The identification and use of specialist skills has previously been mentioned when discussing available resources but could also be considered here.

Individual identification with Organisation

“A broad construct related to how individuals perceive the organization, and their relationship and degree of commitment with that organization” [98].

Studies discussed how ICU clinicians saw aspects of palliative care as their role within ICU and therefore were reluctant to recede the responsibilities [134]. Conversely, nurses felt their role did not encompass detailed psychosocial assessment [137] and that management of patients at the end-of-life is challenging when their usual focus is aggressively restoring health [142]. Myers et al described acute care nurses as “doers and fixers” with this same reflection [166]. Nurses felt able to be autonomous and independent with an intervention that did not involve prescribing medication and so was within their remit [169]. They also found a flat hierarchy during ward rounds facilitated their involvement [147]. Ensuring that all professionals felt involved with the intervention helped buy-in and was appreciated [148, 177]. Paradoxically, having both nurses and physicians involved led to concerns of conflict and confusion [75]. There was benefit reported when the implementation team were part of the ICU team or familiar with those working in ICU [141, 146, 162, 169]. In some cases, external professionals becoming accepted as a member of the ICU team was seen to have a positive impact [161, 166].

Other personal attributes

"A broad construct to include other personal traits such as tolerance of ambiguity, intellectual ability, motivation, values, competence, capacity, and learning style" [98].

Most components that fall under other personal attributes appear amongst other constructs discussed. Intellectual ability and competence are akin to knowledge and skill sets within individual stage of change [134-137, 139, 168, 169]. Values were referenced within beliefs around the intervention [156, 166, 177], and capacity to do the work aligns with available resources [35, 64, 76, 133, 134, 136-138, 141, 145, 148, 153, 161, 162, 165, 175, 176, 181]. Motivation was most referred to in conjunction with relative advantage [133, 169].

7.1.5 PROCESS:

Champions

"Individuals who dedicate themselves to supporting, marketing, and 'driving through' an implementation, overcoming indifference or resistance that the intervention may provoke in an organization" [98].

Champions were referred to in multiple studies [32, 40, 42, 47, 54, 66, 138-141, 144, 147-149, 152, 158, 168, 172, 174, 175, 182, 187]. The absence of champions was highlighted as a potential barrier to adherence [76]. Direct use of the term "champions" [47, 64, 66, 76, 138-140, 147, 152, 158, 168, 172, 174, 186] suggests an awareness of researchers around implementation science terminology and methodology.

Reflecting and evaluating

"Quantitative and qualitative feedback about the progress and quality of implementation accompanied with regular personal and team debriefing about progress and experience" [98].

Ongoing monitoring [48, 54, 59, 160, 161, 177, 181, 190], and regular reflection and updates for staff on implementation results [27, 76, 138, 175, 178, 180, 184], and patient outcomes following intervention [27, 41, 148, 155, 178] were helpful.

Engaging

“Attracting and involving appropriate individuals in the implementation and use of the intervention through a combined strategy of social marketing, education, role modelling, training, and other similar activities” [98].

Where stakeholders were engaged, this facilitated implementation [149, 155, 168, 171, 177, 178]. Difficulty engaging large teams was reported as a barrier [156], as was provision of informal information rather than planned engagement [153].

Planning

“The degree to which a scheme or method of behaviour and tasks for implementing an intervention are developed in advance, and the quality of those schemes or methods” [98].

Planning that considered consistency in educational sessions [142], timeframe of bereavement interventions to maximise benefit but minimise harm [163], commitment from stakeholders [148], location of family meetings to suit families and minimise disruption [159, 163] was beneficial. Sometimes despite planning, unforeseen changes hindered implementation [148, 158].

Opinion leaders

“Individuals in an organization who have formal or informal influence on the attitudes and beliefs of their colleagues with respect to implementing the intervention” [98].

These were not directly mentioned, but this closely links to leadership engagement previously discussed.

External change agents

“Individuals who are affiliated with an outside entity who formally influence or facilitate intervention decisions in a desirable direction” [98].

These were referred to once by Pavlish et al where national experts assessed protocol items to ensure relevance and appropriateness [62].

7.2 OBJECTIVE 2: IMPLEMENTATION STRATEGIES

As previously described, implementation strategies are “methods or techniques used to enhance the adoption, implementation, and sustainability” of an evidence-based intervention [89, 90]. Addressing objective 2; to identify and describe any specific implementation strategies reported, that have been used to address facilitators or constraints, when employing palliative care interventions within the ICU, reported strategies are described here using the ERIC headings [89].

7.2.1 TRAIN AND EDUCATE STAKEHOLDERS

Experts provided palliative care education including end-of-life care and communication [54, 59, 64, 75, 136, 137, 142, 144, 148, 154, 155, 159, 165, 177, 179, 188]. Education around the definition of palliative care, that “it is for all seriously ill patients and their families, focuses on quality of life, and can be provided concurrently with life-prolonging therapies” was specifically mentioned [75]. Teams worked with existing educational departments [59, 142]. It was also acknowledged that education of palliative care professionals around intensive care was important [168].

Training provided before the intervention was implemented was a common theme. This included research/intervention training about the trial itself [134, 164, 169] and presenting to leaders [28, 59]. Training on how to use the intervention included standardised written instructions, recorded material, face-to-face training, email, and was often multi-modal [47, 76, 137, 139, 141, 146, 148, 150, 156, 160, 169, 173, 179]. Training included the evidence behind the intervention [181], information about the people involved and their roles [34, 75], and clarification of terms [137, 169]. Informal conversations around the intervention [169] and slow supported enrolment [175] were discussed as strategies.

Ongoing and additional education throughout was discussed [27, 32, 133, 134, 138, 142, 145]. For example, resources such as posters, leaflets, and checklists, to refer to throughout [28, 29, 41, 54, 59, 66, 139, 146, 148, 164, 175, 188]. Ward rounds where experts attended regularly were educational opportunities [75, 134, 144, 155, 158, 177, 180]. Additional time for ongoing training, practice and re-exposure was planned [133]. Shifrin et al found it beneficial to have a single instructor teach all educational sessions [142].

Train-the-trainer strategies were used mostly with ICU nurses [29, 42, 75, 168]. There was reference to leveraging skills of national experts across the country [176]. Facilitators received training in required skills [54, 161] and were assessed regularly [54].

There were specific strategies for delivering educational interventions. Training involved multiple healthcare disciplines [141, 181, 186]. Knowledge gaps and the impact on patients were highlighted [137, 142, 148]. Teams took advantage of spontaneous learning opportunities [140]. Training took place on ward rounds to engage all members of the team and help to integrate into daily practice [155]. Online teaching and resources were made available [28, 140, 188] and training was designed to coincide with physician rotation and new staff orientation [181]. Training sessions were short and offered frequently [76, 140, 142, 162], sometimes scheduled on a rolling basis [182]. Delivery took place in a room close to the ICU [142, 150], but also not unit based as this was more neutral [151]. Multimodal and dynamic training methods including modelling, practicing and feedback on communication skills, training days, lectures and presentations, pamphlets, posters were used [47, 54, 64, 66, 140, 151, 156, 168, 176, 182, 184, 188, 190]. Interactive sessions were used, as well as facilitating discussion around the topic, and simulation [66, 75, 140, 156, 176]. It was felt that training should be targeted and case based where possible, rather than generalised [155].

There were multiple mentions of a learning collaborative, or a similar concept, between ICU and palliative care [136, 160, 180], within the intensive care unit [138, 151, 156, 175, 184], and areas outside of the ICU [138, 151, 160, 174, 184], such as surgical grand rounds [160]. This was done via huddles, newsletters, bulletin boards [138, 175]. Morbidity and mortality meetings provided a setting for this working in multiple cases [27, 41, 155, 180].

7.2.2 INTERACTIVE ASSISTANCE

This appears to be closely linked to training and educating stakeholders. Facilitation was discussed in terms of onsite coaching and implementation support [47, 54, 148, 168] in one case from an implementation specialist [47]. Facilitators were present to re-enforce teaching and address questions [34, 75, 139-141, 180]. Having this support readily available, through selecting existing members of the ICU team [34, 47, 140, 141, 148], or having a researcher present on the unit [139, 164] was discussed. It was noted that these facilitators should be a neutral person for staff to be able to approach [147, 162]. Again, efforts were required to integrate facilitators outside of ICU team into the team [161]. Regular meetings or calls were held to discuss challenges and help develop strategies [47, 59, 75, 172, 177, 184]. Clinical supervision was also mentioned, usually lead nurses supervising bedside nurses [148] or palliative care teams supervising ICU teams [140, 148, 155, 167]. This included emotional support for clinicians [34].

7.2.3 SUPPORT CLINICIANS

Managers created space and time for the intervention to be implemented [76, 138, 139, 151, 168]. Staff were reminded of resources [140, 175] and of the project via informal unit visits, posters, and huddles for example [28, 140, 156, 164]. This was important at times of changeover [178]. Clinicians were supplied with data regarding the intervention and their work is discussed later under evaluative and iterative processes.

New clinical teams were created by adding in new roles [40, 134], for example family support specialist to compliment and extend the existing team [54, 134], interprofessional teams with different backgrounds [138, 149, 151] and ICU and palliative care partnerships [158]. Palliative care team members were integrated into the ICU team [34, 64, 159]. It was important that these new members were introduced as part of the team to families [40], and integrated into the ICU team [41]. Patients who may benefit from palliative care intervention were identified collaboratively with social workers, pastoral care and nursing staff [164]. It was acknowledged that in centres with fewer ICU beds and therefore fewer deaths, a full-time palliative care post may not be needed [40]. A suggestion was made for part-time roles combined with high volume areas such as the Emergency Department [40]. Where interventions increased demand, more clinicians were hired [157].

As well as the creation of new teams, existing roles were altered. Hospital palliative care teams were utilised as an existing resource [29, 58]. It was suggested that bringing palliative care experts directly into the care of individual critically ill patients and their families would increase intervention effectiveness [64]. However, recognising the potential limitation of access to specialist palliative care, ICU teams were also facilitated to practice primary palliative care [47, 58, 134, 181]. The ICU nurse role changed to include delivering the palliative care intervention [134, 168, 171] due to the nursing ethic of caring and family-centredness as well as their presence on the unit [134]. Nurses often completed the “trigger” of the intervention and alerted the rest of the team [62] and were encouraged to advocate for patients [141]. It was important to have their role clearly outlined [75]. Training existing ICU teams to take on communication roles [47], or building on existing spiritual teams [170] was reported. For an intervention that required nurses to reflect on their own experiences, having a flat hierarchy on rounds encouraged engagement [147].

7.2.4 ADAPT AND TAILOR TO CONTEXT

Planning meetings were described to adapt to context [65, 139]. There were aspects of forward planning identified as facilitating factors. Planning a single instructor for consistency in educational sessions [142], timeframe of bereavement interventions to maximise benefit but minimise harm [163], the use of predefined protocols [41, 62, 159], obtaining pre-commitment from stakeholders [148], and organising the location of family meetings to suit families and minimise disruption [159, 163]. Sometimes despite planning, unforeseen changes hindered implementation [148, 158]. Institutions focused on positive patient experience [138], interventions were tailored to individual families [134] and designed with patient and family needs in mind [152]. Information needs [144], access to interventions out of hours [161] real life impact of scoring systems [146] and timing and location of bereavement interventions for example [163].

Having an open mind towards innovations enabled progress [156]. Previously validated methods were adapted to the ICU setting [152]. Interventions were designed so that different clinical roles can step in if one if unavailable [32, 154, 170, 178] and interventions altered depending on the consumer needs [75, 133, 134, 145, 172, 173, 182, 184]. For example, enabling wishes requested by patients and families [133], an adaptable script for communication interventions [48, 141], a nurse led intervention not requiring a doctor's order [169], the option to select from a range of activities [150, 182], using patient-centred language [75], the contents of a comfort cart tailored for the family [169], and educational interventions tailored to skills or experience [173]. Interventions were modified through stakeholder input to suit the local context [65, 137, 148, 152, 157, 163, 179]. For example, screens to identify patients tailored to the specific unit [27, 137, 148, 152, 179]. If family members were not able to attend the hospital, intervention procedures were implemented by telephone to increase reach [134, 163]. The time and location for in person interventions was made flexible too to overcome time constraints for staff and availability or emotional conflicts for families [29, 40, 48, 76, 150, 161, 163, 166, 182, 188]. Leaders allowing this flexibility helped [138, 139, 151, 167, 168]. Online format made this easier [150]. Sharing these adaptations facilitated spread of implementation [138].

It was recognised that different ICU sites would need different strategies [174]. Meetings were held to formally discuss barriers and devise strategies to directly address them [140, 147]. Having a "grassroots approach" with permanent staff who were integrated into ICU and end-of-life care involved in implementation helped identify unit-level issues [151].

Making intervention content applicable to all consumers increased engagement [147]. Focus for strategies was placed on process of care and communication amongst existing structures and teams rather than adding in new personnel [41, 155]. Physical tools were moved to a more accessible position [169]. Adapting to focus on the use of available resources meant implementation was more achievable [133]. To overcome time constraints, advance notice, and consideration of feasibility, was given ahead of meetings with clinicians [134]. Classes were offered at varying durations, times, and locations [142].

A tailored combination of aspects from integrative and consultative models of integration made good use of resources [136]. Location for medical grand rounds was flexible and guided by local champions [140].

Apps and electronic health records were used [137, 173], as well as electronic protocols [145], implementation tools [139], and auto generated of scoring systems [146] that could be integrated into electronic systems. Progress was hindered when this could not be done [148].

7.2.5 DEVELOP STAKEHOLDER INTERRELATIONSHIPS

Use of advisory boards and/or workgroups to inform the intervention and resources was common, usually combining palliative care and intensive care professionals [29, 32, 42, 60, 62, 65, 136, 138, 142, 148, 156-158, 171, 175, 181, 184]. ICU and palliative care teams working together to develop and implement the intervention led to sustained working [65, 151, 180]. Organising specific implementation meetings allowed planning of efficient and effective strategies [59, 139, 156, 161]. Local consensus meetings helped to identify barriers and strategize for them, as well as inform and reform intervention and implementation design [28, 42, 59, 60, 65, 75, 76, 137, 139, 140, 148, 151, 152, 156, 157, 168, 169, 177, 178].

Identifying and building on the existing working relationships between the ICU team and the palliative care team was important [29, 65, 135, 155, 160, 178, 179, 181]. Meetings organised between interprofessional teams promoted this collaboration [62, 133, 160, 177, 178, 184]. Palliative care professionals were present to simulate the desired behaviours, such as use of screens and communication [144, 155, 159, 167], demonstrate benefit [135, 179], and provide education to the ICU team [137, 142]. Palliative care teams relationship with hospice was used to mobilise hospice staff to ICU [40]. It was also important for the research team to develop a relationship with stakeholders by providing evidence-based information [28, 168].

Teams shared local knowledge [34, 59, 79, 138, 151]. Having a common meeting platform, such as grand rounds, to share regular updates was pivotal to collaboration [160, 168, 171]. Partnerships with schools of nursing [139, 164] and other supportive departments such as food services and engineering [169] were developed. Implementation advisors were available to support ICUs to track implementation and with communication amongst team members [47], program design and workshop facilitation [156]. These were also termed project catalysts [175].

Executive board involvement and approval helped to endorse interventions and encourage engagement through communication of their support and providing space and time [47, 138, 139, 141, 142, 156, 171, 180]. Commitments were obtained from the institution [76, 155], or necessary departments [148]. In one case, there was an institutional commitment to palliative care education, noted to be instrumental to success [155]. Commitment was gained from the Information Technology department during planning stages [148].

Local opinion leaders such as program directors and unit management teams were consulted through meetings to discuss the intervention [59, 75, 76, 135, 140, 148, 156]. Engaging these opinion leaders gave access to physicians, nurses, and patients [168]. Senior physicians were recruited to inform junior physicians of the importance and value of the intervention [135]. Ensuring lead nurses were involved helped to ensure engagement of bedside ICU nurses [75, 76, 141, 148, 169].

Researchers recruited individuals according to their skills and trained them for leadership roles [47, 59, 75, 148, 156]. For example, ICU nurses with strong communication skills [47], and those with palliative and intensive care expertise [59, 75].

Identification and preparation of champions helped promote the intervention and assist in implementation challenges [32, 40, 42, 47, 54, 66, 138-141, 144, 147-149, 152, 158, 168, 172, 174, 175, 182, 187]. Champions rolls included, involvement of palliative care team members attending daily rounds to counter resistance [32, 144], leadership and assistance with implementation challenges or questions [47, 140, 144, 147, 172, 182, 187], teaching [139, 141], ongoing encouragement [138, 139, 141], creating staff partnerships [175], informing local plans for implementation [42, 140, 174], and integration into usual practice for sustained adherence [40, 148, 152, 158, 175, 182]. Nurses were described as overseeing or facilitating interventions due to specific skill sets such as communication [47, 148] and their consistent presence on the units [139, 147, 148, 152]. Other champions included social workers, spiritual care providers, respiratory therapists, and physicians [54, 66, 140, 158].

Use of an implementation glossary was not directly mentioned but the need to clearly define roles was [75, 165]. There was only one mention of visiting other sites to seek successful strategies [32].

7.2.6 ENGAGE CONSUMERS

Engaging key stakeholders was described as an important step [155, 171, 178]. Examples of engagement methods include collaborators' lunches [177], pre-training before implementation [149], and showcasing previous involvement at a national meeting [168].

Early adopters were identified to take part and role-model implementation through their clinical leadership [75, 156, 168, 175]. Efforts were made to transition the intervention from research project to part of clinical care [175]. Recognising the potential burden of the intervention on family members was important during intervention design [163].

Encouraging participation by all patients and close relatives aided family meeting success [159]. Given the sudden onset and rapid trajectory of trauma, and recognising that there is the potential for complex needs from admission to ICU, interventions were designed to be applicable to all patients, from the start [27, 41, 60, 65, 154]. Educating families around the role of palliative care in the ICU was suggested to avoid aggressive and burdensome measures at the end of life [154]. Patient centred language was used [75] and monetary reward for engaging was provided as described under financial strategies.

Researchers intervened to increase implementation by giving more advanced notice to clinicians for family meetings, and ensuring a suitable time for the family [134]. The use of mass media to engage consumers was only mentioned once where a videotaped interview of selected nurses was shown as a national nurses meeting to successfully aid recruitment to a training program [168]. Only one study described creating a policy for implementation to sustain their intervention [181]

7.2.7 USE EVALUATIVE AND ITERATIVE STRATEGIES

A formal implementation blueprint was not directly mentioned, but researchers discussed formulating a plan [139], and determining logistically how to implement the intervention [157].

Local needs assessments were conducted [76, 142, 160, 184], and model of delivery selected based on need [58]. As highlighted by the determinants data, barriers and facilitators were often discussed. Details of a formal process of assessing readiness for implementation, identifying barriers and facilitators were not as common. Meetings with staff who knew the intensive care unit were held pre-implementation to discuss barriers and strategise for them [64, 140, 152, 156, 177]. Some were led by implementation experts [156]. Lessons from previous projects [142, 176] or the use of a pilot, or "run-in phase" [62, 149, 187] helped to identify and reduce barriers. Once implementation was underway, regular discussions to troubleshoot barriers also occurred [59, 75, 147, 156]. Iterative methods were used to refine intervention components such as screening tools, communication protocols, and comfort cart contents [62, 75, 134, 137, 139, 145, 163]. Presenting the same educational material on three consecutive days was questioned when interest appeared to wane [166].

Regular implementation meetings were held to review data and discuss experiences and behaviours [48, 54, 75, 136, 160, 161, 184]. ICU staff were given feedback on their results [48, 59, 64, 140, 156, 175], and results for other units [140]. These were given as part of educational components [140, 175], newsletters [175], and within morbidity and mortality meetings [27, 41, 155, 180]. Favourable results were emphasised and lower results were presented as opportunities for improvement [140]. Palliative care teams fed back to ICU teams about patient outcomes [178], and provided feedback on communication skills [75, 190]. Having data that was easily accessible helped facilitate this process [145]. Data was also presented to management and the wider organisation [76, 151]. Feedback from families was also given [64, 140, 175]. One study discussed developing a record to track nurse and patient data [75]. Conducting small cycle tests of change made use of this data [75, 148, 169, 170]. This is also closely linked to staging implementation scale ups. For example, a comfort cart intervention was trialled with one nurse for one patient before the implementing nurse gave feedback [169], and screening tools were piloted before wider spread use [62, 149]. A one-month implementation phase was used to allow practice and to highlight any difficulties [187].

7.2.8 UTILIZE FINANCIAL STRATEGIES

It was discussed how securing funding required ingenuity [138]. Research grants [138, 164], small corporate grants or contributions for supplies [138, 164, 169], and institutional grants and sponsorship [59, 75, 141, 151] were sought. The importance of teaching staff the grant application process was highlighted [164]. Charitable donations supported some implementation efforts [138, 164]. Participants were paid to take part in an intervention [152, 163, 185, 190]. Sometimes, food was used an incentive [148, 151]. The cost savings of providing palliative care were highlighted to management to encourage buy in [154].

Shared resources were made available but perhaps not used by all ICUs [140]. Pre-implementation agreements with helpful departments such as engineering, management, food services, palliative care, and risk management meant an intervention implementing a comfort cart had access to resources [169]. The palliative care team devoted resources, such as making hospice staff available [40], their time, and administrative work [168].

7.2.9 CHANGE INFRASTRUCTURE

Certificates of completion [185] and education credit [75] were awarded by organisations for the intervention. Change to physical structure or equipment was utilised in some cases. Door magnets were used to identify dying patients [175]. The physical location of equipment was changed to a more centralised location [169, 170]. One of the ICU rooms was transformed to a more home-life atmosphere [169]. Changing record systems such as how discussions and daily rounds were recorded [75, 158, 159, 168, 181], referral forms to palliative care [64, 171] and the novel use of apps [76] or electronic tools as prompts [158] were discussed. Electronic records were also used to automate parts of interventions such as patient identification [152].

7.2.10 OTHER

Other strategies that were not felt to fall under the ERIC categories related to intervention design. Groups ensured the intervention was low cost in terms of money, resources, and burden [47, 76, 163, 165, 172, 187, 189]. Interventions were specifically designed to be a quick, easy-to-use, and accessible intervention [135, 139, 145, 163, 166, 173, 177, 179, 187]. Making the protocol available on the intranet [139], standardised order sets [145], and pre-filled prescriptions [177] are some examples. Theory [47, 64, 161, 164] or evidence [29, 42, 47, 48, 60, 75, 140, 142, 145, 148, 150, 154, 159, 160, 163, 166, 168, 169, 177, 178, 180, 181, 187, 189] was used to ground and inform the interventions.

7.3 OBJECTIVE 3: CAUSAL RELATIONSHIPS AND MECHANISMS

Mechanisms are the processes through which an implementation strategy affects implementation outcomes [92]. Objective 3; to explore the effect of these strategies on implementation and outcomes, refers to these mechanisms by which the strategies work. Table 7 addresses objective 3; to explore the effect of these strategies on implementation and outcomes by presenting the relationships between determinants, implementation strategies, and their mechanisms.

Table 7: Reported determinants, implementation strategies, and mechanisms

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
CFIR construct: Inner setting								
Available resources	Having adequate time or space for the intervention	+	[138, 139, 151, 167, 168]	ICU leaders allocating time or space for the intervention	[138, 139, 151, 167, 168]	c		
				Training sessions short and offered frequently	[76, 140, 142, 162]	a		
				Taking spontaneous learning opportunities	[140, 155]	a		
				Advance notice given ahead of meetings with clinicians	[134]	d	Increased chance of family and clinician attendance	[134]
				Training sessions could be given at varying times and places	[142, 185]	d		
				Utilising tailored combination of consultative and integrative model	[136, 181]	d	Maximised use of available resources	[136]
				Autogenerating scoring systems electronically				
	Access to specialist palliative care team	-	[29, 35, 40, 134, 154, 157, 158]	Developed new clinical roles such as family support specialist	[54, 134]	c	Overcome not having specialist palliative care team	[54, 134]
				Facilitate ICU teams to practice primary palliative care	[47, 58, 134, 181]	c		
		+	[29, 40, 58, 134, 140, 159, 160]	Ward rounds where experts attended regularly	[75, 134, 144, 155, 158, 159, 167, 177, 180]	a, e	Provided educational opportunities to assess and be asked questions	[179]
							Could simulate desired behaviours, such as use of screens and communication	[179]
	Lack of recruitment efforts	-	[141, 142]	Implementation was paused for recruitment	[157]	a		
	Out of hours access to professionals required for the intervention	-	[143, 166]					
		+	[40, 163, 164]					
	Lack of physical or electronic resources	-	[138, 150, 152, 160, 168-173]	Moving physical tools to a more accessible place	[169, 170]	d	Allowed more use	[169, 170]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
				Data warehousing: - Development of an app - Using/integrating into existing electronic records	[173] [137, 139, 145, 146]	c	Convenient, and allowed automation	[152]
				Use of advisory boards and/or workgroups, usually combining palliative care and intensive care professionals	[29, 32, 42, 60, 62, 65, 136, 138, 142, 148, 156-158, 171, 175, 181, 184]	e	Lead to sustained working	[65, 151, 180]
				Developing an academic partnership with schools of nursing	[139, 164]	e	Enabled access to more resources	[139, 164]
				Securing research grants, small corporate grants or contributions for supplies, and institutional grants and sponsorship	[59, 75, 138, 141, 151, 164, 169]	h		
				Focus on process of care and communication amongst existing structures and teams rather than adding in new personnel	[41, 155]	d	Allowed replicability in other units	[41, 155]
Compatibility	Busyness and acuity of intensive care units	-	[27, 32, 64, 76, 133-155]	Training taking place in a room close to the ICU	[142, 150]	a		
				The time and location for in person interventions was made flexible	[29, 40, 48, 76, 150, 161, 163, 166, 182, 185, 188]	d	Overcame time constraints for staff or time/emotional conflicts for families	[76, 159, 163]
							Maximised attendance	[140]
				Interventions designed to be applicable to all patients, from the start of admission	[27, 41, 60, 65, 154]	f	Encouraged integration into daily work	[155]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
				Embed intervention into usual care	[27, 34, 58, 60, 62, 138, 155, 158, 161, 175, 176]	d		
				Local consensus meetings with staff who knew the ICU	[28, 42, 59, 60, 65, 75, 76, 137, 139, 140, 148, 151, 152, 156, 157, 168, 169, 177, 178]	g	Discuss barriers and strategise for them	[140]
				Designing the intervention so that different clinical roles can step in if one is unavailable	[32, 154, 170, 178]	d		
				See "Complexity"				
	Sedated and ventilated patients	-	[27, 155]					
	Interventions involving ICU nurses	+	[134, 169, 178]	Train-the-trainer involving ICU nurses	[29, 42, 75, 168]	a		
Networks and Communications	Interprofessional approaches	+	[62, 75, 149, 151, 155, 165, 168, 177]	Developing multidisciplinary teams with different backgrounds	[138, 149, 151]	c		
				Recruit collaboratively with social workers, pastoral care, and nursing staff	[164]	c	Helped gain clinician support	[164]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
				Identify and build on existing relationships	[29, 65, 135, 155, 160, 164, 178, 179]	e		
				Local knowledge was shared	[34, 59, 79, 138, 151]	e	Helped to co-ordinate efforts	[148, 160]
				Having a common meeting platform, such as hospital grand rounds	[160, 168, 171]			
	Symbiotic relationship between ICU and palliative care	+	[29, 58, 65, 158, 160, 171, 178-180]	Interprofessional learning such as review in morbidity and mortality meetings	[27, 41, 155, 180]	a		
				ICU and palliative care teams worked together to develop and implement the intervention	[65, 75, 151, 158, 160, 180]	e	Intervention more likely to be sustained	[65, 151, 180]
							Increased access to palliative care for patients	[158, 160]
							Reduced mixed messages to families	[75]
				Education around palliative care for ICU teams	[137, 142]	e	Allowed effective collaborative working	[137, 142]
				Ward rounds where experts attended regularly	[75, 134, 135, 144, 155, 158, 177, 179, 180]	e	Demonstrate benefit and build trust	[134, 162]
Culture	Previously fixed culture of team structure and roles	-	[134]	Integrate any new clinical roles into the ICU team	[40, 41]	c	Builds trust	[134]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
				Local consensus meetings	[28, 42, 59, 60, 65, 75, 76, 137, 139, 140, 148, 151, 152, 156, 157, 168, 169, 177, 178]	e	Ensure intervention tailored to culture	[27, 137, 148, 152, 179]
	Culture emphasising the importance of palliative care	+	[138, 148, 182]					
	Formation of new norms	+	[149, 165, 175]	Integrate into normal practice	[27, 134, 155, 165]	a	Gained comfort and placed value	[165]
	ICU focusing on restoring health	-	[40, 142, 166, 174, 177]					
Structural characteristics	Shift-based nature of ICU and high staff turnover	+	[27, 29, 134, 136, 149, 151, 155, 165, 175, 177, 182]	Multimodal and dynamic training	[47, 54, 64, 66, 140, 151, 156, 168, 176, 182, 184, 188, 190]	a	Allowed those who could attend sessions to catch up with online teaching and resources	[28, 140, 188]
				Coincide training with physician rotation and new staff orientation	[178, 181]	a		
				Scheduling training on a rolling basis	[182]	a	Helped reach evening and night shift staff	[182]
	Small centres (hard to manage workload with resources)	-	[138, 158]	Dual ICU and Emergency Department palliative care role	[40]	c	Reduces required resources in small centres	[40]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
	Large centres (hard to disseminate messages)	-	[138, 156]					
Leadership engagement	Hospital and ICU leader involvement	+	[59, 75, 76, 134, 140, 141, 148, 156, 169, 178]	Presenting to leaders pre-implementation	[28, 59]	a	Helped to endorse interventions and encourage engagement through communication of their support and providing space and time	[151, 180]
				Meetings held to consult local opinion leaders such as program directors and unit managers	[59, 75, 76, 135, 140, 148, 156]	e	Gave access to physicians, nurses, and patients they lead	[168]
				Ensuring lead ICU nurses are involved in implementation	[75, 76, 141, 148, 169]	e	Helped engagement of bedside nurses	[148]
				Present results to management and wider organisation	[76, 151]			
Access to knowledge	Access to information on how to use/carry out the intervention	+	[34, 42, 59, 75, 137, 139, 140, 144, 150, 159, 164, 167, 169, 173]	Use of written instructions, recorded material, face-to-face training, email, often multi-modal	[47, 76, 137, 139, 141, 146, 148, 150, 156, 160, 169, 173, 179]	a		

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
				Resources, such as posters, leaflets, and checklists, to refer to throughout	[28, 29, 41, 54, 59, 66, 139, 146, 148, 164, 175, 188]	a		
				Facilitation – onsite coaching and implementation support	[47, 54, 148, 168]	b		
	Lack of understanding of intervention	-	[138, 139, 174]	Terms clarified	[137, 169]	a		
				Regular meetings or calls with ICU staff to discuss challenges	[47, 59, 75, 172, 177, 184]	b	To help develop ICU specific strategies	[64, 140, 152, 156, 177]
				Remind staff of resources and of the project via informal unit visits, posters, and huddles for example	[28, 140, 156, 164, 175]	a		
	Limited educational time in ICU	-	[140, 143]	Working with existing educational departments	[59, 142]	a		
				Planning a single instructor in educational sessions	[142]	d	Provided consistency	[142]
Implementation climate	Strong institutional support	+	[64, 75, 178]	Obtain formal commitment from the institution or department	[76, 148, 155]	e		
				See “leadership engagement:				
	ICU team reluctance to palliative care involvement	-	[32, 40, 134, 144, 156, 179]	See “relative advantage”				
	High pressure environment	-	[40, 139, 143, 177]	See “compatibility”				

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
Readiness for implementation	Formal commitment from leadership	+	[47, 76, 138, 139, 141, 151, 155, 168]	Obtain formal commitment from the institution or department	[76, 148, 155]	e	Helped to endorse and increase engagement	[76, 148, 155]
Relative priority	Intervention aligns with organisational goals/priorities	+	[28, 76, 135, 138, 141, 148]	Research/intervention training about the trial itself	[134, 164, 169]	a		
				Researchers developed relationship with stakeholders to align with overall health system goals	[28, 168]	e		
	Prioritisation of life saving treatment over palliative care	-	[142, 143, 165]	Interventions designed to be applicable to all patients, from the start of admission	[27, 41, 60, 65, 154]	f		
	Patient care activities prioritised over efforts for change	-	[40, 139, 140, 143, 154]					
Organisational incentive and rewards	Incentives provided	+	[75, 185]	Educational rewards (certificates/education credit)	[75, 185]	f		
Tension for change	No perceived need for change	-	[40, 144, 148, 154, 160, 166, 172, 177, 179, 186]	Conduct local needs assessment	[76, 160]	g	Demonstrated need for palliative care in ICU	[76, 160]
	Perceived need for change	+	[34, 76, 136, 142, 148, 155, 156, 168, 169]					
				Highlight knowledge gaps and impact on patients	[137, 142, 148]	a		[136, 142, 155]
Learning climate	Feelings of ownership and empowerment	+	[138, 149, 175, 186]					
	Opportunity to ask questions		[140, 143]	Slow supported enrolment	[175]	a		

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
		+		Ward rounds where experts attended regularly	[75, 134, 144, 155, 158, 177, 180]	a	Provided educational opportunities to assess and be asked questions	[179]
	Support in times of distress	+	[147, 158, 162]	Clinical supervision and emotional support	[34, 140, 148, 155, 167]	b		
	Over formality	-	[147]					
Goals and feedback	Clearly defined goals	+	[59, 178]					
	Feedback given following implementation	+	[27, 41, 59, 138, 140, 167, 175, 177, 178, 180]					
CFIR construct: Intervention characteristics								
Adaptability	Intervention that could be provided by multiple team members	+	[32, 163, 170-172]	Designing the intervention so that different clinical roles can step in if one is unavailable	[32, 154, 170, 178]	d		

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
	Intervention that allowed adaptions to be made (e.g., place, time, delivery method)	+	[29, 48, 62, 134, 147, 150, 152, 161, 163, 166, 169, 176, 182, 184, 187]	Designing an intervention tailored to consumer needs e.g.: - Adaptable script for communication interventions - Educational interventions tailored to skills or experience - Physical contents to meet family needs	[75, 133, 134, 145, 172, 173, 182, 184] [48, 141] [173] [169]	d		
				Interventions were modified through stakeholder input e.g.: - screens to identify patients tailored to the specific unit - telephone if face-to-face not possible	[65, 137, 148, 152, 157, 163, 179] [27, 137, 148, 152, 179] [134, 163, 187]	d		
				The time and location for in person interventions was made flexible	[29, 40, 48, 76, 150, 161, 163, 166, 182, 188]	d	Overcome time constraints for staff or time/emotional conflicts for families	[76, 159, 163]
				Iterative methods were used to refine intervention components (e.g. screening tools, communication protocols, and comfort cart contents)	[62, 75, 134, 137, 139, 145, 163]	g		

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
Complexity	Brief intervention	+	[60, 76, 149, 166, 176, 179, 188, 189]	Interventions specifically designed to be a quick and easy-to-use	[135, 139, 145, 163, 166, 173, 177, 179, 187]	j	Allowed greater access for busy ICU staff	[135]
	Easy to use intervention	+	[65, 76, 137, 158, 166, 187-190]	Auto generation of scoring systems	[146]	d		
				Use of electronic health records and systems	[137, 139, 145, 146]	d		
				Change to physical structures e.g.: - Door magnets to identify dying patients - Move physical assets to central location - Re-purpose rooms	 [175] [169, 170] [169]	i		
				Changing record systems	[64, 75, 76, 158, 159, 168, 171, 181]			
				Standardised order sets	[145]	j		
				Pre-filled prescriptions	[177]	j		
				Making the protocol available on the intranet	[139]	j		
Relative advantage	Demonstrable or perceived benefit to stakeholders	+	[76, 133, 137, 143, 144, 150, 154, 162, 179, 191]	Palliative care attending ICU ward rounds	[75, 134, 135, 144, 155, 158, 177, 179, 180]	a	Demonstrated benefit Provided opportunity for reflection on the importance of the intervention	[134, 162] [27]
				Conduct local needs assessment	[58, 142, 184]	g	Focused intervention and model on local needs and concerns	[58, 184]
				Give ICU staff results feedback	[48, 59, 64, 140, 156, 175]	g		
				Provide feedback specifically from family	[64, 140, 175]	g		
	No perceived benefit of palliative care input	-	[40, 134, 136, 159, 179] [40, 134, 136, 179]	Palliative care teams fed back to ICU teams about patient outcomes post ICU	[178]	g		
				Use of integrative or mixed model	[136, 159, 179]		Helped buy in where ICU team don’t feel external input needed	[159, 179]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
Evidence strength and quality	Interventions grounded in theory or evidence	+	[29, 42, 47, 48, 60, 64, 75, 140, 142, 145, 148, 150, 154, 159-161, 163, 164, 166, 168, 169, 177, 178, 180, 181, 187, 189]	Provide stakeholders with evidence-base of intervention	[28, 168]	e		
				Use theory or evidence to ground and inform interventions	[29, 42, 47, 48, 60, 64, 75, 140, 142, 145, 148, 150, 154, 159-161, 163, 164, 166, 168, 169, 177, 178, 180, 181, 187, 189]	j		
Intervention source	Development process involving stakeholders	+	[28, 60, 65, 75, 137, 148, 149, 151, 152, 158, 160, 168, 177, 178, 180]	Use of advisory boards and/or workgroups, usually combining palliative care and intensive care professionals	[29, 32, 42, 60, 62, 65, 136, 138, 142, 148, 156-158, 171, 175, 181, 184]	e	Promoted engagement and enthusiasm	[149, 169]
				Local consensus meetings	[28, 42, 59, 60, 65, 75, 76, 137, 139, 140, 148, 151, 152, 156, 157, 168, 169, 177, 178]	e	Informed and reformed intervention and implementation design	[163]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
Cost	Low cost	+	[47, 154, 165, 172, 187, 189]	Ensure the intervention is low cost in terms of money, resources, and burden	[47, 76, 163, 165, 172, 187, 189]	j	Aided sustainability	[76]
	Costs a concern	-	[76]	Highlight cost savings of providing palliative care to management	[154]	h	Increased buy in	[154]
CFIR construct: Outer setting								
Patients' needs and resources	Focus on life-saving care needs rather than parallel care	+	[142, 143, 165]	Interventions designed to be applicable to all patients, from the start of admission	[27, 41, 60, 65, 75, 152]	f	Allowed early communication and family support	[41]
				Educating families around the role of palliative care in the ICU	[154]	f	Avoided aggressive and burdensome measures at the end of life	[154]
	Difficultly assessing sedated patients	-	[27, 155]					
External Policy and Incentives	Policy for implementation	+	[181]	Create a policy for implementation	[181]	f	Aided sustainability	[181]
Cosmopolitan	Contributions from the community	+	[40, 138]	Utilise palliative care team relationship with hospice	[40]	e	Hospice provided resources	[40]
	Interaction about the intervention outside of the ICU	+	[138]	Visit other sites	[32]		Allowed sharing of successful methods	[138]
CFIR construct: Characteristics of individuals								
Knowledge & Beliefs about the Intervention	ICU team negative perception of the meaning and consequence of palliative care	-	[40, 75, 137, 144, 148, 166, 177]	Referrals based on trigger/screening system	[27, 137, 148, 152, 179, 180]		Separated out any sense of responsibility about adverse outcomes	[180]
	ICU lack of familiarity or trust with palliative care	-	[32, 134, 137, 169, 179, 186]	Create a learning collaborative between ICU, treating teams and palliative care	[136, 138, 151, 156, 160, 174, 175, 180, 184]	a		

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
				Palliative care attending ICU ward rounds	[75, 134, 135, 144, 155, 158, 177, 179, 180]	a	Built trust	[134, 162]
	ICU belief that palliative care input is not needed	-	[40, 136, 144, 148, 154, 160, 172, 179]	Review in morbidity and mortality meetings	[27, 41, 155, 180]	a	Ensured understanding of the role of palliative care as part of usual practice Increased buy in	[155, 180] [27, 41]
				Provide stakeholders with evidence-base of intervention	[28, 168]	e	Increased perceived benefit	[28, 168]
				See “relative advantage” and “tension for change”				
	Perceived challenge to ICU physician autonomy	-	[144, 148]					
	Palliative care lack of familiarity with the intensive care unit’s biomedical and nursing aspects	-	[168]	Palliative care attending ICU ward rounds	[75, 134, 135, 144, 155, 158, 177, 179, 180]	a	Facilitated learning about ICU setting	[168]
	Knowledge gaps	-	[29, 134, 136, 139, 142, 143, 147, 169, 174, 186]	Providing palliative care education by experts, including end-of-life care, communication	[54, 59, 64, 75, 136, 137, 142, 144, 148, 154, 155, 159, 165, 177, 179, 188]	a		
				Multimodal and dynamic training including modelling, practicing and feedback on communication skills, training days, lectures and presentations, pamphlets, posters	[47, 54, 64, 66, 140, 151, 156, 168, 176, 182, 184, 188, 190]	a	Met various learning needs and maintained motivation	[151]
	Stakeholder belief that there is value in the intervention	+	[76, 133, 138, 139, 143, 144, 147, 150, 155, 156, 160, 166, 169, 175, 181, 188].	Training included the evidence behind the intervention	[181]	a		
				See “relative advantage” and “tension for change”				

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
Self-efficacy	ICU professionals' level of comfort and preparedness with providing palliative care	-	[29, 40, 139, 142, 156, 166, 169, 179]	Clinical supervision. Usually lead nurses supervising bedside nurses or palliative care teams supervising ICU teams	[140, 148, 155, 167].	b		
	Improvement in comfort providing palliative care	+	[139, 166]					
	Sense of ownership and empowerment	+	[138, 149, 175, 186]	Education involved nurses and doctors	[141, 181, 186]	a	Empowered nurses to provide palliative care too	[169, 186]
				Encourage nurses to advocate for patients	[141]	c		
Individual stage of change	Transition for stakeholders into engraining interventions into usual work	+	[138, 139, 149, 175]	Having an implementation advisor available	[47, 156, 175]	e	Supported ICUs to incorporate the intervention into existing workflows	[47, 156, 175]
				Supporting transition from research project to standard clinical care	[175]	f	Made family engagement more intentional	[175]
	Building individual capacity and skillset	+	[34, 133, 138, 160, 166, 175]	Palliative care attending ICU ward rounds	[75, 134, 135, 144, 155, 158, 177, 179, 180]	a	Provided education and modelled behaviour	[75, 134, 144, 155, 158, 177, 180]
				Palliative care teams provided feedback on communication skills	[75, 190]	g		
	Lack of repetition and re-enforcement	-	[139]					
Individual Identification with Organization	ICU clinicians' perception of palliative care as their role within ICU and therefore reluctant to recede the responsibilities	-	[134]	Clearly define roles	[75, 165]	c		
				Promote synergy between ICU and palliative care teams	[29, 181]		ICU teams could deliver primary palliative care so consulting palliative care teams could see complex cases	[29, 181]
	Palliative care not felt to be part of ICU role	-	[137, 142, 166]	Change ICU nurse role to include delivering the palliative care intervention	[134, 168, 171]	c	Worked due to the nursing ethic of caring and family-centredness as well as their presence on the unit	[134]
	Perceived autonomy to conduct intervention	+	[169]					

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
	Implementation team being part of the ICU team or familiar with those working in ICU	+	[141, 146, 162, 169]	Selecting existing members of ICU team for implementation team	[34, 47, 140, 141, 148]	b	Increased empowerment	[175]
	External professionals linked to intervention becoming part of ICU team	+	[161, 166]	Efforts made to integrate external implementation team into ICU team	[161]	b		
				Integrate palliative care professionals into the ICU team	[34, 64, 159]	c		
CFIR construct: Process								
Champions	Presence of champions	+	[32, 40, 42, 47, 54, 66, 138-141, 144, 147-149, 152, 158, 168, 172, 174, 175, 182, 187]	Identify and prepare champions	[32, 40, 42, 47, 54, 66, 138-141, 144, 147-149, 152, 158, 168, 172, 174, 175, 182, 187]	e	Assisted in implementation challenges, provided critical skills and helped promotion	[139, 140, 169]
	Absence of champions	-	[76]					
Reflecting and evaluating	Ongoing monitoring	+	[48, 54, 59, 160, 161, 177, 181, 190]	Use lessons from previous projects	[142, 176]	g		
				Use a pilot or 'run-in phase'	[62, 149, 187]	g	Helped to identify and reduce barriers	[62, 149, 187]
				Regular discussions to purposely re-examine the implementation	[59, 75, 147, 156]	g	Helped troubleshoot barriers	[59, 75, 147, 156]
				Conduct small cycle tests of change using data	[75, 136, 148, 169, 170]	g	Identified and tackled issues before scaling up	[75, 136, 148, 169, 170]
	Regular updates on performance	+	[27, 41, 148, 155, 178]	Regular implementation meetings to review data, discuss experiences and behaviours	[48, 54, 75, 136, 160, 161, 184]	g	Facilitated physician buy in	[27, 76, 138, 175, 178, 180, 184]
				Give ICU staff results feedback	[48, 59, 64, 140, 156, 175]	g	Facilitated changes for improvement	[148, 166, 190]
				Palliative care teams fed back to ICU teams	[75, 178, 190].	g		
				Review in morbidity and mortality meetings	[27, 41, 155, 180]	g	Gave time for reflecting on the importance of goals, and for feedback	[27, 41, 180]

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
Engaging	Engaging key stakeholders	+	[149, 155, 168, 171, 177, 178]	Early adopters were identified to take part and role-model implementation through their clinical leadership	[75, 156, 168, 175]	f	Encouraged incorporation of the intervention into daily practice Built consistency	[155] [149]
				Recruit individuals according to skillset to train them for leadership roles e.g. - Strong communication skills - ICU and palliative care expertise	[47, 59, 75, 148, 156] [47] [59, 75]	e		
				Using patient centred language	[75]	f		
				Encourage participation by all patients and close relatives	[159]	f		
				Use of mass media – videotaped interviews of nurses who previously took part shown at national meeting	[168]	f	Aided in recruitment	[168]
				Educational rewards (certificates/education credit)	[75, 185]	f		
				Monetary/food reward for engaging	[148, 151, 152, 163, 185, 190]	h		
	Difficulty engaging large teams	-	[156]	See “leadership engagement”				
Planning	Presence of pre-defined protocols	+	[41, 62, 159]					

CFIR determinant	ICU palliative care determinants	+/-	Reference(s)	ICU palliative care Implementation strategy	Reference(s)	ERIC category	Reported mechanism	Reference(s)
	Timing and place of intervention planned to context	+	[159, 163]	Additional time for ongoing training, practice and re-exposure planned	[133]	a		
				Planning/implementation meetings organised	[65, 139] [59, 139, 156, 161]	d, e	Tailored to context	[65, 139]
				Consider timeframe of bereavement interventions	[163]	d	Maximised benefit but minimised harm	[163]
				See strategies linked to “Adaptability”				

Barrier (-) or facilitator (+). ERIC categories: a) Train and educate stakeholders, b) Interactive assistance, c) Support clinicians, d) Adapt and tailor to context, e) Develop stakeholder interrelationships, f) Engage consumers, g) Use evaluative and iterative strategies, h) Utilise financial strategies, i) Change infrastructure, j) Other

7.4 OBJECTIVE 4: DETERMINANTS AND STRATEGIES: MODEL OF DELIVERY AND ICU TYPE

7.4.1 DETERMINANTS AND MODEL OF DELIVERY

Most determinants were applicable regardless of which model of palliative care delivery was used. However, there are examples of where determinants were more commonly discussed in relation to one model.

Integrative

Leadership involvement and assistance with implementation challenges or questions was more commonly seen with integrative interventions [47, 140, 144, 172, 182, 187]. Having an adaptable intervention [134, 163, 169, 187] that is low cost [47, 172, 187, 189] also appeared more often. For individuals involved with integrative interventions, professionals and patients or families, perceived value was important [133, 138, 139, 143, 144, 150, 156, 166, 169, 175, 181, 188]. With regards to the inner setting, ICU nurse involvement was pivotal to integrative interventions [134, 161]. Stakeholders having information on how to use the intervention facilitated implementation [42, 137, 139, 140, 144, 150, 164, 167, 169, 173]. Lack of understanding of the intervention inhibited progress [138, 139, 174]. Educational time being limited within ICU made providing this knowledge challenging [140, 143]. Having support from the intervention team on the ICU was beneficial [140, 143].

Consultative

Having an intervention that applies to all ICU patients, removing the need to identify those who require palliative care was more commonly seen to facilitate consultative interventions [27, 41, 60, 75, 152]. Stakeholder involvement developing the intervention was discussed in multiple studies of consultative interventions [65, 75, 148, 149, 151, 152, 160, 168, 180]. Where interventions targeted healthcare professionals only, and not patients or families, this was a barrier [61]. Having interventions that worked to implement existing external policies and guidelines assisted implementation [29, 58, 141, 142, 148]. Some groups found that intensive care staff not perceiving the need for or benefit from palliative care input as a hindering factor [40, 136, 159, 179]. It was recognised that in these cases, an integrative model may be helpful [159, 179] The presence of a well-staffed palliative care team was seen as a facilitator [29, 35, 40, 154, 157]. Lack of efforts made to increase workforce were noted as a hinderance [141, 142]. Interprofessional efforts were beneficial [62, 75, 149, 151, 155, 165, 168]. A symbiotic relationship between the palliative care and

ICU team was advantageous [29, 58, 65, 158, 160, 171, 178-180]. Involvement of palliative care, nursing and social work leaders [148, 157, 178] and senior clinicians [75, 135, 168] helped implementation in these interventions and was seen as a key to success [151, 180].

7.4.2 DETERMINANTS AND ICU TYPE

Again, most determinants were common regardless of ICU type but there were some factors discussed that were specific to the ICU type.

Medical ICU (MICU)

19 interventions were conducted in MICUs alone. It was discussed how an integrative model is favoured on MICUs [136, 179], however 68% of interventions in studies conducted in solely MICUs were classed as consultative. One study involved an intervention that was initiated by a palliative medicine associate consultant after an attachment to the ICU, and was driven mainly by palliative care nursing champions of the ICU [147]. It was reported that MICU attendings have a high turnover [136]. Interventions that did not target the family were harder to implement [61]. Cost savings of palliative medicine intervention were acknowledged [154]. The complex co-ordination needed between ICU staff and with ICU staff and families was considered a barrier [164]. The medical team were found to be receptive to the researcher attending ward rounds [162].

General ICU (GICU)

15 interventions were conducted in GICUs alone. 47% of these were consultative interventions. It was discussed how interventions could be performed by ICU staff, demonstrating that primary palliative care can be integrated into daily ICU care [58]. The technical difficulty in precisely predicting clinical outcomes being magnified for chronically critically ill patients was discussed, given that this patient group are more likely to be admitted to a GICU [40]. Tension for change was seen in that staff felt care planning could be improved for patients at risk of dying [34].It was recognised that the presence of a GICU would likely indicate a smaller centre with no resource for separate ICUs, or large centres with the need for multiple types. In smaller centres limited resources were a barrier [133], and their open, nonteaching, and mixed ICUs were described to have had less robust compliance with the intervention [158]. It was felt that in ICUs with few beds, deploying specialist palliative care resource may not be justifiable [40]. In cases where there were larger GICU teams, dissemination of information was difficult [156]. Where triggers for palliative care were used, they required a broad appeal among several medical staff [157]. The presence of implementation leaders and champions was beneficial [59, 156, 175].

Surgical ICU (SICU)

14 interventions were conducted in SICUs alone. 57% of these were consultative interventions. Interventions that applied to all patients [27, 41, 60, 177], were based on evidence [42, 60, 160, 189], and developed by stakeholders [60, 158, 160, 177, 178, 180] were more likely used in this setting. The fact that surgical patients can be moved out of ICU quickly due to standardised processes was mentioned as a barrier to palliative care [27]. The acute and sudden nature of illness seen on SICUs, as well as the fact that patients are often sedated also acted as barriers [27, 41, 155]. One study discussed difficultly integrating into the SICU team where SICU staff saw family support as their role yet also reflected they may be reluctant, or lack the skills, to talk about prognosis and goals of care [134]. There was a reported hesitation of the primary team or surgeon to consult palliative care [160], with concerns around surgeons' own sense of responsibility about adverse outcomes. It was discussed how goals of care discussions can happen late [165] and palliative care is implemented when all therapeutic options have been exhausted with no chance of recovery [177]. There was a reported difficulty in shifting from a curative to palliative approach [177]. In SICUs it was felt that ICU nurses are in the best position to reach as many people as possible [42, 134, 177]. It was important to have a familiarity important between palliative care and the SICU [158].

7.4.3 IMPLEMENTATION STRATEGIES AND MODEL OF DELIVERY

As with determinants, most strategies were applicable irrespective of model of palliative care delivery. The use of aspects of both models was recognised as a strategy to best apply resources by ensuring utilisation of existing palliative care teams whilst integrating primary palliative care concepts into existing ICU practice [58, 133, 136]. Where ICUs were able to provide primary palliative care, this allowed an increase in the number of palliative care consultations and family meetings whilst freeing up the specialist palliative care team for complex cases [58, 136, 181]. This strategy was also felt to be logical given limited staffing as well as respecting reluctance to introduce external palliative care into the ICUs already comprehensive care plans [136]. There are, nevertheless, some examples of where strategies were more commonly discussed in relation to one model.

Integrative

Integrative interventions were more often specifically designed to be a quick, easy-to-use, and accessible [135, 139, 145, 163, 166, 173, 177, 187]. Training on the research trial itself as well as the intervention was more common with integrative interventions [134, 164, 169]. Strategies were more likely to involve reminding clinicians of the project with informal unit visits, posters, and huddles for example [28, 140, 156, 164]. Electronic systems were used more often in the form of an app [173], electronic health records [137], or a protocol that can be easily incorporated inro any electronic platform [145] such as implementation tools on the intranet [139], and auto generation of scoring systems [146]. Pre-implementation meetings to discuss barriers and strategies were more commonly seen with integrative interventions [64, 140, 156, 177]. Research grants [138, 164] and small corporate grants or contributions for supplies [138, 164, 169] were sought. Finally, integrative interventions more commonly have a theoretical basis [47, 64, 161, 164].

Consultative

Consultative interventions were more often designed to be applicable to all patients, from the start of their ICU admission [27, 41, 65, 154]. Learning collaboratives between ICU and palliative care were created [136, 160, 180]. There was a need to define roles and give information about those involved [34, 75, 165]. It was also acknowledged that education of palliative care professionals around intensive care was important [168]. Educating families around the role of palliative care in the ICU was also suggested [154]. Once implementation was underway, regular discussions to troubleshoot barriers also occurred [59, 75, 147]. and in one case implementation was paused for recruitment [157]. Morbidity and mortality meeting gave time for reflecting on the importance of goals, and for feedback [27, 41, 155, 180]. In these cases, institutional grants and sponsorship were sought [59, 75, 141, 151].

7.4.4 IMPLEMENTATION STRATEGIES AND ICU TYPE

Medical ICU (MICU)

The importance of providing education around palliative care for MICU staff [136, 154, 159, 179, 181], and families [154] was highlighted. This was done by palliative care professionals [136, 159, 179] and one study ensured this coincided with medical turnover [181]. Palliative care physicians were also educated about intensive care whilst on ward round [168]. Strategies explaining the study and/or intervention were seen more commonly in MICU interventions [32, 146, 164, 169, 179, 181]. Interventions were more likely to be designed so that different clinical roles can step in if one is unavailable [32, 154, 170]. MICU interventions commonly modified electronic/written records [32, 76, 159, 168, 181]. Small cycle tests of change were used more often, with iterations to interventions after reviewing data [136, 147, 149, 163, 169]. The two studies that moved physical assets to a more central location were both conducted in MICUs [169, 170]. MICUs more commonly reported strategizing to use a combined approach of the integrative and consultative models, with the ICU team providing primary palliative care and specialist palliative care input for more complex cases [136, 181].

General ICU (GICU)

For GICUs its implementation strategies included incorporating additional time for integration activities such as ongoing practice, re-exposure and education [133, 175] with slow supported enrolment [150]. Given GICUs can be in smaller hospitals, a strategy used here was to combine palliative care positions in GICU and the Emergency Department to best use resources [40]. Interventions tended to be adaptable in terms of timings [29, 40, 150]. Interventions were more often mandatory [135, 150, 176, 185]. Collaboration was important between the palliative care team and the intensive care team and multidisciplinary team members [29, 34, 58, 133, 135, 157, 175]. Opinion leaders consulted for GICU interventions included residency chiefs to enable a trusting relationship with ICU residents [135]. Reflecting the majority integrative interventions, strategies involving those with critical care backgrounds as palliative care leaders were used [40, 144].

Surgical ICU (SICU)

In SICUs, education was given around the roles of palliative care [134]. Role modelling was used conducting palliative care assessments at admission during rounds to engage physicians and nurses in prognostication and symptom assessment [155, 180]. Urgent palliative care consultations were also available if needed [180]. External communication facilitators were used to complement and extend the SICU team support [134, 155].

Interventions that applied to all patients [27, 41, 60, 177] were based on evidence [42, 60, 160, 189], and developed by stakeholders [60, 158, 160, 177, 178, 180] were more likely used in this setting. Strategies worked to incorporating the intervention into daily work [27, 41, 60, 155, 158, 165] and use minimal resources [165, 189]. Again, collaboration was an important strategy [42, 155, 158, 160, 165, 177, 178, 180] but differing to the other ICUs, strategies within SICUs needed to involve the surgeons caring for the patient, as well as the ICU and palliative care team [158, 160, 180]. It was important for these consulting services to be familiar with palliative care [158]. Reflecting this, in one study, the attending surgeon was given the decision to consult palliative care or not [160]. Another reported having a trauma surgeon as a champion for the intervention as essential to adoption and adherence [158]. Engaging with the wider hospital outside of the SICU was used to foster these collaborations, such as at surgical grand rounds [42, 160]. Feedback to the SICU team was given and collected [160, 178]. Surgeons presenting patients for review in morbidity and mortality meetings, discussing palliative care input, was a unique reflective and evaluative method for SICUs [27, 41, 155, 180].

7.5 QUALITY AND BIAS ASSESSMENT

7.5.1 MIXED METHODS APPRAISAL TOOL (MMAT)

31 quantitative non-randomised, 19 mixed methods, 12 quantitative descriptive, 7 randomised controlled and 2 qualitative studies were included. 8 process evaluations, which were classed as qualitative for MMAT assessment, were included. As recommended by the tool developers [192], MMAT scores for each study are shown in Appendix 7. Where studies did not meet a MMAT criterion, this was considered when interpreting the data. However, given this review aimed to synthesise reported factors, rather than effectiveness, this does not impact conclusions presented.

7.5.2 GRADE-CERQUAL

Table 8 shows the completed Grading of Recommendations Assessment, Development and Evaluation - Confidence in the Evidence from Reviews of Qualitative research (GRADE-CERQual) for this systematic review.

Table 8: GRADE-CERQual assessment

Review findings	Studies contributing to findings	Methodological limitations	Coherence	Adequacy	Relevance	GRADE-CERQual assessment of confidence in the evidence	Explanation of GRADE-CERQual assessment
Determinants (barriers and facilitators)	All included papers	No concerns about methodological limitations	No or very minor concerns about coherence.	Minor concerns about adequacy.	No or very minor concerns about relevance.	High confidence	Methods not related to reported determinants. Agreement across studies and barriers/facilitators named. Majority of studies conducted in America with poor global representation. Adequate volume of data. High relevance with narrow study inclusion criteria.
Implementation strategies	All included papers	No concerns about methodological limitations	Minor concerns about coherence.	Minor concerns about adequacy.	No or very minor concerns about relevance.	Moderate to high confidence	Methods not related to reported strategies. Agreement across studies but implementation strategies interpreted as such rather than explicitly stated in primary studies. Majority of studies conducted in America with poor global representation. Adequate volume of data. High relevance with narrow study inclusion criteria.
Mechanisms	[27-29, 40, 41, 47, 54, 58, 59, 62, 64, 65, 75, 76, 134-140, 142, 144, 147-149, 151, 152, 154-156, 158-160, 162-165, 168-170, 175, 177, 179-182, 184, 186-188]	No concerns about methodological limitations	Moderate to major concerns about coherence.	Moderate to major concerns about adequacy. Thin data.	No or very minor concerns about relevance.	Low confidence	Methods not related to reported mechanisms. 41 out of 79 studies reported mechanisms and minimal repetition so coherence and adequacy a concern. High relevance with narrow study inclusion criteria.

8 DISCUSSION

Despite heterogeneity in interventions and outcomes in the published evidence, there were common implementation determinants (barriers and facilitators) and implementation strategies reported across all ICU types and model of delivery. The main facilitators were having adequate resources (physical and skills) and a symbiotic relationship between palliative care and ICU teams including culture and beliefs that reflected the importance of palliative care. The main barriers were ICU teams' reluctance towards palliative care involvement, lack of skills and familiarity with palliative care, and specific ICU characteristics: high acuity and focus on cure. The main implementation strategies addressing these determinants were the utilisation of champions, providing education and resources, involving stakeholders, creating adaptable interventions, and building relationships between palliative care and ICU teams. The mechanisms by which these strategies worked were less frequently reported but most commonly related to: facilitating collaborative working; building trust; co-ordinating efforts; demonstrating benefit and overcoming challenges specific to individual ICUs.

When findings were examined in the context of model of delivery, consultative or integrative, differences were found. If an integrative model is more feasible, extra attention may be needed to remind clinicians of the intervention during their day-to-day work. If a consultative model is preferred, strategies to clearly define roles, and provide education about specialist palliative care involvement are more appropriate. Some determinants and strategies are seen more commonly, depending on the specific ICU type. Notably, general ICUs may need to consider the fact that their patient group may be more likely to include chronically ill patients with 'difficult to recognise' deterioration, and they may need to strategise for this either by integration of palliative care for all patients, or adopt tools to identify palliative care needs. Medical ICUs may strategise for the higher staff turnover by ensuring there are multiple people who can carry out their intervention. Surgical ICUs could implement interventions for all patients to overcome the difficulties seen in engagement with palliative care teams.

8.1 STRENGTHS AND LIMITATIONS

This systematic review robustly follows PRISMA reporting guidance [130] and uses validated implementation structures (hypernym encompassing models, frameworks, theories and taxonomies) to provide detailed, well organised, translatable, novel findings. There is growing concern over the evidence to practice gap within healthcare [193]. To benefit patients, families, and

HCPs the way that palliative care interventions have been shown to, they must be successfully implemented in practice. This requires dedicated effort to identify and action implementation factors within the ICU context. Previous studies examining healthcare professional perceived barriers to, and facilitators for, providing palliative care in the ICU have been reviewed [82, 83]. However, this study is the first to systematically review implementation factors reported whilst trialling palliative care interventions within the ICU. The wider reaching findings this review offers are therefore more all-encompassing when thinking about this evidence to practice gap. Although this review concurred with the reviews of HCP perceived barriers and facilitators in their findings, it provides a deeper understanding of these determinants. Prior to this review, implementation/provision of palliative care in the ICU has not been reviewed using validated implementation structures. To my knowledge, this is also the first study in any research field to use the Implementation Research Logic Model (IRLM) as a framework for systematic review synthesis. The structures used in this review as previously described in Chapter 4, are the Implementation Research Logic Model [97], the Consolidated Framework for Implementation Research [98], the Expert Recommendations for Implementing Change [89], the Template for Intervention Description and Replication [99], and published palliative care [10] and implementation science [100] outcome frameworks.

Use of validated implementation structures provides a conceptual way to systematically understand the phenomenon in question, in this case, implementation/provision of palliative care in the ICU. It is in keeping with recommendations within the field of implementation science [86]. When used in research, these structures can provide shared language to acquaint stakeholders with implementation and improve communication of findings [86]. It is recommended that researchers select structures appropriate for their study aims [86]. The specific use of the CFIR in this review allowed identification of factors related to palliative care interventions themselves. This information is critical when designing new interventions. Use of the CFIR also facilitated more in-depth review of personal factors and interactions between individuals and their organisations, crucial considerations when implementing palliative care interventions. Assessing for patient and family related implementation factors, which was outside of the remit of the HCP reviews, identified a gap in reporting of these important considerations. CFIR and ERIC have previously been used in combination within implementation science literature therefore findings from this review are in keeping with this translatable nomenclature.

As well as building on the knowledge base around determinants, using the IRLM to combine frameworks allowed novel exploration of which strategies had been used to address certain determinants. It also identified causal mechanisms between implementation strategies and outcomes. This highlighted that Implementation barriers, facilitators, and strategies are more commonly reported than the potential pathways by which they work (mechanisms). This gap in understanding of mechanisms is documented in the literature [194, 195] and so this is not unexpected. The clinical implications of these novel findings, within an under researched field, are described in section 8.2 and have the potential to improve palliative care provision for ICU patients, their families, and those caring for them. As implementation science grows to help close the evidence to practice gap, this transferable methodology will be valuable in all fields of healthcare research. Research implications of the unique methodology are described in section 8.3.

Although some studies scored poorly when using the MMAT (Appendix 7) [131], this review aimed to synthesise researcher’s reported implementation factors rather than intervention effect. It is unlikely that these factors would differ if the quality of the study itself were to improve and so these scores do not impact conclusions. The quality of reporting of intervention characteristics was high when compared to recommendations within the TIDieR checklist and guide [99], apart from ‘when and how much’ of the intervention was delivered (i.e. the timing and dosing of the intervention delivered).

The high proportion of articles excluded at full text screening due to ‘no implementation data’ highlights the lack of importance placed on how evidence-based interventions are to be put into practice. The lack of homogenous and comparable outcomes, and robust reporting of mechanisms, has limited inference as to whether the implementation strategies which we identified in the evidence did or did not impact implementation outcomes. Where mechanisms were reported, there was little coherence between studies, with most reporting novel mechanisms compared to other studies. These trepidations are reflected in the GRADE-CERQual assessment with moderate to major concerns regarding the coherence and adequacy of data on mechanisms (Table 8). The majority of studies were conducted in America. This may limit transferability of findings to other countries. However, the commonality of reported determinants and strategies across studies and countries, despite heterogeneity of interventions and outcomes, does support generalisability. Coding and mapping to implementation frameworks and the Implementation Research Logic Model was a subjective process for the authors and GRADE-CERQual confidence assessments are reported to mediate this [132] (Table 8).

8.2 CLINICAL IMPLICATIONS

The common threads in implementation determinants and implementation strategies addressing these have clinical implications for ICUs worldwide. They provide a reference list for all intensive care units when they are implementing palliative care interventions to allow them to consider their own barriers to implementation, facilitating factors present, and therefore which strategies they should consider incorporating into their implementation plan. Factors reported more commonly depending on ICU type or model of delivery, can help ICUs to further focus their strategies to make best use of their resources. If ICUs can identify the model of delivery that aligns with their staff mix, they can emphasise efforts on strategies that were reportedly used in a similar model. Understanding the causal mechanisms by which implementation strategies have been reported to work provides ICUs with the ability to adapt strategies to their own setting while keeping this underlying mechanism in mind. For example, if time is identified as a barrier, Table 7 demonstrates how giving advance notice ahead of meetings with clinicians addressed this and effected outcomes by increasing the chance of family and clinician attendance [134]. An ICU using these findings may choose to adopt the same strategy or may wish to instead ensure all meetings are within a certain time frame that they know would increase the chance of family and clinician attendance.

Thorough reporting of intervention characteristics likely reflects journal requirements, is in keeping with recommendations [99], and will be beneficial for those wanting to replicate interventions.

8.3 RESEARCH METHODOLOGY IMPLICATIONS

Suboptimal use of implementation structures within research can lead to wasted resources and erroneous conclusions, negatively impacting viability and success of future implementation efforts. In this review, the Implementation Logical Model was successfully used to guide a framework synthesis of evidence on implementation of palliative care interventions within ICUs throughout the systematic review process. The model allowed for reporting of relationships between determinants, strategies, and mechanisms, and how these varied with intervention characteristics including ICU type and model of delivery of palliative care. The CFIR provided a robust and logical framework for the reporting of determinants to implementation. Implementation strategies reported could be mapped to the ERIC taxonomy. The novel methodology of using the IRLM as a framework for systematic review can be translated to many other healthcare contexts to identify and synthesise implementation knowledge.

8.4 FUTURE RESEARCH

Future work is needed, particularly to explore patient and family perceived barriers, facilitators, and strategies to receiving palliative care in the ICU, as they are key stakeholders that have thus far been overlooked in the literature. Given the lack of reporting found in this study, further examination of the mechanisms by which strategies to implement palliative care in the ICU work is also needed to optimise their use [194]. The use of theory to explore the processes involved in implementing palliative care in the ICU could facilitate this understanding. Normalisation Process Theory provides a set of constructs based in sociological science to understand and explain the processes surrounding implementation of practices within a given context [196, 197]. The theory conceptualises implementation, embedding, and integration of complex interventions within healthcare settings [119]. Rather than individual behavioural theories such as the COM-B model [121], Normalisation Process Theory considers implementation at a team-level within specific organisational contexts [122] and is therefore likely an appropriate fit to further this work. Future work developing specific resources to enable ICUs to conduct assessment of their own determinants, will be beneficial. Development of evidence-based, theory and stakeholder driven implementation tools to then action the appropriate strategies as reported in this study will be beneficial to help ICUs in the process of tailoring existing well described and evidence-based interventions to their own context and resources. Finally, trials of interventions to provide palliative care in the ICU should include a robust hybrid assessment of both effectiveness and implementation. This will help to prospectively address the gap of evidence-based interventions getting into practice and support better delivery of their intended benefit.

9 RECOMMENDATIONS WHEN IMPLEMENTING AN ICU PALLIATIVE CARE INTERVENTION

1. Implementation structures (models, frameworks, theories, and taxonomies) should be used throughout, from development to evaluation.
2. ICU and palliative care teams should work together to use findings from this review and assess their own barriers to, and facilitators for, providing palliative care in their ICU. These will depend on their model of delivery and ICU type.
3. Following this, implementation strategies addressing these factors can be identified to maximise success.
4. Information presented here on mechanisms can be used to develop new strategies tailored to the ICU context.
5. Focused efforts should be made to include patient and family perspectives.
6. Utilisation of champions, providing education and resources, involving all stakeholders from the beginning of the implementation effort, and creating adaptable interventions, are well supported by the evidence, and should be considered as strategies in all cases.

10 CONCLUSION

Most research into ICU-based palliative care interventions does not report on or take account of how the intervention could be implemented into practice. If recommendations from this review continue to go unfollowed, even with strong effectiveness evidence for an intervention, improvements in care will not be achieved. Collaborative working between ICU and palliative care teams to identify and action context-specific implementation factors within their ICU will increase the success, impact, and longevity, of ICU-based palliative care interventions. In turn, this will maximise patient, family, and healthcare professional benefit. Findings from this robust systematic review, using validated implementation models, frameworks, theories, and taxonomies, support teams to undertake these required efforts.

11 APPENDICES

11.1 APPENDIX 1: EXAMPLE SEARCH STRATEGY

Ovid MEDLINE(R) ALL <1946 to January 19, 2022>
1 "burn* unit*".ti,ab.
2 "coronary care unit*".ti,ab.
3 "respiratory care unit*".ti,ab.
4 "intensive cardiac care".ti,ab.
5 icu.ti,ab.
6 Intensive Care Units/
7 "intensive care unit*".ti,ab.
8 "high dependency unit*".ti,ab.
9 hdu.ti,ab.
10 Burn Units/
11 Coronary Care Units/
12 "continuous renal replacement therapy".ti,ab.
13 Respiratory Care Units/
14 "critically ill".ti,ab,kw. or critical illness/
15 or/1-14 [ICU terms]
16 Palliative Care/
17 Palliative Medicine/
18 (hospice and palliative care nursing).mp.
19 Terminal Care/
20 Hospice Care/
21 palliat*.ti,ab.
22 "eol care".ti,ab.
23 EOLC.ti,ab.
24 ("ethic* consultat*" or "ethics intervention*").mp.
25 "terminal care".ti,ab.
26 ("end of life" or end-of-life).ti,ab,kf.
27 "terminal illness*".ti,ab.
28 "terminal patient*".ti,ab.
29 "terminally ill".ti,ab.
30 "limited survival".ti,ab.
31 "advance* care plan*".mp.
32 "terminal phase".ti,ab.
33 "terminal stage*".ti,ab.
34 "life-limiting".ti,ab.
35 "comfort care".ti,ab.
36 "symptom management".ti,ab.
37 "symptomatic treatment".ti,ab.
38 "symptomatic therapy".ti,ab.
39 "limited life".ti,ab.
40 "supportive care".ti,ab.
41 "supportive treatment".ti,ab.
42 "supportive therapy".ti,ab.
43 ("high risk of death" or "family support" or bereavement).mp.
44 or/16-43 [palliative terms]

45 Implementation Science/ or implementation.ti,ab,kw.
46 facilitat*.mp.
47 barrier*.mp.
48 determinant*.mp.
49 implement*.mp.
50 integrat*.mp.
51 disseminat*.mp.
52 knowledge translation.mp.
53 adhere*.mp.
54 adopt*.mp.
55 compliance.mp.
56 (process adj evaluation*).mp.
57 acceptability.mp.
58 Feasibility Studies/ or feasibility.mp.
59 sustainability.mp.
60 Process Assessment, Health Care/ or "Outcome and Process Assessment, Health Care"/
61 Program Evaluation/
62 (intervention or quality improvement* or stakeholder*).mp.
63 or/45-62 [implementation terms]
64 exp Case-Control Studies/
65 exp Cohort Studies/
66 Randomized Controlled Trials as Topic/
67 randomised controlled trial.mp.
68 exp controlled clinical trial/
69 cohort study.mp.
70 case-control study.mp.
71 observational study.mp. or Observational Study/ or Controlled Before-After Studies/ or Comparative Study/
72 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 [Controlled studies]
73 Communication/ or communication.ti,kf.
74 cpr.mp. or Cardiopulmonary Resuscitation/
75 Decision Making/
76 decision making.mp.
77 Cardiopulmonary Resuscitation.mp.
78 74 or 75 or 76 or 77
79 73 and 78 [communication around decisions/CPR]
80 44 or 79 [palliative or communication around decisions/CPR]
81 15 and 80 and 63 [ICU and pall/communication and implementation]
82 15 and 80 and 72 [ICU and pall/communication and controlled studies]
83 limit 82 to dt=20200801-20220224 [limit controlled studies to after Metaxa search date]
84 81 or 83
85 Case Reports/
86 Editorial/
87 Comment/
88 (adolescent/ or exp Pediatrics/ or exp child/ or exp infant/) not exp Adult/
89 (animals not humans).sh.
90 or/85-89 [unwanted publications and participants]
91 84 not 90 [Final]

11.2 APPENDIX 2: DATA EXTRACTION FORM

DATA EXTRACTION FORM

Study ID (surname of first author and year first full report of study was published e.g. Smith 2001)		
Date form completed		
ID person extracting data		
1) Study data		
1.1 Reference details (citation to include year of publication, first author name, journal)		
Study reference		Process evaluation reference (if applicable)
1.2 Study design		
2) Participants		
PICOS: Adult patients admitted to the ICU or HDU and/or their families AND/OR palliative care professionals or teams		
2.1 Clinical setting		
2.2 Country of study		
2.3 Population description		
2.4 Total no. participants and group numbers	Intervention study	Implementation study
3) Comparator(s)		

PICOS: No palliative care intervention or alternative palliative care intervention(s)	
3.1 Type of comparator, if any (e.g. usual care)	
4) Intervention(s) (Taken from TIDieR Checklist) [99]	
PICOS: Palliative care intervention occurring in/in relation to the ICU	
4.1 Brief Name	
4.2 Why	
4.3 What (Materials and procedures)	
4.4 Who provided	
4.5 How (Mode of delivery)	
4.6 Where	
4.7 When and how much	
4.8 Tailoring	
4.9 Modifications	
4.10 How well	
4.11 Actual	

4.12 Domain		4.13 Integrative/Consultative

5) Determinants (Consolidated Framework for Integration Research) [98]	
5.1 Intervention Characteristics	
5.1.1 Intervention Source	
5.1.2 Evidence Strength & Quality	
5.1.3 Relative Advantage	
5.1.4 Adaptability	
5.1.5 Trialability	
5.1.6 Complexity	
5.1.7 Design Quality & Packaging	
5.1.8 Cost	
5.2 Outer setting	
5.2.1 Patient Needs & Resources	
5.2.2 Cosmopolitanism	
5.2.3 Peer Pressure	

5.2.4 External Policy & Incentives	
5.3 Inner setting	
5.3.1 Structural Characteristics	
5.3.2 Networks & Communications	
5.3.3 Culture	
5.3.4 Implementation Climate	
5.3.5 Tension for Change	
5.3.6 Compatibility	
5.3.7 Relative Priority	
5.3.8 Organizational Incentives & Rewards	
5.3.9 Goals and Feedback	

5.3.10 Learning Climate	
5.3.11 Readiness for Implementation	
5.3.12 Leadership Engagement	
5.3.13 Available Resources	
5.3.14 Access to Knowledge & Information	
5.3.15 Structural Characteristics	
5.4 Characteristics of individuals	
5.4.1 Knowledge & Beliefs about the Intervention	
5.4.2 Self-efficacy	
5.4.3 Individual Stage of Change	
5.4.4. Individual Identification with Organization	

5.4.5 Other Personal Attributes	
5.5 Process	
5.5.1 Planning	
5.5.2 Engaging	
5.5.3 Opinion Leaders	
5.5.4 Formally Appointed Internal Implementation Leaders	
5.5.5 Champions	
5.5.6 External Change Agents	
5.5.7 Executing	
5.5.8 Reflecting & Evaluating	
6) Implementation strategies (Expert Recommendations for Implementing Change) [89, 106]	
6.1 Engage consumers	
6.1.1 Involve patients/consumers and family members	

6.1.2 Intervene with patients/consumers to enhance uptake and adherence	
6.1.3 Prepare patients/consumers to be active participants	
6.1.4 Increase demand	
6.1.5 Use mass media	
6.2 Use evaluative and iterative strategies	
6.2.1 Assess for readiness and identify barriers and facilitators	
6.2.2 Audit and provide feedback	
6.2.3 Purposefully reexamine the implementation	
6.2.4 Develop and implement tools for quality monitoring	
6.2.5 Develop and organize quality monitoring systems	
6.2.6 Develop a formal implementation blueprint	
6.2.7 Conduct local need assessment	
6.2.8 Stage implementation scale up	
6.2.9 Obtain and use patients/consumers and family feedback	
6.2.10 Conduct cyclical small tests of change	
6.3 Change infrastructure	

6.3.1 Mandate change	
6.3.2 Change record systems	
6.3.3 Change physical structure and equipment	
6.3.4 Create or change credentialing and/or licensure standards	
6.3.5 Change service sites	
6.3.6 Change accreditation or membership requirements	
6.3.7 Start a dissemination organization	
6.3.8 Change liability laws	
6.4 Adapt and tailor to the context	
6.4.1 Tailor strategies	
6.4.2 Promote adaptability	
6.4.3 Use data experts	
6.4.4 Use data warehousing techniques	
6.5 Develop stakeholder interrelationships	
6.5.1 Identify and prepare champions	

6.5.2 Organize clinician implementation team meetings	
6.5.3 Recruit, designate, and train for leadership	
6.5.4 Inform local opinion leaders	
6.5.5 Build a coalition	
6.5.6 Obtain formal commitments	
6.5.7 Identify early adopters	
6.5.8 Conduct local consensus discussions	
6.5.9 Capture and share local knowledge	
6.5.10 Use advisory boards and workgroups	
6.5.11 Use an implementation advisor	
6.5.12 Model and simulate change	
6.5.13 Visit other sites	
6.5.14 Involve executive boards	

6.5.15 Develop an implementation glossary	
6.5.16 Develop academic partnerships	
6.5.17 Promote network weaving	
6.6 Utilize financial strategies	
6.6.1 Fund and contract for the clinical innovation	
6.6.2 Access new funding	
6.6.3 Place innovation on fee for service lists/formularies	
6.6.4 Alter incentive/allowance structures	
6.6.5 Make billing easier	
6.6.6 Alter patient/consumer fees	
6.6.7 Use other payment schemes	
6.6.8 Develop disincentives	
6.6.9 Use capitated payments	
6.7 Support clinicians	
6.7.1 Facilitate relay of clinical data to providers	
6.7.2 Remind clinicians	

6.7.3 Develop resource sharing agreements	
6.7.4 Revise professional roles	
6.7.5 Create new clinical teams	
6.8 Provide interactive assistance	
6.8.1 Facilitation	
6.8.2 Provide local technical assistance	
6.8.3 Provide clinical supervision	
6.8.4 Centralize technical assistance	
6.9 Train and educate stakeholders	
6.9.1 Conduct ongoing training	
6.9.2 Provide ongoing consultation	
6.9.3 Develop educational materials	
6.9.4 Make training dynamic	
6.9.5 Distribute educational materials	

6.9.6 Use train-the-trainer strategies	
6.9.7 Conduct educational meetings	
6.9.8 Conduct educational outreach visits	
6.9.10 Create a learning collaborative	
6.9.11 Shadow other experts	
6.9.12 Work with educational institutions	

7) Outcome(s)/Finding(s)

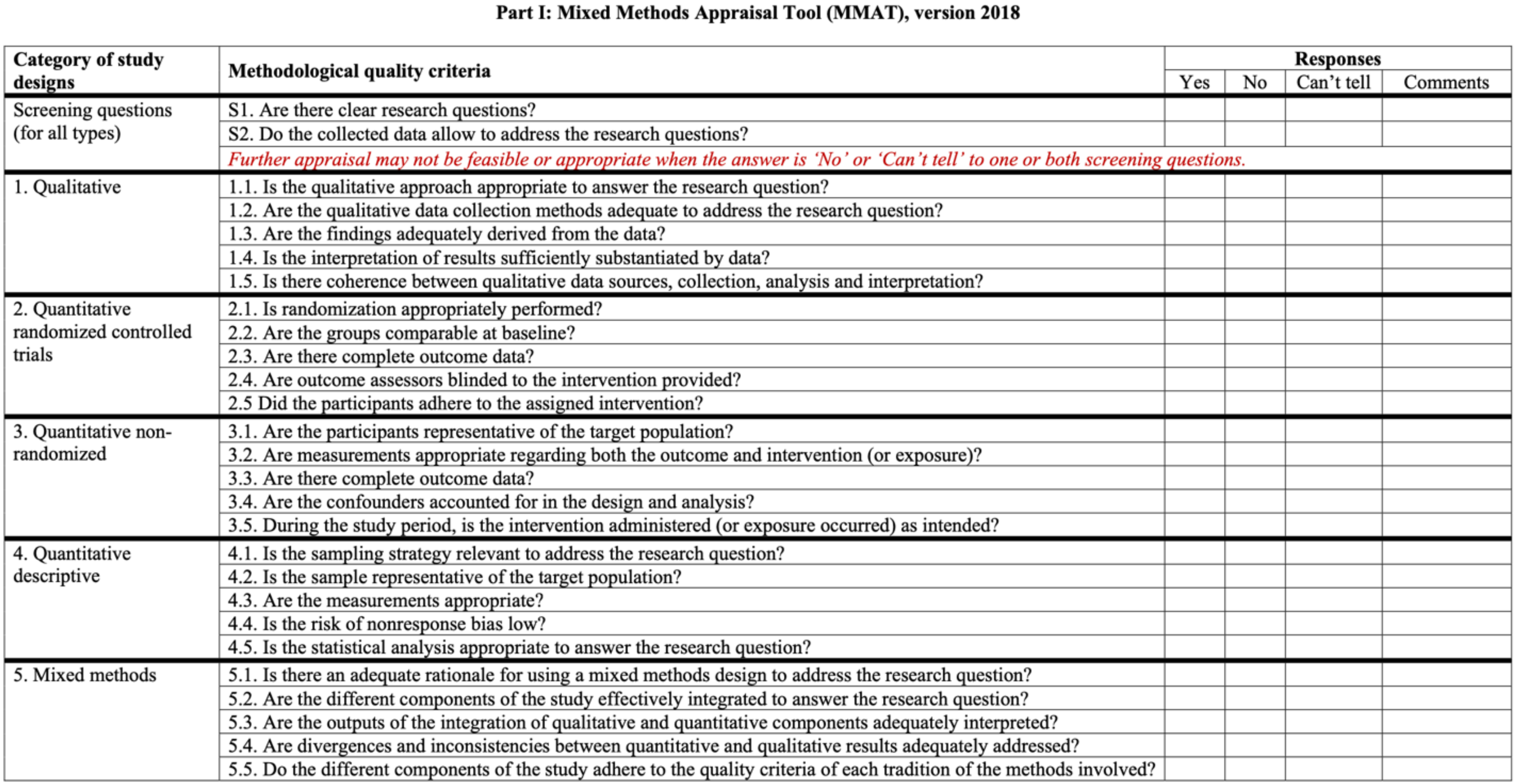
	7.1 Palliative care (PC) outcome	PC outcome(s) category (patient/family, clinician, system, content related)	7.2 Implementation outcome(s)	Implementation outcome category (acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, sustainability)
Primary outcome(s) + unit of measurement				
Secondary outcome(s) + unit of measurement				

8) Key themes identified	Theme or subtheme	Illustration from publication

outside of framework		
Author’s conclusion		
Reviewer’s comments		
Other information		

11.3 Appendix 3: Mixed Methods Appraisal Tool

Table 9: Mixed Methods Appraisal Tool taken from Hong et al



Part I: Mixed Methods Appraisal Tool (MMAT), version 2018

Category of study designs	**Methodological quality criteria**	**Responses**			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	S1. Are there clear research questions?				
	S2. Do the collected data allow to address the research questions?				
	Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Is the qualitative approach appropriate to answer the research question?				
	1.2. Are the qualitative data collection methods adequate to address the research question?				
	1.3. Are the findings adequately derived from the data?				
	1.4. Is the interpretation of results sufficiently substantiated by data?				
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?				
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed?				
	2.2. Are the groups comparable at baseline?				
	2.3. Are there complete outcome data?				
	2.4. Are outcome assessors blinded to the intervention provided?				
	2.5 Did the participants adhere to the assigned intervention?				
3. Quantitative non-randomized	3.1. Are the participants representative of the target population?				
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?				
	3.3. Are there complete outcome data?				
	3.4. Are the confounders accounted for in the design and analysis?				
	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question?				
	4.2. Is the sample representative of the target population?				
	4.3. Are the measurements appropriate?				
	4.4. Is the risk of nonresponse bias low?				
	4.5. Is the statistical analysis appropriate to answer the research question?				
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?				
	5.2. Are the different components of the study effectively integrated to answer the research question?				
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?				
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?				
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?				

11.4 Appendix 4: Study Characteristics

Table 10: Study characteristics

Study ID	Study design	MMAT category	ICU type(s)	Country of study	Interventions Domain(s) *	Model of delivery	PC outcomes **	Implementation outcomes ***
Zalenski 2017	Prospective observational	4. Quantitative descriptive	Medical	America	C,F,G	Consultative	1	
Zalenski 2014	Observational	4. Quantitative descriptive	Medical	America	C,F,G	Consultative	1,2	9
Yeung 2021	Process evaluation	1. Qualitative	General	Canada	A,D,H,K	Integrative	4	
Yang 2021	Quasi-experimental	3. Quantitative non-randomised	ICU type not specified	South Korea	B,F	Integrative	4	
White 2012	Mixed-methods	5. Mixed methods	Neuro	America	A,F,G,K,M	Integrative	1,2,3	5,6,11
White 2018	Stepped-wedge cluster-randomised	2. Quantitative randomised controlled trials	Medical, general, neuro, transplant	America	A,B,H,K	Integrative	2,3	5
Weiner 2020	Observational	4. Quantitative descriptive	General	America	B,C,F	Consultative		8
Vuong 2019	Pre-post intervention study	3. Quantitative non-randomised	Medical	America	A,D,F,G,H,J,K	Integrative	1,2,4	7
Villarreal 2011	Pre-post intervention study	3. Quantitative non-randomised	Medical	America	C,F,G	Consultative	1	
Vig 2019	Mixed-methods	5. Mixed methods	Medical	America	C,E,F,G	Consultative	1	5,6
Venis 2020	Mixed-methods	5. Mixed methods	General	Canada	F,G	Integrative		5,6,12
Vanstone 2020	Process evaluation	1. Qualitative	Medical, general, neuro	America, Canada	A,D,H,K	Integrative		10,12,13
VanHorn 2020	Mixed-methods	5. Mixed methods	General, neuro, cardiology or thoracic	America	B,F	Integrative	4	7
Treece 2006	Process evaluation	1. Qualitative	ICU type not specified	America	A,B,F,K	Integrative	2,3,4	
Treece 2004	Pre-post intervention study	3. Quantitative non-randomised	Trauma	America	B,F,I	Integrative	2,4	

Study ID	Study design	MMAT category	ICU type(s)	Country of study	Interventions Domain(s) *	Model of delivery	PC outcomes **	Implementation outcomes ***
Takaoka 2021	Mixed-methods	5. Mixed methods	General	Canada	A,D,H,K	Integrative		7,10
Stolzman 2020	Process evaluation	1. Qualitative	Medical	America	A,H,K	Integrative		5
Sinha 2021	Pre-post intervention study	3. Quantitative non-randomised	Neuro	America	C,F,G	Consultative	1,2	
Sihra 2011	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical	America	C,F,G	Consultative	1	
Shifrin 2016	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical, neuro, cardiology or thoracic, trauma, burns	America	B,F	Consultative	4	
Schwarzkopf 2020	Pre-post intervention study	3. Quantitative non-randomised	Surgical, neuro, cardiology or thoracic	Germany	A,B,F,K	Integrative	3,4	
Schenker 2015	Process evaluation	1. Qualitative	Medical	America	A,H,K	Integrative	3	6
Scharf 2021	Mixed-methods	5. Mixed methods	Medical	America	A,H,M,K	Integrative	3	8
Santiago 2017	Mixed-methods	5. Mixed methods	Medical	Canada	A,H,M,K	Integrative	2	5,7,8
Radcliffe 2015	Qualitative in-depth semi-structured interviews	1. Qualitative	General	England	A,B,D,F,G,K	Integrative		5,6
Poi 2021	Prospective, observational study	4. Quantitative descriptive	Medical, surgical, neuro, cardiology or thoracic	Singapore	A,C,D,F,G,I,K	Consultative	1,2	
Poi 2022	Pre-post intervention study	3. Quantitative non-randomised	Neuro	Singapore	A,B,C,F,K	Consultative	1,2,	10
Penrod 2011	Pre-post intervention study	3. Quantitative non-randomised	General	America	B,F	Consultative	2	
Pavlish 2020	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical, neuro, cardiology or thoracic, transplant	America	A,D,C,E,F,K	Consultative	1,2	
Pachchigar 2021	Prospective single-centre observational study	4. Quantitative descriptive	General, cardiology or thoracic	Australia	A,D,F,I,K	Integrative	4	
Orr 2020	Mixed-methods	5. Mixed methods	Medical	America	D,G	Integrative		5,6
Ong 2020	Qualitative descriptive design	1. Qualitative	Medical	Singapore	C,F	Consultative	4	

Study ID	Study design	MMAT category	ICU type(s)	Country of study	Interventions Domain(s) *	Model of delivery	PC outcomes **	Implementation outcomes ***
O'Mahony 2010	Mixed-methods	5. Mixed methods	General	America	C,F	Consultative	1,2,3	
Noome 2017	Mixed-methods	5. Mixed methods	General	Netherlands	B,F	Integrative	3	9
Neville 2022	Quantitative non randomised	3. Quantitative non-randomised	Medical, neuro, cardiology or thoracic, transplant, general	America	A,D,H,K	Integrative	3	
Myers 2021	Pre-post intervention study	3. Quantitative non-randomised	Cardiology or thoracic	America	A,B,F,K	Integrative	4	7
Mun 2018	Pre-post intervention study	3. Quantitative non-randomised	General	America	A,C,D,F,G,K	Consultative	1	
Mun 2016	Pre-post intervention study	3. Quantitative non-randomised	General	America	A,C,D,F,G,K	Consultative	2	5
Mosenthal 2008	Cohort	4. Quantitative descriptive	Surgical, trauma	America	A,C,D,F,G,H,I,K	Consultative	1,2	7
Mosenthal 2006	Process evaluation	1. Qualitative	Surgical, trauma	America	A,C,D,F,G,H,I,K	Consultative	1,2	7
Minor 2009	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical, neuro, cardiology or thoracic	Canada	B,F	Integrative	4	8
McCormick 2010	Pre-post intervention study	3. Quantitative non-randomised	ICU type not specified	America	A,B,F,K	Integrative	3,4	
McCormick 2008	Pre-post intervention study	3. Quantitative non-randomised	ICU type not specified	America	A,B,F,K	Integrative	3,4	
McCarroll 2018	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical	America	C,F,G	Consultative	1	
Markin 2015	Pre-post intervention study	3. Quantitative non-randomised	General	America	B	Integrative	4	
MachareDelgado 2009	Cohort	4. Quantitative descriptive	Medical	America	A,C,F,K	Consultative	2	5,7
Ma 2019	Cluster randomized crossover	2. Quantitative randomised controlled trials	Medical	America	C	Consultative	1,2	
Love 2022	Quantitative descriptive	4. Quantitative descriptive	Surgical	America	C	Consultative	1	

Study ID	Study design	MMAT category	ICU type(s)	Country of study	Interventions Domain(s) *	Model of delivery	PC outcomes **	Implementation outcomes ***
LeFrancois 2018	Mixed-methods	5. Mixed methods	Vascular surgery	Canada	A,B,F	Integrative	1	5,6
Lamba 2012	Mixed-methods	5. Mixed methods	Surgical, transplant	America	A,B,C,D,F,G,K	Consultative	1,3	
Kentish-Barnes 2022	Cluster randomised controlled trial	2. Quantitative randomised controlled trials	Medical, surgical	France	A,K,M,K	Integrative	3	
Kentish-Barnes 2017	Randomized clinical trial	2. Quantitative randomised controlled trials	Medical, general, surgical, nephrology	France	A,M,K	Integrative	3	6,7
Kaminski 2022	Pre-post intervention study	3. Quantitative non-randomised	Surgical	America	B,D	Integrative	4,1	
Jones 2017	Cohort study	4. Quantitative descriptive	General	America	C,F,G	Consultative	1	
Jenko 2015	Mixed-methods	5. Mixed methods	Medical	America	C,F,G	Consultative	1,2,4	7
Hurst 2018	Quasi-experimental	3. Quantitative non-randomised	Medical	America	C,F,G	Consultative	1,2	
Higginson 2013	Mixed-methods	5. Mixed methods	General, surgical	England	A,B,D,F,K	Consultative	3	7,8
Graham 2018	Mixed-methods	5. Mixed methods	General	Canada	B	Integrative		5,6,8,9,11
Gordon 2012	Mixed-methods	5. Mixed methods	General, cardiology or thoracic	Canada	B,F	Consultative		6,10,13
Ganz 2020	Mixed-methods	5. Mixed methods	ICU type not specified	Israel	B,F	Integrative	4	
Finkelstein 2016	Cohort	4. Quantitative descriptive	Surgical	America	C,F,G	Consultative	1,2	
Dowdy 1998	Prospective controlled study	3. Quantitative non-randomised	General	America	A,D,E,G,K	Consultative	1,2	
Curtis 2016	Parallel-group randomized trial	2. Quantitative randomised controlled trials	General, trauma	America	A,B,F,K	Integrative	2,3	

Study ID	Study design	MMAT category	ICU type(s)	Country of study	Interventions Domain(s) *	Model of delivery	PC outcomes **	Implementation outcomes ***
Curtis 2011	Cluster-randomized trial	2. Quantitative randomised controlled trials	ICU type not specified	America	A,B,F,K	Integrative	2,3,4	
Curtis 2012	Process evaluation	1. Qualitative	General, trauma	America	A,B,F,K	Integrative	2,3	
Creutzfeldt 2015	Cohort	4. Quantitative descriptive	Neuro	America	F,G	Integrative	1	
Cralley 2022	Pre-post intervention study	3. Quantitative non-randomised	Surgical	America	B,D,F	Integrative	1,2	
Cox 2018	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical, neuro, cardiology or thoracic	America	A,C,F,K	Consultative	1,2,3	5,6
Constantine 2016	Pre-post intervention study	3. Quantitative non-randomised	Medical, surgical	America	B,F	Integrative	1,2	
Carson 2016	Randomized clinical trial	2. Quantitative randomised controlled trials	Medical	America	A,C,K	Consultative	1,2,3	
Brown 2015	Pre-post intervention study	3. Quantitative non-randomised	General	America	B,F	Integrative	4	
Braus 2016	Pre-post intervention study	3. Quantitative non-randomised	Medical	America	C,F	Consultative	1,2,3	
Booth 2016	Pre-post intervention study	3. Quantitative non-randomised	Trauma	America	B,D,F	Integrative	4	
Black 2013	Single-arm prospective	3. Quantitative non-randomised	Medical, general, neuro, cardiology or thoracic, trauma, respiratory	America	B,F	Integrative	1,2	4
Billings 2006	Process evaluation	1. Qualitative	Medical	America	A,B,C,F,K	Consultative	1,2,3,4	
Barnato 2017	Mixed-methods	5. Mixed methods	Medical, general, cardiology or thoracic, trauma	America	A,H,M,K	Integrative		5,6
Babar 2021	Cohort	4. Quantitative descriptive	Medical	America	C	Consultative	1,2	
Anderson 2017	Mixed-methods	5. Mixed methods	Medical, general, neuro, cardiology or thoracic, trauma	America	B,F	Consultative	4	

Study ID	Study design	MMAT category	ICU type(s)	Country of study	Interventions Domain(s) *	Model of delivery	PC outcomes **	Implementation outcomes ***
Akgun 2019	Pre-post intervention study	3. Quantitative non-randomised	Medical, general, surgical, cardiology or thoracic	America	A,B,F,K	Consultative	1,3	

* Intervention domains: A : Communication interventions, B : Educational interventions, C : Palliative care team involvement, D : Advance care planning, E : Ethics consultations (A-E taken from Metaxa et al 2021), F : Emotional and organizational support for ICU clinicians, G : Patient or family centred decision making, H : Emotional and practical support (family or patient), I : Symptom management and comfort care, J : Spiritual support, K : Communication within the team and with patients and families, L : Continuity of care (F-L taken from Clarke et al 2003), M: Bereavement (new domain).

** PC outcomes: 1 : System-related, 2 : Content-related, 3: Patient/family-related, 4: Clinician-related (taken from Aslakson et al 2013).

*** Implementation outcomes: 5 : Feasibility, 6 : Acceptability, 7: Adoption, 8: Appropriateness, 9: Adherence, 10: Sustainability, 11: Fidelity, 12: Costs, 13: Penetration (taken from Proctor et al 2011).

11.5 APPENDIX 5: INTERVENTION CHARACTERISTICS REPORTED AS PER THE TEMPLATE FOR INTERVENTION DESCRIPTION AND REPLICATION CHECKLIST

Table 11: Intervention characteristics

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
Zalenski 2017 Zalenski 2014	Palliative care screening and consultation.	There are few multicentre studies that examine the impact of systematic screening for palliative care and specialty consultation in the intensive care unit (ICU).	Seven-item palliative care screening tool. Patients with one or more risk factors classified as screen positive.	ICU teams were screened patients on admission, within the first 24 hours Screen scores were presented by nurses at interdisciplinary rounds. Intensivist or attending physician made the decision whether to order a PC consultation.	Face to face screening on admission. Presentation of scores at meeting. Face to face palliative care consult.	Screening once on admission
Yeung 2021 Vanstone 2020 Takaoka 2021 Neville 2022	3 wishes project.	For patients, to dignify their death and celebrate their life. For family members, to humanize the dying process and create positive memories. For ICU clinicians, to foster patient and family-centred end of life care and inspire a deeper sense of our vocation.	Elicitation and implementation of 3 wishes for patients, family members, and/or clinicians.	ICU staff, palliative care and spiritual care staff. Interdisciplinary collaboration during EOL.	Face to face enrolment by clinicians. Wishes elicited face to face. Variable wish delivery methods.	3 wishes per enrolled patient.
Yang 2021	Mobile end-of-life care program for intensive-care nurses.	Intensive-care unit nurses may experience difficulties in end-of-life care because of frustration or lethargy.	Android phone-based End of Life Care app consisting of end-of-life educational material.	Authors and nursing school professors and head nurses of the intensive care unit determined the content validation index.	Mobile phone application.	Daily - average daily learning time was 30 minutes for 7 days total.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
White 2012	The Four Supports Intervention.	Problems with surrogate decision making in ICUs can lead to distress for surrogates and treatment that may not reflect patients' values.	The addition of a trained Family Support Specialist (FSS) to the usual clinical team, and interventionist. Delivers four kinds of support: 1) Emotional support 2) Communication support 3) Decision support 4) Anticipatory grief support.	Screening - research coordinator Introduction to intervention -bedside nurses Enacting the intervention - Family Support Specialist.	A series of encounters with the family and the clinical team, including initial individual meetings, preconference meetings with the family and clinicians, unstructured clinician-family meetings in which the FSS participates, post conference meetings, daily check-ins, and anticipatory grief sessions.	Clinical team and family meet within 48 hours of study enrolment and at regular intervals thereafter.
White 2018	PARTNER (Pairing Re-engineered ICU Teams with Nurse-Driven Emotional Support and Relationship-Building).	Surrogate decision makers for incapacitated, critically ill patients often struggle with decisions related to goals of care.	1) the PARTNER nurses received advanced communication training 2) a family support pathway was instituted, in which the PARTNER nurses met with families.	Intervention was delivered by members of the interprofessional ICU team and overseen by four to six nurses in each ICU (called the PARTNER nurses).	Advanced communication skills training - didactic teaching, modelling of communication skills, and provision of structured feedback. Nurse/clinician/family meetings - face to face.	Advanced communication skills training was 12 hours. PARTNER nurses met with families on a daily basis, according to a standardized protocol, and arranged clinician/family meetings within 48 hours after enrolment and then every 5 to 7 days.
Weiner 2020	Palliative Care Rounds (PCR).	Lacking medical school training in end-of-life care and in palliative issues is.	Residents prepare and present cases with psychosocially and ethically complex patient/family dynamics related to the end of life and life limiting illness.	The Palliative Care Team developed the program. Palliative Care Social Worker facilitated sessions for residents. Residency Chiefs recruited to lead communication efforts.	Face to face.	Monthly mandatory Palliative Care Rounds.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
Vuong 2019 Penrod 2011	Care and Communication Bundle tool.	To improve clinician/family communication is a central component of medical decision-making in the intensive care unit (ICU).	Day 0 = admission Day 1 = identification of appropriate decision-maker, advance directive status, assessment and treatment of pain, and distribution of family information leaflet. Day 3 = social work and spiritual support offered Day 5 = interdisciplinary family meeting.	A multidisciplinary committee was convened to implement the bundle in the MICU. .	Education around tool: Didactic, educational video. Care and Communication Bundle tool - included in daily goal sheet Information leaflet Electronic health record.	Triggers on ICU day 1, day 3, and day 5 added to a daily rounding goal sheet
Villarreal 2011	Daily 'pre-rounds'.	To identify patients who may benefit from a palliative care consultation.	Daily 'pre rounds' between palliative and medical ICU teams using clinical judgment and five clinical conditions to identify patients who may benefit from a palliative care consult.	Palliative care and medical ICU teams held the 'pre round' sessions.	Face to face.	Pre-rounds held each morning.
Vig 2019	Physician with ethics, palliative care, and geriatrics expertise attending weekly morning MICU rounds.	Ethics and palliative care involvement may promote improved quality of care and reduced staff moral distress.	Board certified palliative care and geriatric medicine specialist attended morning rounds with the medical ICU team.	Board certified palliative care and geriatric medicine specialist.	Face to face.	Rounds lasted approximately 1.75 hours per week.
Venis 2020	Palliative approach screening tool.	Identifying critically ill patients who have unmet needs for palliative care is the first step in integrating the palliative approach for patients and their families into intensive care units.	Screening tool used for patients admitted to ICU.	Bedside nurses.	Four step process on a single page with yes/no and tick boxes.	Screening done within 72 hours of ICU admission, then every Wednesday, and when required.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
VanHorn 2020	Minute of Silence nurse-facilitated reflective exercise.	To improve ICU nurses' emotional coping skills.	A guided reflective exercise for nurses to use immediately following a patient's death.	ICU bedside nurses completed the exercise.	Written answers to a printed question.	Following each patient's death in the intensive care unit.
Treece 2006 Curtis 2011 McCormick 2008 McCormick 2010	Interdisciplinary multifaceted intervention.	To improve ICU clinicians' ability to provide end-of-life care to critically ill patients and their families.	(1) clinician education about palliative care in the ICU, (2) identification and training champions (3) address individual ICU-specific barriers (4) feedback of individual ICU-specific quality data (5) implementation of system supports.	Authors delivered education at grand round and produced videos and pamphlets. At least one physician and several nurses in each ICU to serve as a champion, social workers, spiritual care providers, and respiratory therapists - were identified through interviews with the nurse and physician directors. Authors provided written material and local champions adapted it.	Education via grand round presentations, workshops, video presentations, written tools. Face-to-face meetings. Written materials.	Time commitment of interventions not stated
Treece 2004	Withdrawal of life support order form.	To improve quality of end-of-life care in the intensive care unit.	A standardized order form has sections on preparations, sedation/analgesia, withdrawal of mechanical ventilation, and the principles of life support withdrawal.	Used by ICU physicians and nurses.	Printed two-page order form.	To be used when withdrawing life support where the patient was expected to die.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
Stolzman 2020	Comfort care cart.	To provide a sense of a security that enhances the caring experience for friends and family experiencing imminent death of a loved one.	A 3-drawer dresser containing items for physical and emotional support.	Bedside nurses.	A 3-drawer dresser and physical items.	As required for families once goals of care shifted from curative to comfort-driven.
Sinha 2021	Asking the 'modified surprise question' - "Would you be surprised if this patient died during this hospital stay?".	To identify patients with whom to have a goals of care discussion with a shared decision-making model in a timely fashion.	Asking the 'modified surprise question' during unit huddle. If positive, legal surrogate decision maker documented in electronic medical record and medical team were then encouraged to explore goals of care and document this discussion.	A physician from the palliative care team attended the unit huddle to pose the modified surprise question. Social worker identified the patient's legal surrogate decision maker. Primary team were encouraged to have the patient/legal surrogate discussion.	Face-to-face.	Up to three weekdays per week - modified surprise question ideally asked within 24 hours of admission. Patient's screening positive would have their legal surrogate documented by day 3 and a discussion regarding goals of care was attempted by day 4.
Sihra 2011	Direct telephone communication between the palliative care physician and the attending physician.	To increase the number of palliative care consults in the ICU.	Patients were screened, then a phone call was placed by palliative care physician to the attending physician discussing palliative care domains and offering palliative care services to the patient.	Patients were screened by medical ICU nurses. A palliative care physician conducted the phone call with the attending physician.	Telephone.	Patients screened 2 or 3 times per week.

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Shifrin 2016	An educational session.	Improve end-of-life care amongst registered nurses.	A classroom and evidence based educational session on end-of-life nursing.	Three nurse practitioners with doctoral degrees and practice experience in palliative care and/or critical care reviewed the educational content and served as content experts for the curriculum development. A single instructor taught all education sessions.	Face to face teaching.	3.5 hours.
Schwarzkopf 2020	Multifaceted intervention.	To improve end-of-life decision-making and communication.	(1) improved documentation in electronic records of long-term and daily goals of care and (2) content of family conferences (3) introduction of psychologist communication facilitator (4) ICU diary (5) EOL communication skills training (6) debriefing sessions (7) quiet waiting and conference rooms.	Treating nurses or physicians decided use of ICU diary and/or communication facilitator (psychologist). Nurses, physicians, psychologists, and relatives completed ICU diaries. Hospital pastor and experienced attending moderated the debriefing sessions.	Electronic records. Face-to-face meetings.	Goals of care – daily.

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Schenker 2015 Barnato 2017	A post-intensive care unit storytelling intervention.	To reduce emotional distress among surrogates involved in a decision to limit life support in the ICU.	Printed bereavement materials (mailed letter of condolence, newsletter, and guide about support resources), and follow-up assessments. Storytelling involved a single 1–2 hour home or telephone visit by a trained interventionist who elicited the surrogate's story 4 weeks after death. Storytelling training including an in-person didactic and experiential seminar, detailed review of the manual, and study of interview examples.	2 x trained interventionists (licensed social workers) collated stories.	Contact via letter. Home visit or telephone assessments. In-person training.	Contact via letter 1 week after death. 1–2-hour home or telephone visit 4 weeks after death.
Scharf 2021	Psychological support tools for families of patients receiving withdrawal of life-sustaining treatment in the intensive care unit.	To provide information needed to prepare for withdrawal of treatment, and support during the active phase of dying	Items from a comfort cart, and psychological support provided before, during, and after withdrawal.	Psychological support provided by a research nurse specialising in end-of-life family support. Intensive care unit team provided their usual care (nurses, physicians, pastoral care representative, case manager, social worker, and palliative care clinician).	Educational booklet - printed resource. Psychological support - in person. Comfort cart - two-drawer cabinet containing items for physical and emotional support.	Screen for potential patients at daily collaborative care meetings.

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Santiago 2017	Formal bereavement program.	To help family members who experience the death of a loved one in the ICU.	Bereavement brochure/pamphlet including community support system information and educational materials about grief management. Sympathy card signed by ICU staff. Telephone follow-up using a structured script. Invitation to a hospital memorial service.	Brochure developed by spiritual care department, provided by chaplain or bedside nurse to the next of kin. ICU staff signed sympathy cards, which were mailed by the study team. Intensive care unit social workers conducted telephone follow-up. The memorial service is developed and delivered by the spiritual care department with the medical-surgical ICU chaplain recording attendance.	Printed resources. Telephone follow-up. In person memorial service.	Sympathy cards were sent 10 days after a patient's death. Bereavement brochure given to next of kin following a patient's death. Telephone follow-up conducted 3 weeks after patient's death. Memorial services held quarterly.

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Radcliffe 2015	A supportive care pathway for end-of-life care.	Ensure that all individuals have access to high-quality palliative care, regardless of diagnosis. Facilitate preferred place of care. Provide evidence of care given. Prompt holistic care. Enable clear planning of care. Provide patients with a clear understanding of the final phase of their illness. Improve patient experience and reduce variation in care.	A paper document that directs attention to the care needs of patients and families to create individualised care plans. Supported by regular ward round involving consultant with specialist interest in palliative care to identify patients who would benefit from the care pathway.	Supportive care pathway completed by nursing, medical, and allied health professional staff members. Consultant with specialist interest in palliative care.	Face to face (ward rounds). Supportive care pathway = paper document.	Supportive care pathway was used as the main clinical record.
Poi 2021	ICU-Palliative Care Referral Checklist + combined ICU-palliative care ward rounds + Palliative care team review.	To improve provision of effective, high-quality end-of-life care for critically ill patients.	19-point ICU-Palliative Care Referral Checklist. Combined ICU-palliative care ward round to screen patients and ICU team could refer on non-screening days. Critically ill patients who met the referral criteria referred to ICU-Palliative Care Service.	Screening and referrals were done by the ICU and palliative care teams. ICU-palliative care team - palliative care physicians and clinical nurse specialist.	In person ward rounds. Physical checklist.	Weekly combined ICU-palliative care ward rounds but ICU teams could refer any day. Palliative care team review of patients on same day as referral. Patients with high symptom burden were reviewed daily. Families were updated regularly on the progress of their loved ones.

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Poi 2022	Neuro ICU-Palliative Care referral criteria + combined ICU-palliative meetings + Palliative care team review.	To improve accessibility of palliative care to critically ill neurosurgical patients.	4-point referral criteria. Patients referred if met 1 and review by palliative care team. Weekly combined ICU-palliative meetings.	Palliative care team initially and then ICU nurse in charge triggered referrals. Palliative care team – palliative care physician and advanced nurse practitioner with ICU experience.	Checklist/screening criteria. Face to face meetings.	Screening within 24 hours of admission. Weekly inter-professional meetings. Regular discussions between palliative care and ICU teams throughout the week. Palliative care team review patients on same day of referral. Daily review of symptomatic patients to optimize symptom control.
Pavlish 2020	Team-based ethics protocol.	To promote ethics-related discussion and activate early family conferences and referrals for additional support.	Ethics Early Action protocol – required clinicians to analyse patient, family, and situational risk factors - each risk level accompanied by an action plan.	Clinicians completed protocol.	Protocol via computer software.	Protocol completed daily.
Pachchigar 2021	Electronic clinical information-based end-of-life care protocol.	To provide an efficient method for documentation, communication, and timely delivery of comfort care.	End-of-life care (EOLC) protocol with links to standard medication order sets, EOLC progress notes for documenting family meetings/goals of care/Acute Resuscitation Plan, and an area for recording symptoms EOLC checklist to prompt actions in specific areas of EOLC.	ICU teams used the protocol.	Electronic clinical information system-based end-of-life care protocol (computer-based tick box process).	Used for end-of-life care patients.

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Orr 2020	Sequential Organ Failure Assessment (SOFA) Score.	To increase the precision of prognosis and timeliness of EOL goals-of-care communication.	SOFA (sequential organ failure assessment) for mortality risk prediction used as part of workflow and practice.	Researchers calculated SOFA score ICU providers (MICU fellows, residents, intern physicians, Acute Care Nurse Practitioners, Physician Assistants) reviewed the SOFA score.	SOFA score calculated online.	Scores calculated daily.
Ong 2020	'death rounds'/ 'care rounds'.	To support critical care nurses providing end-of-life care.	Meetings involving one minute of reflection, then discussion, and expressions of appreciation.	A palliative medicine associate consultant conducted the death rounds. Mainly for nurses but were opened to whole multidisciplinary team.	Face to face meetings.	Monthly for one hour each time.
O'Mahony 2010	Integration of palliative care team.	(1) provide a culturally competent model of care for critically ill patients at the end of life; (2) integrate the palliative care service into daily operations of the ICU; and (3) increase access to hospice services for patients at the end of life in the ICU.	Advanced Nurse Practitioner identified eligible patients by attending daily rounds of the interdisciplinary critical care team and reviewed appropriateness of referral with the intensivist team. Consultative clinical service provided to those referred.	Palliative care team included a palliative medicine physician, an advanced practice nurse, and a palliative care social worker.	Face to face rounds. Electronic referrals. Face to face reviews.	Daily ICU rounds and referrals electronically when needed.
Noome 2017	Implementation support for End-of-life care guidelines.	To support intensive care units to implement end-of-life care guidelines.	A programme supporting the nurses during guideline implementation. Meetings covered teaching on implementation.	2 nurses with at least 1 year ICU work experience acted as 'implementation leaders'. Nurses attended the meetings.	Folders, presentations Face to face meetings - lectures, workshops, group work.	4 meetings. Each meeting lasted 1 day.

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Myers 2021	Teaching techniques for stress reduction and active listening.	To decrease stress and discomfort when communicating with patients and their families when providing end-of-life care.	Taught content using short presentations, exercises, roleplays, demonstrations of active listening skills, and hands-on experiences of evidence-based techniques for stress reduction.	The first author (J.C.M.) planned and presented the program.	Face to face.	Sessions were 4 to 5 minutes each,3 days a week during morning huddle, for 4 weeks.
Mun 2016 Mun 2018	Trigger criteria.	To improve more timely palliative care involvement.	6-point trigger criteria - initiated a process to determine the need for an ICU family meeting, directed patients/families to informational videos on goals of care and then, should further intervention be required, for a palliative care consultation.	ICU team screened. Family meeting - social worker and ICU physician. Multidisciplinary palliative care consultation.	Online videos. Checklist. Face to face meetings.	Screening criteria were used on admission and as a daily checklist. ICU family meeting by day 3 post-admission. Multidisciplinary palliative care family meeting by day 5 if needed.

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Mosenthal 2006 Mosenthal 2008 Lamba 2012	Multistep palliative care intervention.	To Integrate palliative care into the ICU and improve end-of-life care practice.	Bereavement/psychosocial support. Interdisciplinary palliative care assessment. An interdisciplinary family meeting was held regardless of prognosis. Comprehensive palliative care plan by 72 hrs. Palliative Care Standing Order Set for patients who are identified as imminently dying. Integration of palliative care performance measures into morbidity and mortality review.	Bereavement/psychosocial support by a team consisting of palliative care counsellors and pastoral care. Palliative care assessment by physician and nurse. Family meeting with physician and nurse	Face to face rounds and meetings.	Bereavement/psychosocial support and Interdisciplinary palliative care assessment within 24 hrs of admission. Family meeting within 72 hours of admission. Comprehensive palliative care plan by 72 hrs.
Minor 2009	A formal palliative and EOL care curriculum for junior residents during an ICU rotation	To improve palliative and EOL attitudes and competencies	Didactic lectures (2 x 1-hour sessions), ethics seminars (4 x 1-hour sessions), and opportunities to conduct meetings with patients and families with formal feedback.	Residents received teaching. Not stated who delivered teaching.	Face to face lectures, seminars, and meeting. Printed material - learning guide for ICU patient/family conferences.	2-month curriculum. 6 x 1-hour lecture/seminar sessions.

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McCarroll 2018	Palliative care screening tool.	To help increase the proportion of palliative care consultations in the ICU setting.	8 point palliative care screening tool. If a consultation was warranted based on the presence of a palliative care trigger, the nurse was expected to discuss this during daily interdisciplinary grand rounds with the pulmonary critical care attending physician.	Unit secretary placed the screening tool in patient's bedside book upon admission, and each day thereafter. Nursing staff responsible for administering the screening tool.	Physical screening tool form.	Daily upon admission and each day thereafter.
Markin 2015	Simulation-Based Communication Workshop.	To improve resident preparedness for end-of-life communication in the ICU.	Small group sessions on end-of-life communication skills. Written module sent 1 week prior to the session, a short didactic overview of the core skills, faculty demonstration, and resident practice with a simulated ICU family member.	A primary faculty facilitator and a co-facilitator trained in the 'VitalTalk' method. Simulated ICU family member (improvisational actor).	Written materials. Face-to-face sessions.	3 x 90-minute sessions held over 2 x 3-day workshops

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MachareDelgado 2009	Multidisciplinary family meeting for patients at high risk of dying	To improve communication and understanding between patients' family and the treating team.	Meeting held between the multidisciplinary team and the family of each patient deemed at high risk of dying using a structured multidisciplinary team and family conference (MTFC) form to record pertinent details of the meeting as well as the treatment goals.	Potential participants included the critical care attending physician, fellow and residents, the ICU nurse, clinical nurse specialist, members of the palliative care team, other consulting physicians, social worker, and pastoral care provider. A designated discussion initiator was chosen prior to each family meeting. After meetings, the MTFC was reviewed by the critical care attending physician.	Face-to-face meetings. Written form.	For all patients requiring mechanical ventilation for 5 days and then further meetings held every 3 days thereafter or earlier if requested by the relatives until consensus and treatment plan formed.

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Ma 2019	Early triggered palliative care consultation	To improve care of high risk, critically ill patients.	Nine-point screening tool to identify patients at high risk for morbidity and mortality. Intervention group received a palliative care consultation within 48 hours of MICU admission - included a chart review of the patient's hospitalisation, meeting with the patient and available healthcare proxies, identification of physical and emotional needs of the patient and family, discussion with the primary team on how best to meet those needs, and communication between all parties with respect to goals, values, and treatment decisions Regular visits by the interprofessional palliative care team followed.	Interprofessional palliative care team including a physician board-certified in palliative care, nurse practitioners, a palliative care clinical fellow, a social worker, and a chaplain. A board-certified palliative care physician or nurse practitioner performed the initial evaluation, and a care plan for each consultation was discussed by the entire palliative care team at rounds, with additional team members participating as appropriate.	Face to face	Within 48 hours of admission. Patients followed throughout admission, but not stated at what intervals.

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Love 2022	Palliative Care Triggers.	To improve interdisciplinary collaboration for patient and family care.	A 3-point trigger system. If a patient in the SICU met any of the 3 trigger criteria, the SICU team consulted palliative care and listed the trigger criterion as the reason for consult. The SICU team discussed this with the surgeon of record at the time the consult was placed to ensure provider agreement and collaboration. The palliative care team then completed initial consultation and continued follow-up as needed.	SICU team used trigger criteria.	Not stated for triggers. Palliative care consultant recorded in electronic records.	All patients screened – Time commitment of interventions not stated.
LeFrancois 2018	Multifaceted intervention.	To improve end-of-life care for patients in an open intensive care unit.	Training in end-of-life care and adaption of tools to promote communication with the patient or family or to facilitate interdisciplinary work.	Nurses, physicians, managers, and other stakeholders working in the unit	Face-to-face training. 'Who am I' poster. Sunset sign. Poster of main values of care.	Time commitment of interventions not stated

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Kentish-Barnes 2022	Three-step support strategy for families.	In relatives of patients dying in intensive care units (ICUs), inadequate team support can increase the prevalence of prolonged grief and other psychological harm.	A physician-driven, nurse-aided, three-step support strategy for families throughout the dying process. Three meetings held with relatives: a family conference to prepare the relatives for the imminent death, an ICU-room visit to provide active support, and a meeting after the patient's death to offer condolences and closure.	ICU physician and nurse in charge of the patient.	Face-to-face.	First meeting following a decision to withdraw or withhold life support. Second during the dying process when deemed appropriate. Third within the hours following patient's death or when family returned for administrative purposes.
Kentish-Barnes 2017	Handwritten condolence letter.	To reduce symptoms of stress, anxiety, depression, posttraumatic stress disorder (PTSD), and/or prolonged grief.	Hand-written condolence letter and address written 3 days after patient's death, kept in the physician's office until it was sent by standard mail 15 days after the patient's death.	The physician and nurse in charge at the time of death wrote the letter and address on the envelope. Study investigators provided a guide for writing letters.	Handwritten letter.	Condolence letter prepared within 3 days after the patient's death - sent by standard mail 15 days after the patient's death.

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Kaminski 2022	An educational program.	1) increase awareness of surgical intensive care unit (SICU) providers on the need for end-of-life education, and 2) increase confidence of SICU providers in having end of life conversations with patients and families over a 3-month time period	Virtual presentation - review of advance care planning principles and importance of goals of care conversations for the SICU population, how to initiate goals of care conversations, and components of ACP documentation.	Presentation was created by the author	Virtual presentation with EOL conversation simulation videos and plain text PowerPoint slides.	30-minute presentation.
Jones 2017	Palliative triggers.	To integrate palliative care discussions into the ICU setting.	ICU team presented with triggers if not seen by palliative care team already). If the patient met 1 of the 4 triggers - 3 different options. Exit – screen shown next time record opened Not appropriate – reshown in 48 hours Refer to palliative care team for review	ICU physician, advanced practice practitioner or nurses used the tool.	Triggers within electronic medical record.	Each time a patient chart was opened triggers appeared. Reshown 48 hours later if negative screen.
Jenko 2015	Palliative Performance Scale, version 2 (PPSv2), as a trigger for palliative care referral.	Increase the use of palliative care services.	PPSv2 (11-point scale) used as a prognostic tool and score of 40-60 triggered palliative care referral.	ICU nurses.	Training of bedside nurses (N=27) face to face with handouts, PowerPoint presentation and posters/badge sized scale. PPSv2 documented on daily review.	PPSv2 on daily review.

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Hurst 2018	Screening tool.	To increase timeliness and frequency of palliative care consultation.	Six-point screening tool. Selection of any item on the screening tool triggered palliative care consultation.	MICU rounding team screened patients.	Paper screening form.	Single screen within first 24 hours of admission.
Higginson 2013	Psychosocial Assessment and Communication Evaluation (PACE) record.	To improve communication and palliative care	The PACE record asks for assessment of five aspects: a) Family details, b) social details, c) patient preferences, d) communication and information, e) Any other issues plus space for a continuing log of any communication update and a list of useful resources.	Nurses, doctors, staff from palliative care, pharmacy, physiotherapy, occupational therapy, speech and language therapy, and chaplaincy departments.	The PACE record is on two sides of paper.	Within 24 hours of admission to ICU
Graham 2018	Interprofessional end-of-life/palliative care educational intervention.	To improve knowledge around palliative and end of life care in ICU.	Seven self-accessible online modules via Dropbox, and following their completion, participation in a one-hour in-person group integration activity.	ICU clinicians.	Online modules via Dropbox. Face-to-face group.	Seven online modules (10,60,45,30,60,30,60mins) + 60 minute in-person group integration activity afterwards.

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Gordon 2012	The Building Bridges Education Day.	To raise awareness of end-of-life care challenges and improve interprofessional dialogue	8-hour education day. An opportunity to explore common elements of ICU work including moral distress, demonstrated Wellness and team communication strategies.	ICU staff.	Face-to-face mixed methods teaching - panel format in small and large groups, interprofessional teaching models, role play, panel discussion, hands-on activities to promote staff care and wellness, facilitated participant discussions, case studies. Resource sheets - "Plan to thrive" worksheet.	8-hour education day, delivered 12 times over 6 months
Ganz 2020	Continuing education course in ICU palliative care.	Improve palliative care knowledge, attitudes, and practices.	Theoretical and experiential content including history and principles of palliative care; symptom management; communication; end of life treatment of chronic illnesses; spiritual care; ethics; legal aspects and its impact on nursing care; and patient and family cantered care.	Lecturers included known national nursing and physician leaders in palliative and intensive care.	Face-to-face meetings. Then train the trainer model where members would serve as champions on their own units.	The course met every 2 weeks over a 6-month period for a total of 112 h. Content over a total of 14 days.

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Finkelstein 2016	Palliative care triggers.	To integrate palliative care into the surgical intensive care unit.	Six-point trigger criteria. Palliative care consultation team rounded with the SICU intensivist and concurred that a patient met a trigger criteria plus palliative care consultation was available on an as-needed basis.	Surgical ICU and palliative care clinicians.	Face-to-face rounds. Written trigger criteria.	Palliative care consultation team then rounded with SICU intensivist on weekdays after morning bedside rounds + referral on an as-needed basis.
Dowdy 1998	Proactive ethics consultation.	To improve communication and decision-making between physicians, patients, and the full care team.	A proactive ethics consultation was provided to the clinical team as a consultee-centered consultation designed to increase the team's attention to key decision-making and communication process issues as they arise in the care of critically and terminally ill patients. Six core questions – chart review first to find and highlight answers plus observational tool to gather documentation in the patient's medical record of communications regarding treatment decisions.	Consultation was provided by a team of two clinicians trained in clinical ethics.	Face-to-face meetings. Patient charts. Documentation tool.	Efforts to facilitate communication were conducted in the normal course of visiting the unit each day in the early morning and afternoon hours. Daily rounds by physicians provided the opportunity for the consultants to continue exploring any issues which remained unresolved.

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Curtis 2012 Curtis 2016	Communication facilitator.	To increase families' and clinicians' self-efficacy expectations about communication in the ICU	1) in-person interviews by the facilitator with the family 2) in-person meetings by the facilitator with physicians, nurses, or other clinicians in which a summary describing the family's concerns, questions, needs, and unique communication characteristics 3)provision of emotional support in a manner most likely to complement the family member's attachment style 4) facilitator participation in family conferences when possible 5)facilitator follow-up with the family throughout the ICU stay and at discharge	Communication facilitators - individuals with nursing or social work backgrounds	Communication facilitators assisted families of patients by providing communication support during the ICU stay.	Time commitment of interventions not stated except >24 hours after admission.
Creutzfeldt 2015	Palliative Care Needs Screening Tool.	To encourage the ICU team to identify palliative care needs for patients and their families and potential ways to meet those needs	Four-point Palliative Care Needs Screening Tool.	Implemented by one of the ICU team members, most often the critical care nurse practitioner.	Screening questions read out loud on face-to-face rounds.	Daily on morning rounds for 1 of 2 neurocritical care services that alternate admitting days to a single neuro-ICU. Questions asked every morning after each case presentation.

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Cralley 2022	Multifaceted intervention.	To implement palliative care principles and practices.	Surgeon champion, resident education, and an electronic medical record template, called the Advance Care Planning (ACP) Note, for use on daily rounds.	Trauma surgeon champion driven. Resident education by a multidisciplinary working group composed of a trauma surgeon, a palliative care physician, and a specialized palliative care advance practice provider. Advance Care Planning Note - completed by SICU residents.	Face to face, digitally via electronic medical record.	Resident education 1 hour lecture. Advance Care Planning Note - completed for all patients within 24 hours of admission after a conversation with a patient or family members.
Cox 2018	Palliative Care Planner.	To enhance the delivery of needs-targeted palliative care.	An electronic health record (EHR) system-integrated mobile web app system - PCplanner (Palliative Care Planner). PCplanner screens the EHR for ICU patients meeting any of five prompts (triggers) for palliative care consultation, allows families to report their unmet palliative care needs, and alerts clinicians to these needs.	Nurse champion, ICU attending.	Electronic health records. Face to face palliative care team and family meetings.	Daily review for e-trigger positive patients.

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Constantine 2016	Multifaceted educational intervention.	To improve the documentation of the nine quality measures of the Care and Communication Bundle in the ICU.	Education materials included academic detailing at leadership and staff meetings, presence of posters in the ICU and a bedside nursing checklist, and completion of an online learning module.	The project leader developed and implemented materials and procedures	Face to face, printed materials, online learning module.	1 month of educational interventions being made available (no time commitments noted other than 45-minute online module).
Carson 2016	Palliative care clinician-led informational and emotional support meetings.	To improve family anxiety and depression.	Brochure describing chronic critical illness. Pre-meetings for information gathering. Structured family meetings led by palliative care specialists.	Support and information team (palliative care physician and nurse practitioner +/- social worker, chaplain, other disciplines as required).	Brochure. Face-to-face meetings.	The first meeting was conducted after 7 days of mechanical ventilation. The second support meetings was 10 days later.
Brown 2015	Educational intervention.	Addressing palliative care in the intensive care unit and the needs of the HIV/AIDS patients and families.	Conference/classroom-based educational intervention. Content included an overview of HIV/AIDS palliative care along with common health and physical assessment skills, pharmacological interventions, nutritional measures, and communication skills, with emphasis on issues such as the stigma, experienced by patients with HIV/AIDS.	Does not state who taught.	Face-to-face teaching. Materials included PowerPoint presentations, videos, handouts, class participation.	5 teaching days (8am - 12.30pm) over 10 weeks.

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Braus 2016	Placement of palliative care specialists within the ICU department.	To prompt the critical care team to consider patients' and families' palliative care needs.	A member of the hospital's Palliative Care (PC) consult team was relocated from the palliative care unit to the ICU. The PC clinician was informed about patients meeting trigger criteria and then reviewed the electronic medical record (EMR) of each of these patients and participated in interdisciplinary morning bedside ICU rounds with the critical care medicine team. Day 1 of identification - PC clinician informed the medical team that the patient met one or more of the trigger criteria, and which trigger criteria or criterion the patient met. Subsequent days - the PC clinician would make suggestions about addressing palliative care needs, as appropriate, including recommending that interdisciplinary family meetings be held in a timely fashion.	Investigators screened ICU census identify patients with pre-specified criteria. Member of the hospital's Palliative Care (PC) consult team (on most days a Palliative Care clinical nurse specialist, who has many years of experience in both hospice and palliative care practice, and on other days (<10%), a Palliative medicine fellow or faculty member)	Electronic medical record. Face-to-face meetings.	Each weekday morning to identify and interactions on subsequent days.

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Booth 2016	Educational plan.	For change of knowledge and behaviours related to advance care planning	Educational intervention - informal discussion led by investigator. State-specific resources on completing a living will. Brochure detailing advance directives. PowerPoint slides on patient codes, code status, and how knowledge of advance directives affects treatment preferences.	Investigator provided educational information.	Face-to-face. Brochure. PowerPoint slides.	Time commitment of interventions not stated

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Black 2013	Multifaceted behavioural change intervention.	To improve compliance with process measures for ICU clinician communication with ICU patients and families.	The intervention was developed with the following components: a multidisciplinary steering committee, development and distribution of print and web-based educational materials, recruitment, and training of local champions in each institution, state-wide launch meetings (Learning Sessions), educational outreach meetings at each institution, monthly conference calls, and a secure database for data collection and to support routine audit and feedback at an institutional and state-wide level.	Multidisciplinary steering committee. Local champions. Not specified further.	Print and web-based educational materials, recruitment, and training of local champions. Face-to-face and online meetings.	Time commitment of interventions not stated.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
Billings 2006	Multifaceted intervention.	So palliative care and intensive care clinicians would share their expertise and develop projects that promote end-of-life care in a medical intensive care unit (ICU) setting.	1. Collaborate with intensive care unit leaders. 2. Palliative care nurse champions. 3. Staff education around: Communication skills, Goals of care and shared decision making, Psychosocial assessment and management, Cultural sensitivity, Symptom management, Existential/spiritual suffering. 4. Palliative care specialist on rounds. 5. Promote family meetings through teaching, role play, modelling, coaching, and providing and encouraging feedback. 6. Open visiting hours. 7. Get to know me poster. 8. Staff support.	ICU nurses and physicians. Palliative care specialists.	Written information - 3x5‚Äìinch cards and brief handouts on family meetings, Get to Know me posters, a ventilator withdrawal protocol, a brochure for patients and families to introduce them to MICU organization and procedures, and brochures on advance care planning and acting as a proxy Staff Education - Specialized training was conducted in a variety of forums: through the daily work of the Palliative Care Nurse Champions, standard and new teaching sessions, discussions on rounds, informal consultations, and written materials, monthly teaching conference for residents. Variety of forms meant to cue staff to attend to palliative care issues. Face-to-face palliative care specialist physician presence on rounds.	Time commitment of interventions not stated.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
Babar 2021	Screening at morning huddle for early palliative medicine consultation.	To improve change in code status, referral to hospice, tracheostomy, and or percutaneous gastrostomy tube placement.	Case managers screened all newly admitted patients with four pre-determined triggers; primary care team identified other suitable candidates who did not meet triggers. At morning huddle, the case managers announced the patients who triggered the early palliative medicine consultation. Patient information was updated on whiteboard to indicate potential palliative medicine referrals; referrals process was followed as usual.	Huddle is comprised of critical care physicians, a critical care fellow, internal medicine residents, the ICU charge nurse, respiratory therapists, a clinical pharmacist, and nurse and/or social work case managers. Case managers and primary care team identified patients.	Face-to-face huddle. Whiteboard.	Morning huddle daily at 8:30 am
Anderson 2017	Palliative care professional development program for ICU bedside nurses	To improve ratings of nurses' palliative care communication skills in surveys, and nurses' identification of palliative care needs during coaching rounds.	Program consisted of 8-hour communication workshops for bedside nurses and structured rounds in ICUs, where nurse leaders coached bedside nurses in identifying and addressing palliative care needs.	Palliative care advanced practice nurses and nurse educators completed a train-the-trainer program followed by mentoring to implement the initiative.	In-person training session followed by 2-day site visits, monthly phone calls, and yearly in-person meetings to guide nurse leaders at each site; leaders then went to respective hospitals and implemented the initiative to their nursing teams.	3-day training session followed by 2-day site visits, monthly phone calls, and yearly in-person meetings over 2 years.

Study ID(s)	Brief name	Why?	What? (Materials and procedures)	Who provided?	How? (Mode of delivery)	When and how much?
Akgun 2019	Clinical champion and ICU-Family Meeting templates.		1) ICU-Family Meeting toolkit 2) Didactics and training 3) Networking and coaching between local facilities and coaches	ICU-FM workgroup was led by a physician with expertise in medical oncology and palliative medicine and included nursing and physician professionals with a breadth of experience in QI, system redesign, and clinical care for patients with serious medical illnesses.	The toolkit included handouts, pocket cards, and worksheets for clinicians to reference and informational booklets for patients and families. Samples of FM note templates also provided. Didactics and training - interactive webinar, roleplay Networking and coaching - teleconference	Coaching meetings held at least quarterly. Time commitment of interventions not stated.

11.6 Appendix 6: Reported Palliative Care Outcomes

Table 12: Reported palliative care outcomes

System - related (do not relate to a single unit of observation but rather to a percentage or group of delivered care)	Content - related (actual care being provided for individual)
Discharge destination Mortality Site of death Frequency of trigger item Frequency of code/escalation statuses Frequency/proportion of palliative care referrals/consultations Frequency of ethics consultations Frequency of use of mechanical ventilation or vasopressors Frequency/timing of the documentation of surrogate decision maker and goals of care conversations Frequency/timing of family meetings Frequency of WOLST Frequency of investigations	ICU length of stay ICU length of stay after palliative care consultation Hospital length of stay ICU cost Number of ICU days before death Antibiotic administration Vasopressor administration Parenteral nutrition administration Narcotic administration Benzodiazepine administration Administration of medications for symptoms control Advice on symptom management Screen score

Frequency of invasive procedures Frequency of change in treatment focus Frequency of advance care planning discussions Frequency of documentation of proxy and living will Frequency of use of withdrawal protocol Proportion with pastoral care visit Proportion who achieved regular pain assessment based on 4-hour intervals Proportion who achieved regular optimal pain management based on 4-hour intervals Proportion with change to code/escalation status during admission Proportion readmitted within a timeframe Proportion positive/negative on scoring/trigger system Proportion of GOC conversations conducted by the primary team	Date of/number of days until palliative care referral/consult Timing of the documentation of surrogate decision maker and goals of care conversations Timing of family meetings Content of communication Participation of social workers Participation of spiritual support Duration of mechanical ventilation Number of ventilator-free days Duration of vasopressors Management of withdrawal of life-sustaining measures
Patient/family - related	Clinician - related
Surrogate rating of quality of care (Quality of Communication (QOC)) Surrogates rating of patient-centeredness of care Surrogates’ perceived self-efficacy to make medical decisions for the patient (Decision Self-Efficacy Scale)	Clinician assessment of quality of EOLC using ICU-QODD Clinician end-of-life care knowledge/skills Clinician self-reported self-efficacy in end-of-life care Clinician satisfaction

Surrogates’ long-term psychological distress (Hospital Anxiety and Depression Scale score) Family depression (Patient Health Questionnaire [PHQ]-9) Family anxiety (Generalized Anxiety Disorder-7) Post-traumatic stress disorder incidence Symptoms of PTSD (Civilian Post-Traumatic Stress Disorder Checklist (PCL-C)) Complicated grief incidence Surrogate rating of the quality of clinician Families Quality of Dying and Death (QODD) score Family Satisfaction in the ICU (FS-ICU) score Emotional distress (The Subjective Units of Distress scores (SUDS)) Preparedness and support Prolonged Grief score (PG-13) Wellbeing and health Impact of events scale Family quality of EOLC using ICU-QODD + family focus group Palliative care needs - adapted needs of social nature, existential concerns, symptoms, and therapeutic interaction (NEST) scale	Clinician emotions after death Clinician Quality of Dying and Death (QODD) score Risk for professional burn out for clinicians Clinician emotional exhaustion Clinician depersonalisation Clinician accomplishment Clinician experience anxiety/frustration when communicating with a patient or family regarding EOL care. Clinician perceived support Provider confidence (End-of-Life Professional Caregiver Survey)

Patient-Centeredness of Care Scale (PCCS) Perceived Stress Scale (PSS) Bereaved Family Survey (BFS) Bereaved Family Survey-Performance Measure (BFS-PM)	

11.7 Appendix 7: Mixed Method Assessment Tool Scores

Table 13: Mixed Methods Assessment Tool Scores

Study ID	MMAT Criterion																									Score
	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	5.4	5.5	
Zalenski 2017																0	1	1	1	1						****
Zalenski 2014																1	1	1	1	1						*****
Yeung 2021	1	1	1	1	1																					*****
Yang 2021											1	1	0	1	0											***
White 2012	1	1	1	0	1						0	1	1	1	1						1	1	1	1	1	****
White 2018						1	1	1	1	1																*****
Weiner 2020																1	1	1	1	1						*****
Vuong 2019											0	1	1	0	1											***
Villarreal 2011											CT	1	1	0	1											***
Vig 2019	0	0	0	1	1											1	0	1	0	0	1	1	1	CT	CT	**
Venis 2020	1	1	1	CT	1											1	0	1	0	1	1	0	1	1	0	***
Vanstone 2020	1	1	1	1	1																					*****
VanHorn 2020	1	0	1	0	1											1	1	1	0	1	1	1	1	0	0	***
Treece 2006	1	1	0	0	0																					**
Treece 2004											1	1	1	1	0											****
Takaoka 2021	1	1	1	1	1											1	1	1	1	1	1	1	1	1	1	*****
Stolzman 2020	1	0	0	1	1																					***
Sinha 2021											1	1	1	0	1											****
Sihra 2011											0	1	1	1	0											***
Shifrin 2016											0	1	1	0	0											**
Schwarzkopf 2020											1	1	1	1	1											*****
Schenker 2015	1	1	1	1	1																					*****
Scharf 2021	0	1	1	0	0											1	1	1	1	1	1	1	1	0	0	**
Santiago 2017	0	1	1	0	0											1	0	1	0	0	1	1	0	1	CT	**
Radcliffe 2015	1	1	CT	1	0																					***
Poi 2021																1	1	1	1	1						*****
Poi 2021											1	1	1	v	1											****
Penrod 2011											1	1	CT	0	1											***
Pavlish 2020											1	1	1	CT	1											****
Pachchigar 2021																CT	1	1	1	1						****
Orr 2020	1	1	1	1	1											1	1	1	1	1	1	1	1	CT	CT	****
Ong 2020	1	1	1	1	1																					*****
O'Mahony 2010																					1	1	1	1	0	****
Noome 2017																					1	1	1	CT	CT	***
Neville 2022											1	1	1	0	1											***

Myers 2021											CT	1	1	0	1											***
Mun 2018											CT	0	1	1	0											**
Mun 2016											CT	1	1	0	0											**
Mosenthal 2008																CT	1	1	1	1						****
Mosenthal 2006	1	1	CT	1	0																					***
Minor 2009											CT	1	CT	1	1											***
McCormick 2010											CT	0	0	1	1											**
McCormick 2008											CT	1	0	0	1											**
McCarroll 2018											CT	1	0	1	0											**
Markin 2015											1	1	1	0	1											****
MachareDelgado																1	1	1	1	1						*****
Ma 2019						1	1	1	0	CT																***
Love 2022																CT	1	1	0	1						***
LeFrancois 2018	1	1	1	0	1											1	0	1	0	0	1	1	CT	1	1	**
Lamba 2012	1	1	1	0	1											1	1	1	1	1	1	1	1	CT	1	****
Kentish-Barnes	1	1	1	0	1																					****
Kentish-Barnes						1	1	1	1	1																*****
Kaminski 2022											0	1	0	1	1											***
Jones 2017																1	1	1	1	1						*****
Jenko 2015	1	1	1	1	1						1	1	1	1	1						1	1	1	1	1	*****
Hurst 2018											0	1	1	CT	1											***
Higginson 2013	1	1	1	1	1						1	1	1	1	1						1	1	1	1	1	*****
Graham 2018	1	1	1	1	1						1	1	1	1	1						1	1	1	1	1	*****
Gordon 2012	1	0	1	0	1											1	0	1	0	0	1	1	CT	1	0	**
Ganz 2020	1	0	1	1	1						1	1	1	1	1						1	1	1	1	1	****
Finkelstein 2016																1	1	1	1	1						*****
Dowdy 1998											1	1	1	1	1											*****
Curtis 2016						1	1	0	CT	1																***
Curtis 2011						CT	1	1	0	0																**
Curtis 2012	1	1	1	1	1																					*****
Creutzfeldt 2015																1	1	1	1	1						*****
Cralley 2022											1	1	CT	1	1											****
Cox 2018											1	1	0	1	1											***
Constantine 2016											0	1	0	1	1											***
Carson 2016						1	1	0	1	1																****
Brown 2015											0	1	1	0	1											***
Braus 2016											1	1	0	1	1											****
Booth 2016											1	0	0	0	1											**
Black 2013											1	1	1	1	1											*****
Billings 2006	1	1	0	0		CT																				**
Barnato 2017	1	0	1	1	1						0	1	1	1	1						1	1	1	1	1	****
Babar 2021																1	1	1	1	1						*****

Anderson 2017	1	1	1	1	1						0	1	1	0	1						1	1	1	CT	1	***
Akgun 2019											1	1	0	1	1											****

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