

Evidence-based Medicine in General Surgical Postgraduate Training

Evripidis Tokidis

This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

May 2026

Supervisors

Pirashanthie Vivekananda-Schmidt

Saba P Balasubramanian

Declaration

I, Evripidis Tokidis, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis. Copyright transfers have been obtained for all previously published work arising from this thesis, including permission from co-authors and collaborators to reproduce the work within this thesis.

Acknowledgements

First and foremost, I would like to thank my supervisors, Professor Saba Balasubramanian and Professor Pirashanthie Vivekananda-Schmidt — not only for guiding me through this PhD, but for helping me grow, understand myself, and find my ikigai. I am grateful to the CRAMSURG charity for their support and in particular, Giordano Perin and Maria Digby. I am grateful to the Association of Surgeons of Great Britain and Ireland (ASGBI), the Association of Coloproctology of Great Britain and Ireland (ACPGBI), and The Duke's Club for distributing the survey to General Surgery trainees across the United Kingdom. I would like to thank the General Surgery department of Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust for supporting my clinical development during this research period, and Janet Clapton of the Royal College of Surgeons of England Library for her invaluable training in literature searching. I would like to thank the Delphi study collaborators. I would also like to acknowledge Ali Kordzadeh, whose academic dedication and generosity during my early surgical steps in the UK has been a lasting inspiration. To my family in Greece — Alexandros Tokidis, Sonia Margaritou, and Giorgos Tokidis — thank you for your steadfast support across countless calls and countless miles. The distance between us has only strengthened our bond. Finally, to Lewis Holloway, my husband: you watched me give so much to this work without ever fully understanding why. Your support and patience have meant more to this journey than you could ever imagine.

Table of Contents

Declaration 2
Acknowledgements 3
Table of Contents 4
I - Research output during this PhD 7
II - Figures and Tables 8
III - List of Abbreviations 10
IV - Statement of Publications, Authorship, and Permissions 11
Positionality Statement 16
Abstract 17
Chapter 1. Introduction 19
1.1. Prologue 19
1.1.1 Evidence-based medicine and Evidence-based Surgery 19
1.1.2 Training in EBM; historically an issue 21
1.1.3 Assessing EBM Competencies 23
1.1.4 Surgical training and EBM 26
1.1.5 The situation in the United Kingdom 29
1.2. Problem statement 34
1.3 Research questions 36
1.4 Research Paradigms informing the choice of methods 36
1.4.4 Summary 39
1.5 An overview and approach of the research question 41
1.5.1 Scoping review 41
1.5.2 Mixed-method study 42
1.5.3 Focus Group Discussions 44
1.5.4 Survey Study 45
1.5.5 Delphi study 47
1.5.6 Summary of method choice to answer the research question 52
Chapter 2: Scoping review 54
2.1 Abstract 56
2.2 Introduction 57
2.3 Methods 58
2.4 Results 60
2.5 Discussion 75

2.6 Key point summary of scoping review and linking narrative to the mixed-method study 79
Chapter 3: Mixed Method Study 81
3.1 Focus Group Discussions 81
3.1.1 Abstract 82
3.1.2 Introduction 83
3.1.3 Methods 85
3.1.4 Results 88
3.1.5 Discussion 97
3.1.8 Linking narrative: from qualitative findings to UK-wide snapshot survey 102
3.2 Survey study 103
3.2.1 Abstract 104
3.2.2 Introduction 105
3.2.3 Methods 107
3.2.4 Results 111
3.2.5 Discussion 122
3.2.6 Linking Narrative: From Mixed-Methods Findings to Delphi Consensus 127
Chapter 4: Delphi study 130
4.1 Abstract 131
4.2 Introduction 133
4.3 Methods 134
4.4 Results 138
4.5 Discussion 148
4.6 Limitations 150
4.7 Future considerations 151
4.8 Conclusion 152
4.9 Summary of Delphi findings and linking narrative to the Discussion chapter 152
Chapter 5: Discussion 155
5.1 Integration of Findings Across All Research Phases 155
5.1.1 Answers to the research questions 155
5.1.2 Synthesis of key findings 161
5.1.3 Quality 163
5.1.4 Triangulation 165
5.1.5 Participatory approach 167
5.2 Contribution to Knowledge 169

5.2.1 Conceptual Contributions 169
5.2.2 Empirical Contributions 170
5.2.3 Methodological Contributions 170
5.2.4 Contributions to Educational Theory 171
5.2.5 Practical and Policy Contributions 172
5.3 Implications for Policy, Practice, and Curriculum Reform 173
5.4 Methodological Strengths and Limitations 177
5.4.1 Scoping review 177
5.4.2 Focus Group Discussions 178
5.4.3 Survey study 180
5.4.4 Delphi study 181
5.4.5 Broader thesis limitations 183
5.5 Recommendations for Future Research 185
5.6 Reflections, reflexivity and positionality 188
Chapter 6. Appendices 193
6.1 Appendix A – Scoping Review Database searches. 193
6.2 Appendix B - Focus Group Discussion Supplementary Documents 195
6.2.1 Focus Group Discussion Participant Information Sheet 195
6.2.2 Focus Group Discussions Consent Form 197
6.2.3 Focus Group Discussion Invitation Letter 200
6.3 Appendix C– COREQ Checklist 202
6.4 Appendix D - Delphistar Checklist 204
6.5Appendix E – Survey study supplementary documents 211
6.5.1 Survey Participant Information Sheet 211
6.5.1 Survey study consent form 213
6.5.2 Survey invitation 216
6.5.4 Cherries checklist 216
6.5.5 Survey Tool 218
6.7 Approvals for PhD studies 249
6.7.1 Ethics approvals 249
6.7.2 Co-author approvals 251
6.7.3 CC-BY-Licenses 253
References 258

I - Research output during this PhD

Peer reviewed publications directly related to this thesis

- Tokidis E; Vivekananda-Schmidt P; Balasubramanian SP. *Evidence-based medicine within surgical practice and training: a scoping review*. World Journal of Surgery. 2025;49(4):916–929. doi:10.1002/wjs.12479
- Tokidis E; Vivekananda-Schmidt P; Balasubramanian SP. *A focus group discussion study exploring general surgery trainees' views on evidence-based medicine*. Journal of Surgical Education. 2025;82. doi:10.1016/j.jsurg.2024.103348
- Tokidis E; Balasubramanian SP; Vivekananda-Schmidt P. *Evidence-based medicine training in general surgery in the United Kingdom: a survey study*. Langenbeck's Archives of Surgery. 2025. doi:10.1007/s00423-025-03955-7

Articles under peer-review

- Tokidis E; Balasubramanian SP; Vivekananda-Schmidt P, *Integrating Evidence-Based Medicine into UK General Surgical Training: A Modified Delphi Consensus Study.* https://doi.org/10.21203/rs.3.rs-9504664/v1

Published abstracts during this PhD

- Tokidis E; Perin G; Digby M; Vivekananda-Schmidt P; Balasubramanian SP. Evidence-based medicine training in general surgery in the UK: a survey study. British Journal of Surgery. 2025 (Supplement).

II - Figures and Tables

Figure 1 The five As of EBM, figure adapted from Dawes et al[2] 19
Figure 2 The CREATE framework by Tilson et al (Sicily statement)[35] available on CC BY 4.0 license 26
Figure 3 A summary of the thesis studies and their methodological stance and achievement 53
Figure 4 PRISMA flowchart describing search strategy 61
Figure 5 Geographical spread of the location of the primary authors of the included studies 62
Figure 6 Chart demonstrating code saturation 97
Figure 7 Delphi study flow 139
Figure 8 A map of which studies answer the research questions 160

Table 1 Summary of validated tools for evaluating evidence-based medicine (EBM) teaching in medical education (adapted from Kumaravel et al., 2020[31]) 25
Table 2 Barriers to Implementing EBM curricula adapted from Halalau et al[20] 29
Table 3 Distribution of the surgical specialty involved in the included studies 63
Table 4 Training in EBM and Assessment of EBM competency 69
Table 5 EBM curricula in Surgery (1): Curriculum Development Studies 73
Table 6 EBM curricula in Surgery (2): Studies Evaluating Educational Activity 74
Table 7 Focus Group Questions 87
Table 8 Focus Group Discussion Participants 88
Table 9 Themes and subthemes of the focus group discussions with representative quotes 91
Table 10 Trainees' attitudes to EBM; compared against hospital type, level of training and higher degree qualifications. Data are presented number (n) and percentage (%) of respondents. The final three columns display p-values calculated using the Kruskal–Wallis test to assess differences across hospital type, level of training, and possession of a higher degree. 115
Table 11Barriers to EBM; compared against hospital type, level of training and higher degree qualifications. Data are presented number (n) and percentage (%) of respondents. The final three columns display p-values calculated using the Kruskal–Wallis test to assess differences across hospital type, level of training, and possession of a higher degree. .. 118
Table 12 Trainees' understanding of EBM terminology; compared against hospital type, level of training and higher degree qualifications. Data are presented as number (n) and percentage (%) of respondents. The final three columns display p-values calculated using the Kruskal–Wallis test to assess differences across hospital type, level of training, and possession of a higher degree. 120
Table 13 Suggestions of trainees categorised as per Kirkpatric level of curricular development 121
Table 14 Stakeholder discussion table 135
Table 15 Delphi Round 1 statement consensus 143

Table 16 Delphi Round 2 Statement Consensus 144
Table 17 Qualitative comment mapping to the Kirkpatric framework for curriculum development 147

III - List of Abbreviations

EBM – Evidence-based Medicine

EBP – Evidence-based Practice

EBS – Evidence-based Surgery

NTN – National Training Number

FRCS – Fellowship of the Royal College of Surgeons

ABSITE – American Board of Surgery In-Training Examination

ISCP – Intercollegiate Surgical Curriculum Programme

CEX – Clinical Evaluation Exercise

CBD – Case Based Discussion

PBA – Procedure Based Assessment

DOPS – Direct Observation of Procedural Skills

MCR – Multi-Consultant Report

ES – Educational Supervisor

CS – Clinical Supervisor

CiP – Capabilities in Practice

GPC – General Professional Capabilities

CCT – Certificate of Completion of Training

GMC – General Medical Council

UK – United Kingdom

NELA – National Emergency Laparotomy Audit

NBOCA – National Bowel Cancer Audit

NICE – National Institute for Health and Care Excellence

IV - Statement of Publications, Authorship, and Permissions

This thesis is submitted in publication format, in accordance with the regulations of the University of Sheffield. It comprises sequential peer-reviewed publications and manuscripts prepared in a format suitable for submission to peer-reviewed journals, supported by connecting commentary chapters that establish the intellectual coherence, methodological progression, and scholarly significance of the programme of research. The overarching focus of the thesis is the teaching, learning, and embedding of Evidence-Based Medicine (EBM) within General Surgery training in the United Kingdom, examined through sequential mixed-method medical education research.

The thesis includes four inter-related studies. The first is a scoping review entitled *Evidence-Based Medicine Within Surgical Practice and Training: A Scoping Review*, authored by Evripidis Tokidis et al published in the *World Journal of Surgery* (DOI: 10.1002/wjs.12479). The second is a qualitative focus group study entitled *Exploring General Surgery Trainees' Views on Evidence-Based Medicine Within Their Training Program in the United Kingdom*, authored by Evripidis Tokidis et al, published in the *Journal of Surgical Education* (DOI: 10.1016/j.jsurg.2024.103348). The third is a survey study entitled *Evidence-based medicine training in general surgery in the United Kingdom: an exploratory snapshot survey study*, authored by Evripidis Tokidis et al, published in *Langenbeck's Archives of Surgery* (DOI: 10.1007/s00423-025-03955-7). The fourth study is a Delphi consensus study, conducted

with the same author group as the survey study, which builds directly on the findings of the preceding phases to achieve expert consensus on EBM competencies and curricular priorities in General Surgery. The study is currently under peer review in BMC Medical Education.

Each publication is presented as a chapter or sub-chapter within the thesis and is integrated through original commentary chapters that synthesise findings across studies and situate them within the wider educational literature.

The candidate, Evripidis Tokidis, is the primary contributor to all publications included in this thesis. In accordance with the CRediT taxonomy statements provided within each publication, the candidate led the conception and design of all studies, undertook data acquisition where applicable, conducted data analysis and interpretation, and drafted the initial and final versions of each manuscript.

For the scoping review, the candidate led the review design, literature search, data charting, synthesis, and manuscript preparation, with Giordano Perin contributing to study selection and validation, and Pirashanthie Vivekananda-Schmidt and Saba P. Balasubramanian providing senior oversight, methodological guidance, and critical revision of the manuscript

For the focus group study, the candidate designed the study, moderated the focus group discussions, conducted transcription, coding, and thematic analysis, and drafted the manuscript. Pirashanthie Vivekananda-Schmidt contributed to qualitative methodological

oversight and supervision of data collection and analysis, while Saba P. Balasubramanian contributed to study design and critical revision of the manuscript

For the survey study, the candidate led study conception, survey development, data collection, statistical and thematic analysis, and manuscript drafting. Saba P. Balasubramanian and Pirashanthie Vivekananda-Schmidt contributed to study design, interpretation of findings, and critical revision of the manuscript.

The Delphi study follows the same authorship structure as the survey study, with the candidate acting as primary contributor and corresponding author, and co-authors contributing to study design, expert panel development, interpretation, and manuscript revision.

All research presented was undertaken while the candidate was registered at the University of Sheffield and supervised by University of Sheffield academic staff. Ethics approval has been obtained for the mixed-method studies and the Delphi study (6.7.1 Ethics approvals). A confirmation review has been undertaken at the relevant doctoral checkpoint.

The thesis incorporates material that has been published in peer-reviewed journals, accepted for publication, or prepared in a format suitable for submission to peer-reviewed journals. Full bibliographic details, publication status, and authorship information are provided at the beginning of each relevant chapter.

The originality of this thesis lies in the generation of new empirical data through the use of sequential mixed-method qualitative, quantitative, and consensus methodologies, and the critical integration of findings across a scoping review, focus group study, survey research,

and Delphi consensus process. Originality is further demonstrated through the analytical commentary chapters that synthesise the included publications into a coherent programme of research, advancing understanding of the cultural, educational, and structural barriers to EBM integration within General Surgery training in the United Kingdom informing future curricular development. Reuse of text from published work does not detract from originality, as the original contribution resides in the research questions, study designs, data, analyses, interpretations, and synthesis rather than in novel wording alone.

Some chapters reproduce, in full or in part, material that has been previously published or accepted for publication. This practice is explicitly permitted under the University of Sheffield regulations for publication-format theses. Consequently, similarity detection software may identify overlap between the thesis and the candidate's own published work. Such overlap represents legitimate reuse of the candidate's intellectual output, is transparently declared and licensed.

All included publications are published under Creative Commons Attribution (CC BY 4.0) licences (6.7.3 CC-BY-Licenses) or publisher policies that permit inclusion within a doctoral thesis. Where required, the Author Accepted Manuscript version has been used. Accepted manuscripts have been deposited in White Rose Research Online via myPublications. Confirmation that appropriate permissions have been obtained has been secured prior to submission of the final electronic thesis (6.7.2 Co-author approvals).

Pagination is continuous throughout the thesis wherever possible. Each publication is preceded by a title page stating its title, authors, publication status, and position within the

thesis. Figures and tables are included at appropriate points within the text to enhance readability. Where methodological details are common across multiple publications, these are consolidated where appropriate to improve conciseness and coherence.

Positionality Statement

At this stage, I would like to declare that I am a General Surgery trainee currently undertaking an Out of Programme Research period. This insider position provided direct access to the problems and phenomena under study in this thesis but also carried risks of preconception and professional bias, which were managed through reflexive journalling, supervisory dialogue, and the methodological strategies described throughout this thesis. My dual identity as clinician and educational researcher is acknowledged as both a strength and a limitation of this work. A reflective chapter at the end of this thesis explores positionality further.

Abstract

Background and Aims

Although EBM is central to modern clinical practice, its teaching, assessment, and integration within postgraduate General Surgery training remain poorly defined. This thesis investigated the educational, cultural, and organisational influences shaping EBM in UK General Surgery, and developed stakeholder-informed consensus recommendations for embedding EBM education within the specialty.

Methods

A sequential mixed-methods design was used across four phases: a scoping review of postgraduate surgical EBM education; focus group discussions with UK General Surgery trainees; a national trainee survey; and a modified Delphi study with expert stakeholders to reach consensus on learning outcomes, teaching approaches, and structural requirements for an EBM curriculum.

Results

The scoping review revealed fragmented evidence, limited discipline-specific guidance, and a near-absence of studies focused on General Surgery in the UK. Focus group discussions revealed that EBM competence in surgery is shaped as much by cultural and relational factors — hierarchy and service pressures — as by formal teaching, suggesting it functions as a socially negotiated practice rather than a purely cognitive skill. The survey corroborated these findings, with time constraints, limited structured teaching, and cultural factors emerging as the most significant obstacles to EBM integration. The Delphi

study achieved consensus on a proposed competency framework grounded in both international evidence and the empirically identified needs of UK trainees.

Conclusions

This thesis offers the first sequential, mixed-methods examination of EBM education in UK General Surgery, generating empirical evidence of the cultural and structural barriers to EBM integration and a stakeholder-derived consensus on the top-level EBM competencies relevant to general surgeons. While structural and cultural barriers require targeted interventions beyond the scope of this consensus, the framework provides clarity on priority competencies and a foundation for future national curricular reform and intervention research.

Chapter 1. Introduction

1.1. Prologue

1.1.1 Evidence-based medicine and Evidence-based Surgery

EBM[1] is a framework within which clinicians make informed decisions regarding patient care by integrating the best available research evidence with clinical expertise and patient values[2]. Asking appropriate clinical questions (Ask), acquiring relevant literature (Acquire), appraising the evidence (Appraise), using evidence in clinical decision making (Apply), and monitoring the impact and performance (Assess) are the five processes that comprise EBM[2] (Figure 1).

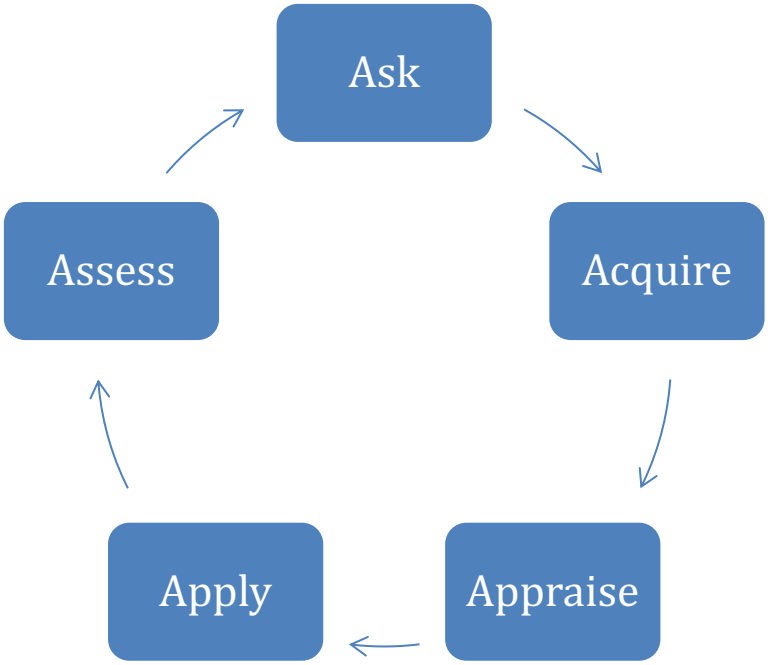


Figure 1 The five As of EBM, figure adapted from Dawes et al[2]

EBM is essential in modern medical practice[3]. Since its introduction by Sackett[1], EBM has become an integral part of the curriculum for undergraduate, graduate, and continuing education health programmes internationally[4]. When doctors and other healthcare professionals apply EBM to practice, there are demonstrable benefits to individual patients, patient care pathways, healthcare teams and organisations, and doctors themselves[5].

The benefits of healthcare research for patients, society, and clinicians are well documented[6]. Patients benefit from better diagnoses and treatments, access to the latest therapies, a better understanding of health conditions, improved safety of care pathways, tailoring of treatment strategies, improvement in quality of life and increased survival[7]. Additionally, the overall well-being of society improves[7] as survival rates increase, healthcare costs are reduced and quality of life is upgraded. Healthcare research is strongly associated with advancements in technology, and a better understanding of health disparities[8]. Clinicians themselves enhance their professional development and are enabled to provide up-to-date patient care[7].

Meshikhes et al[9] suggest that surgery was 'not likely included in the initial concept of EBM by Sackett' and that 'surgeons conceived EBM as something more physician related'[9]. Indeed, the surgical community has found the adoption of randomised controlled trials challenging[10–12]. Surgical practice is often influenced by tradition and the perception that results of surgical trials are often not generalisable[10,13]. In addition, surgical trial designs were considered to have 'difficult to overcome' obstacles in areas such, as blinding and standardisation of interventions[14–16]. Other barriers included specific issues in patient

recruitment, ethical and publication biases[13]. Over the years, the relationship between medicine and surgery has changed, and the focus is more patient-centric versus procedure-centric[17]. These challenges have led some to question whether EBM as conventionally defined — with its emphasis on RCT-derived evidence — is fully transferable to surgical specialties, where operative skill, tacit knowledge, and intraoperative judgement are central to practice[9,21]. Nonetheless, the core principles of EBM remain applicable to surgical training and are explicitly required by the UK regulatory framework for surgical certification. The focus of this thesis is therefore on developing these foundational competencies within the specific context of UK postgraduate General Surgery training, rather than resolving broader debates about the epistemology of surgical evidence.

Meshikhes et al[9] describe surgeon-related factors in EBM acquisition, with reduced knowledge and skills relating to Evidence-Based Practice being a significant barrier[18,19]. The practice of EBM is observed to require ongoing education and training[20];some may be resistant to change[21,22] and not willing to adopt it.

Nevertheless, modern surgery has advanced from Sackett's era with published evidence available that has shaped modern practice. Randomised controlled trials, large cohort studies based on national databases and collaboratives are part of practiced guidelines that have improved patient outcomes[23] in the United Kingdom, Europe, and United States of America.

1.1.2 Training in EBM; historically an issue

EBM is one of the essential competencies required for ongoing improvement of the quality and safety of healthcare, according to the National Academy of Medicine, an independent, non-profit organisation that offers advice, counsel, and independent research on important topics in healthcare[24]. In an effort to promote EBM education, a proposal was developed by participants at the second international conference of Evidence-Based Health Care Teachers and Developers in Sicily in 2003[2]. This proposal consisted of three key components: 1) a well-defined explanation of what EBM entails, 2) a description of the minimum competencies necessary for the implementation of evidence-based practice, and 3) an educational curriculum outlining the minimum standards for training healthcare professionals in EBM.

Following the Sicily statement[2], EBM was recommended for integration in under-graduate as well as postgraduate (foundation, medical and surgical) education curricula in the UK, North America, Europe and overseas. In addition, most regulators identify the need for medical professionals to be competent in research and scholarship throughout their careers. The General Medical Council (GMC) of the United Kingdom has a goal of fostering a culture within the medical profession where doctors are encouraged to engage in and be aware of research. To support this, the GMC has established standards and expectations for medical students and doctors related to research and scholarship, as outlined in the Generic Professional Capabilities Framework[25] and Good Medical Practice[5]. These standards include the ability to keep up to date with current research and best practice, critically appraise academic literature, understand the role of evidence in clinical practice,

locate and utilise clinical guidelines, demonstrate knowledge of research methods and principles, and apply concepts such as stratified risk and personalised medicine.

It is essential that doctors and other clinicians have protected time in their schedules to engage in such EBM-related professional activities. However, many face challenges in prioritising research due to increasing workloads and pressures within the healthcare system. Empowering healthcare staff to recognise the importance of participating in research as part of their job and implementing specific interventions to ensure that research opportunities are fully inclusive for both doctors and patients is essential to deliver greater quality care[5].

1.1.3 Assessing EBM Competencies

With regards to assessing EBM competencies, several competency assessment tools are available. These include the Fresno test[26] as well as the Berlin[27], MacRae[28], ACE[29], and Taylor-Bradley[30] tools, which have been shown to be reliable against objective outcome measures and tested on different aspects of validity[31]. These tools can evaluate learners' capacity to apply EBM concepts in clinical practice, assess the effectiveness of EBM education, and identify growth opportunities. Additionally, librarians can assist surgical trainees in developing effective search techniques, critically reviewing literature sources, and obtain the information literacy skills that are needed in practice[32].

1.1.3.1 Tools for assessing EBM

Kumaravel et al[31] identified twelve unique instruments that fulfilled strict inclusion criteria relating to psychometric evaluation, objective outcome measures, and relevance to the steps and domains of EBM (Table 1). Of these, six tools met the authors' definition of high quality, demonstrating established interrater reliability, multiple forms of validity evidence, and objective scoring mechanisms. The review represents the most current consolidation of EBM assessment instruments suitable for evaluating knowledge and skills across the spectrum of EBM competencies.

Tool	Type of Assessment	EBM Steps Assessed	Educational Domains Measured	Key Features
Berlin Questionnaire[27]	Multiple-choice questionnaire	Appraise	Knowledge, skills	Scenario-based MCQs assessing interpretation of research evidence and epidemiological concepts.
Fresno Test[26]	Open-ended written test	Ask, Acquire, Appraise	Knowledge, skills	Uses clinical scenarios with structured scoring rubrics; widely used to assess EBM competence.
ACE Tool (Assessing Competency in EBM)[29]	Dichotomous question tool	Ask, Acquire, Appraise, Apply	Knowledge, skills, attitudes	15-item tool assessing multiple EBM steps including question formulation and evidence application.
Utrecht Questionnaire (U-CEP)[33]	Knowledge assessment questionnaire	Ask, Appraise, Apply	Knowledge	Two sets of questions assessing clinical epidemiology knowledge among trainees.
MacRae Examination[34]	Article-based critical appraisal exam	Appraise	Knowledge, skills	Requires appraisal of research papers with short-answer questions and rating scales.

Taylor Questionnaire[30]	Multiple-choice questionnaire	Acquire, Appraise	Knowledge, attitudes	Designed to evaluate effectiveness of EBM teaching across different learner groups.

Table 1 Summary of validated tools for evaluating evidence-based medicine (EBM) teaching in medical education (adapted from Kumaravel et al., 2020[31])

A key finding from this review was the disproportionate emphasis on the appraise step. All twelve tools assessed appraisal skills, whereas far fewer assessed the earlier steps—ask, acquire—and only a minority addressed the ability to apply evidence in clinical decision-making. None of the identified tools assessed the final step of EBM—assess—reflecting an ongoing gap in the evaluation of the impact of EBM activity in clinical practice. Similarly, when mapped to the CREATE framework[35], most tools measured knowledge and skills, with very limited assessment of attitudes, behaviour, or self-efficacy, and none evaluating reaction to teaching or patient benefit. This suggests that available assessment instruments remain primarily focused on cognitive and technical components of EBM.

The review applied the CREATE framework[35] (Figure 2) to classify high-quality instruments according to their purpose, educational domain, and relevance to the five-step EBM model. This taxonomy has direct implications for curricular design in postgraduate General Surgery. Importantly, the findings reinforce the lack of validated assessment tools capable of evaluating the full breadth of EBM competencies required by the General Surgical curriculum in the United Kingdom. The absence of instruments assessing behaviours or the integration of evidence into clinical judgement is particularly relevant in surgical practice, where decision-making is contextual, time-pressured, and shaped by experience, team culture, and operative workflow.

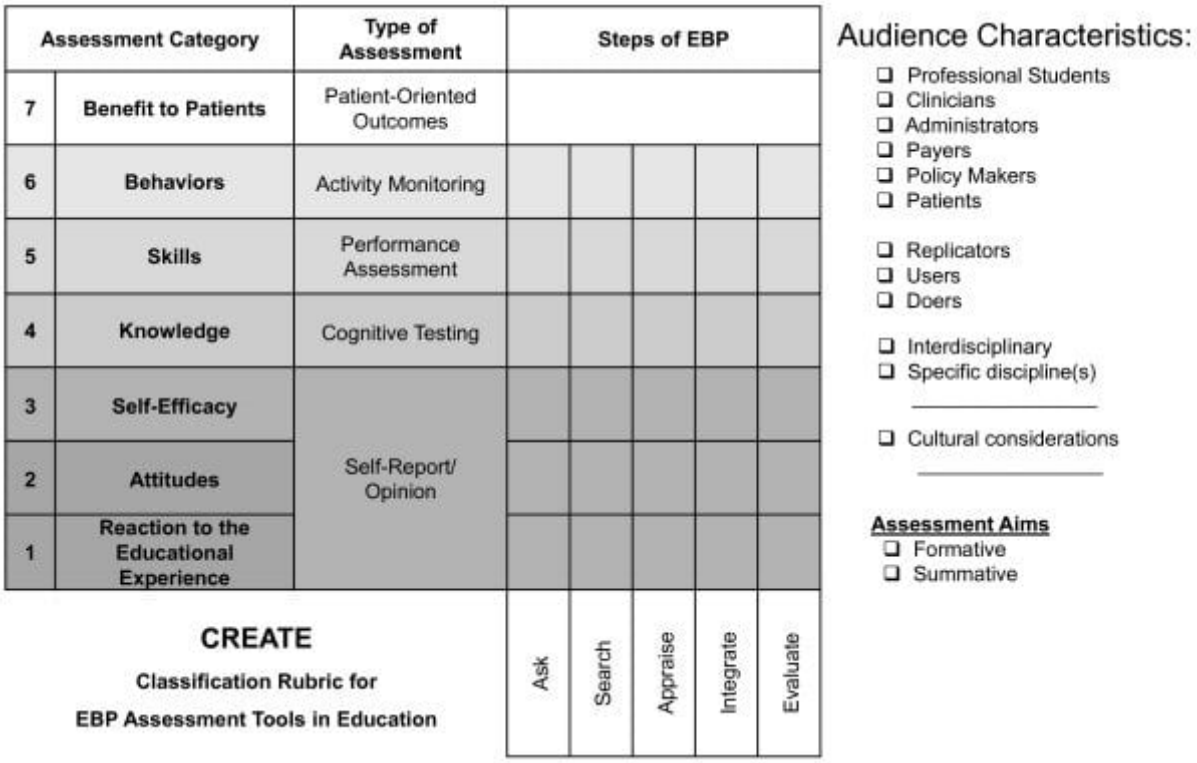


Figure 2 The CREATE framework by Tilson et al (Sicily statement)[35] available on CC BY 4.0 license

The evidence consolidated by Kumaravel and colleagues therefore supports the need for the development of assessment frameworks tailored to the General Surgical context; an issue addressed in the curricular recommendations produced in the Delphi study.

1.1.4 Surgical training and EBM

Surgical training is defined as postgraduate training of surgical skills and surgical practice while surgical education refers to the formal and informal learning opportunities and educational sessions that complement the surgical training[36]. Within the field of surgery, regardless of subspecialty of choice, in the United Kingdom[36], there is currently no formal route of education towards competency in EBM[21]. While there is evidence on the utility of undergraduate medical school EBM curricula[37] and more limited evidence related to

postgraduate training[38], surgery is not the focus of these studies. The lack of attention to EBM in surgical education and training is becoming evident in literature[9,21].

The consequences of inadequate education and training in EBM for surgeons are significant[9]. Surgeons, like other doctors[39], make critical decisions regarding patient care, which in turn have a significant impact on their outcomes. Without a robust understanding of EBM, surgeons may be more likely to rely on outdated or ineffective treatments, which can lead to negative patient outcomes[9,21]. Ultimately, the lack of attention to EBM in surgical education and training could undermine the overall quality of care provided to patients[40].

The teaching and training of EBM skills and knowledge in under- and postgraduate healthcare education is also important for developing a strong research and scholarship skillset among healthcare professionals[4,39]. To ensure good quality teaching and training, validated educational tools and competency assessment toolkits are required[31,41]. Various EBM teaching modalities are available, including lectures[26], seminars[42], research courses[43],workshops[44] and journal clubs[45]. These modalities can provide learners with the principles and methods of EBM and offer practical examples of its application in clinical practice.

The lack of education can be tackled by a structured curriculum within a surgical training programme[46]. However, existing limitations and obstacles should be understood and addressed prior to identifying potential strategies for implementing an evidence-based curriculum in surgery. This includes understanding the significance of the surgical faculty[47].

Surgeons and trainers may not understand what EBM entails and mistake it for merely 'the best approach to teach something'[21]. Frequently, teachers will have had no formal training when enrolled in a surgical programme or as they advance to supervisor positions[46]. The foundation of EBS is information literacy which is a competency that remains underemphasised in surgical training and insufficiently addressed by curriculum designers[22].

Over the last 20 years, only a small number of studies[9,21,48] have addressed postgraduate surgical training in EBM specifically. These are useful resources providing a scoping lens in the broader subject of barriers of EBM curricula for doctors in training summarised by Halalau et al in 2021[20] (Table 2). Some studies in Halalau et al review were of surgical orientation but only one study was specifically designed around General Surgical trainees[49]. The study included 52 participants over a 2-year period in the United States and described how a programme could work and showed success in retention of knowledge of EBM amongst residents.

Category	Barrier	Description / Explanation
Barriers to Teaching EBM	Lack of dedicated teaching time	Insufficient protected time for structured EBM sessions within residency schedules.
	Difficulty recruiting teachers	Shortage of faculty with adequate EBM expertise, limiting sustainable curriculum delivery.
	Variable learner abilities	Heterogeneity in baseline skills and knowledge, complicating targeted instruction.
	Learner fatigue with repetition	Reduced engagement when similar EBM concepts recur without perceived progression.

	Lack of consensus on teaching strategies or curriculum content	Educators disagreed on essential topics, optimal sequencing, and pedagogic approaches.
	Learners not completing pre-reading	Poor preparation before sessions reduced teaching efficiency and interaction quality.
Barriers to Learning EBM	Learner fatigue with repetition	Repetition without contextual progression reduced motivation and cognitive engagement.
Barriers to Practising EBM	Time constraints	Limited time during clinical duties to search, appraise, and apply evidence.
	Insufficient knowledge or skills	Residents lacked confidence in searching databases and appraising study designs.
	Inadequate access to resources	Suboptimal access to databases, journals, or institutional tools required for EBM practice.
	Low frequency of exposure	EBM content revisited too infrequently to enable consolidation of skills.
	Poor search skills and limited familiarity with databases	Residents struggled with effective use of EBM sources, such as MeSH terms or advanced search functions.

Table 2 Barriers to Implementing EBM curricula adapted from Halalau et al[20]

1.1.5 The situation in the United Kingdom

The Intercollegiate Surgical Curriculum Programme (ISCP) from the Joint Committee on Surgical Training (JCST) in the United Kingdom presents the surgical curriculum as a web-based platform that helps surgical trainees meet the educational requirements for their specialty and track their progress through a series of assessments. It is used to ensure that trainees have the knowledge, skills, and competencies necessary to become competent surgeons[36]. The ISCP covers all ten surgical specialties, including General Surgery. Each specialty has its own set of requirements that trainees must meet to achieve competence. These requirements may include completing a certain number of surgeries, participating in

specific training programs, and passing exams and assessments; which usually test knowledge and competence in dealing with a variety of surgical diseases and conditions[50]. One area of debate in surgical training has been the emphasis on research and scholarship competence.

Some have argued that first authorship of peer reviewed publications should be a required part of surgical training certification, while others have argued that it is knowledge and understanding of evidence based practice that is key for a well-rounded surgeon[51]. This debate has shaped the specialty certification requirements in the UK, with some specialties placing a greater emphasis on research and scholarship certification requirements than others[50,51].

General surgical trainees must meet the learning outcomes in domain 9 of the General Professional Capabilities (GPC) framework: research and scholarship capabilities[52]. To achieve these goals, trainees are encouraged to participate in clinical research and collaborative trials, as well as journal clubs, literature reviews, and systematic reviews, and to make significant contributions to the publication of novel findings in peer-reviewed journals. Understanding the principles of research, its interpretation, and the safe implementation of evidence-based methods, processes, and techniques is critical for modern, progressive surgical practice and is in the interests of patients and the service.

The research and scholarship criteria for certification in General Surgery are summarised below:

- The demonstration of evidence-based practice.

- Understanding how to critically appraise literature and conduct literature searches and reviews.
- Understanding and applying basic research principles.
- Understanding the basic principles of research governance and how to apply relevant ethical guidelines to research activities.

Some trainees choose to take time away from training to conduct formal research, as specified in the 'Gold Guide'; a reference handbook for Postgraduate Specialty Training in the UK[53]. For most, this results in the award of a higher degree in a field related to their chosen specialty. Some choose to devote a significant portion of their training time to academic medicine, but to achieve certification as an independent practitioner, they must successfully complete all the essential elements of their specialty curriculum. The Annual Review of Competency Progression (ARCP) process determines the rate of progression through the clinical component of their training to ensure that all clinical requirements are met in accordance with the curriculum. Academic training arrangements however differ in detail across the United Kingdom and the Republic of Ireland. The ISCP General Surgical curriculum is undergoing change at present, and the researcher has been involved in discussions about the change however this research is not directly related to the ISCP reform.

The UK lacks a formal surgical postgraduate curriculum in EBM[36]. Anecdotally, there is awareness about this in various deaneries and efforts to incorporate this in the curriculum did not come to fruition. Time is an issue identified generally in postgraduate education of

EBM regardless of specialty and country[20,48]. Usually, trainees rely on courses for statistics or exam preparation courses to obtain necessary knowledge for exam purposes only. At local level, some hospitals provide regular journal clubs where trainees can obtain knowledge in EBM[54] but this varies and there is no published evidence for this. At regional level, monthly journal clubs[55] take place to support self-directed post graduate EBM learning in General Surgery. At some parts of the UK, trainees are asked to produce academic work such as posters, presentations, and publications to prove their competence in "research and scholarship" capabilities, however, this is not formally published on any Health Education England Resource.

Furthermore, the consultant recruitment process requires the assessment of competence in Evidence Based practice and document it on their application in the form of academic achievement (publication, research grant acquisition, research award, presentations, posters). Throughout their training, surgeons have access to and can utilise evidence-based surgery resources through databases such as NELA[56] and NBOCA[57] and guidelines from various surgical societies and the National Institute of Clinical Excellence (NICE) through their local departments. Trainees always practice under direct or indirect supervision, therefore the use of those evidence-based surgery resources is strongly connected to their relationship with their consultant colleagues/supervisors[53]. Therefore, their surgical practice is based on their training, whether this is firmly evidence-based or not.

It is now clear that evidence-based practice is leading modern patient care in medicine and surgery[58]. For General Surgery, national database outputs[56,57,59], vigorous guideline review and subspecialty society recommendations are an integral part of the specialty's practice.

642 Postgraduate general surgical trainees are required by the ISCP to demonstrate
643 competence in EBM, yet the curriculum provides no structured framework through which
644 competence can be systematically developed or assessed. Addressing this is therefore a
645 matter of both regulatory compliance and educational quality. This will enable them to ask
646 those relevant clinical questions, acquire critical knowledge in their field as well as appraise
647 and use the available literature in impactful decision making.

1.2. Problem statement

Thesis problem statement

A General Surgical curriculum focused on EBM in postgraduate education and training is currently lacking.

However, the curriculum for specialty certification for General Surgery requires competence in EBM.

Therefore, review of current status of EBM in surgical practice, needs appraisal and a stakeholder informed consensus curriculum for Evidence-based Practice in General Surgery will be of benefit.

Although EBM training is embedded within national regulatory expectations for resident doctors, postgraduate General Surgery training in the United Kingdom lacks a defined, structured curriculum that supports the development and assessment of EBM competencies. The ISCP specifies that trainees must demonstrate capability in research and scholarship, including the appraisal, interpretation, and application of research evidence. However, the curriculum provides no pedagogical framework, progression model, or educational resources that operationalise the EBM requirements. As a result, the acquisition of EBM skills is inconsistent across training regions, heavily dependent on local initiatives, individual supervisors, and informal learning opportunities.

The wider literature, as well as emerging empirical work, indicates that surgical practice faces distinctive cultural and structural barriers to integrating EBM into routine training. These include hierarchical norms, variability in faculty expertise, limited protected time for scholarship, entrenched tradition-based practice, and misconceptions about the nature

672 and purpose of EBM. Without explicit educational structures to address these factors,
673 trainees experience uneven opportunities to engage with evidence-based processes, and
674 their progression towards competence lacks clarity and standardisation[20].

675 At present, published evidence on EBM education in surgery is sparse, and very few studies
676 address General Surgery specifically. Existing interventions are small-scale, locally
677 developed, and rarely evaluated with validated assessment measures[60]. Furthermore, no
678 stakeholder-derived curriculum exists to guide the teaching, learning, and assessment of
679 EBM, specifically, for general surgical trainees. This perpetuates a misalignment between
680 regulatory expectations, service demands, and the educational support available to
681 trainees.

682 The literature informed key messages highlighted so far suggest that EBM competence in
683 surgery cannot be understood as a purely cognitive or technical skill acquired through
684 formal instruction alone. The literature points towards EBM as a socially negotiated
685 practice which is shaped by the local learning environment, supervisory relationships, team
686 culture, and the professional norms that govern surgical communities. This perspective,
687 supported by social constructivist theory[61,62], proposes that trainees develop their
688 understanding of and engagement with EBM through participation in shared clinical and
689 educational activities, and through alignment with the values modelled by senior
690 colleagues. Therefore, any curriculum seeking to embed EBM in General Surgery should
691 attend not only to knowledge and skills, but to the cultural and relational conditions that
692 enable or constrain their development. This conceptual framing informs the design and
693 interpretation of the empirical phases of this thesis.

1.3 Research questions

To address the overarching problem statement of this thesis, the following research questions have been formulated.

1. What is the evidence underpinning the practice of EBM in the context of surgical training, with particular focus on attitudes, training and curricula in EBM, and assessment of EBM competencies?

2. What are the perceptions, attitudes and barriers towards developing EBM competencies amongst surgical trainees (and stakeholders) in the UK?

3. To what extent does the current General Surgery curriculum in the United Kingdom support the structured development and assessment of EBM competencies?

4. What are the essential components of an EBM curriculum for UK General Surgery postgraduate training, as determined through stakeholder consensus?

1.4 Research Paradigms informing the choice of methods

Understanding the perspectives of key stakeholders, particularly general surgery trainees, is crucial for developing an EBM curriculum. This PhD adopts a sequential mixed-method approach to address this need and its philosophical underpinning is based on the

recognition that a single methodological approach may not suffice to comprehensively address the research questions[63]. Therefore, this research is situated within a pragmatic paradigm, which rejects the notion that any single methodological or philosophical tradition can fully address complex educational questions. Pragmatism prioritises the research problem and the practical consequences of inquiry over allegiance to a particular worldview. It therefore permits flexibility in the choice of methods, enabling the integration of qualitative and quantitative approaches when each offers a distinctive and complementary contribution to understanding. Given the multifactorial nature of surgical education—shaped by culture, hierarchy, organisational structures, and evolving pedagogical expectations—pragmatism provides a suitable overarching framework[64].

In this thesis' postgraduate training setting, a pragmatic approach acknowledges that EBM competence cannot be understood without reference to local training cultures, supervisory relationships, service pressures, and regulatory structures. Under a pragmatic philosophical background, this thesis is informed by post-positivist, interpretivist, and social constructivist assumptions[62], each underpinning different components of the overarching mixed-methods sequential design.

The post-positivist paradigm[65], which aligns with quantitative methods, posits that there is an objective reality that can be measured and understood through scientific methods. This approach can be utilised for the assessment of the extent and nature of the current EBM training and its outcomes among general surgery trainees through quantitative methods. The qualitative elements of this thesis are grounded in interpretivism[66], which posits that

742 social reality is understood through the meanings that individuals and groups assign to
743 their experiences. Interpretivism assumes that educational phenomena cannot be reduced
744 to mere variables but must be understood through the subjective perspectives of learners
745 embedded within their social and cultural settings. This paradigm is particularly relevant in
746 surgical education, where informal learning, implicit expectations, and interpersonal
747 dynamics shape the way trainees perceive and enact EBM[67].
748
749 Complementing interpretivism, the qualitative strands of this PhD further draw on social
750 constructivism, which extends the interpretivist emphasis on meaning-making by
751 foregrounding the collective processes through which knowledge, norms, and professional
752 identities are formed. Social constructivism asserts that understanding develops through
753 interaction and shared interpretation, making it highly relevant for focus group
754 methodology. Within the surgical training context, beliefs about EBM, attitudes toward
755 research, and perceptions of professional expectations emerge from interactions within
756 communities of practice. A social constructivist epistemology therefore provides a strong
757 conceptual foundation for exploring how trainees collectively negotiate the meaning and
758 value of EBM within their cultural and organisational environment[62].
759
760 Together, these philosophical positions support the use of a mixed-methods approach, in
761 which different forms of inquiry illuminate different dimensions of the same phenomenon.
762 Mixed-methods research allows for methodological triangulation, integrating numerical
763 description with the detailed exploration of experience. Quantitative findings provide
764 breadth, enabling the mapping of national patterns, while qualitative findings offer depth,

enabling the interpretation of the cultural, relational, and pedagogical influences that shape trainees' engagement with EBM. This integration enhances validity and provides a comprehensive foundation for the development of an educational intervention that is empirically grounded, contextually sensitive, and informed by stakeholder perspectives. Adopting a mixed-methods approach allows for triangulation, where different methods complement and corroborate each other, enhancing the validity and depth of the research findings. For instance, while the quantitative survey can provide broad insights into the prevalence and impact of EBM training, qualitative methods can uncover deeper, contextual factors that influence trainees' engagement and application of EBM in their practice. This methodological synergy is essential for developing a comprehensive understanding and for informing the iterative design of the EBM curriculum. Three studies (scoping review, focus group discussions and survey) aim to capture the landscape of EBM in surgical training with a focus in General Surgery in the UK. Where findings from different phases align, this will be treated as convergence; where they offer different perspectives, this will be treated as complementarity, enriching rather than simply confirming the overall picture[62].

1.4.4 Summary

The paradigms outlined above directly inform the structure and execution of the research methods employed in this thesis. The pragmatic orientation supports the use of multiple complementary methods, while the combination of post-positivist, interpretivist, and social constructivist assumptions provides the basis for selecting specific quantitative and qualitative techniques. Each methodological component is therefore aligned with the type of knowledge it seeks to generate: the scoping review maps existing evidence; qualitative

788 focus groups explore socially constructed understandings; the survey captures measurable
789 patterns across a wider population, and the Delphi study facilitates consensus building.
790
791

1.5 An overview and approach of the research question

Prior to discussing how the research questions are approached methodologically, it is useful to provide some terminology used in this thesis for clarity.

- Evidence-Based Medicine (EBM): the integration of the best available research evidence with clinical expertise and patient values.
- Surgical trainee or resident: a doctor enrolled in a recognised UK postgraduate surgical training programme leading to certification in a surgical specialty. This term can and will be used interchangeably in this thesis.
- Surgical trainer/supervisor: a consultant surgeon responsible for overseeing trainees' progress, learning opportunities, and workplace-based assessments.
- Scoping review: a method of evidence synthesis designed to map the extent, range, and nature of research activity and to identify gaps in existing knowledge.
- Focus group discussion: a qualitative method enabling collective exploration of experiences, perceptions, and attitudes through facilitated group interaction.
- Cross-sectional, exploratory, snapshot survey: a quantitative method capturing data at a single time point from a defined population to identify patterns, attitudes, and barriers.
- Delphi study: a structured consensus method involving iterative rounds of expert input to refine and agree on key elements of a topic.

1.5.1 Scoping review

This PhD starts by systematically collecting and synthesizing current evidence relevant to the research questions via a scoping review.[68] The choice of method was to broadly scan

the literature for evidence regarding EBM in Surgery, specifically within the postgraduate training and education domain and to evaluate the hypothesised knowledge gap. A scoping review was chosen as the appropriate method because in this project, the literature, particularly for surgery, appeared sparse and no synthesis of it was available[69]. Additionally, the type of available evidence, the key concepts and methodological frameworks that have been utilised so far need to be clarified to ensure that the next steps are purposeful. Hence, the choice of a scoping review as a first step provided a tangible solution through synthesis of current literature in this area and hence clarity on key themes identified in the current literature. Furthermore, this choice of method has also allowed intersecting themes to emerge[69] around competency in EBM for surgeons to direct future work in the area. This was important, given the complexity of medical education interventions[70]. However, later, the focus narrows to General Surgery (rather than Surgery as a whole area), given the focus of this thesis.

1.5.2 Mixed-method study

Having completed the scoping review, the next step was the understanding of the 'voice'[71] of General Surgery trainees in the matter, given they are the receivers of the education. Therefore, the choice of a mixed-method study[72] was made as a first step on this participatory model focused research. Following the participatory framework, stakeholders are engaged at a later stage, once trainees' viewpoints are captured from the mixed-method study. Participatory approaches in medical education research emphasise the involvement of those who deliver, receive, or regulate training, thereby enhancing the acceptability, feasibility, and contextual grounding of any resulting curriculum model[73].

As outlined earlier, the project follows a sequential exploratory design, in which qualitative insights inform the development of quantitative measures. The initial qualitative phase (focus group discussions) identifies key concepts, experiences, and contextual influences relating to EBM competence. These findings are then translated into measurable constructs to be examined in the national survey. The rationale for this sequence lies in the need to ensure that the survey instrument reflects the lived realities and priorities of trainees, thereby enhancing content validity and relevance.

The choice of a mixed-methods design is also underpinned by the philosophical foundations of the research. The pragmatic paradigm supports the integration of methods according to their usefulness in answering the research questions. Interpretivist and social constructivist assumptions[62] guide the qualitative exploration of trainees' meanings and experiences, while post-positivist principles inform the subsequent quantitative assessment of patterns and associations. This alignment ensures coherence between philosophical stance and methodological execution.

A further benefit of the mixed-methods approach is the opportunity for triangulation[63]**,** in which findings from different data sources complement or corroborate each other. Triangulation strengthens the credibility of the research by enabling the convergence of qualitative and quantitative evidence, detecting inconsistencies, and offering a more nuanced interpretation of the educational landscape. This is especially important in surgical training, where cultural and contextual factors may shape responses in ways that single-method designs may not fully capture.

Mixed-methods research is also particularly well suited to studies with an applied or developmental outcome, such as the creation of a curriculum. Each method contributes a distinct perspective: qualitative work illuminates context, culture, and lived experience; quantitative data reveal prevalence, distribution, and variation; and the integration of both provides a solid foundation for designing, refining, and implementing a curriculum that is evidence-informed and acceptable to stakeholders. This phased approach positions the research to proceed logically into the Delphi consensus exercise, ensuring that curriculum development is grounded in empirical evidence and stakeholder priorities.

1.5.3 Focus Group Discussions

The conclusions of the scoping review were utilised to develop a focus group discussion study aimed at better understanding the current perceptions and challenges faced by surgical trainees in developing competencies in EBM. This focus group study provides qualitative insight into the barriers and facilitators perceived by trainees. Focus group discussions[74] were preferred over semi-structured interviews[75] (more detail but costly, time consuming, few opinions are not powerful data) which allowed for multiple views to be observed in a setting where meaningful dialogue was encouraged. Focus groups allowed for building an evaluation overview of the problem at trainee level, collaboration between participants and growing their learning and reflections together. Furthermore, obtaining diversity of opinion and a 'bigger picture' by observing participants agreeing and disagreeing with shared sentiments is helpful for participatory research[76]. In addition, during interviews, risk of interviewer bias might skew responses[75]. The researcher was not expecting different types of respondents (all respondents were surgical resident doctors),

hence supported the choice of focus groups. From a time management perspective, it was deemed not feasible to perform one-to-one interviews at this stage; also considering that the researcher is a self-funded postgraduate student with part-time clinical duties. The researcher chose thematic analysis[77] to identify key themes arising from the focus group discussions.

The key findings from both the scoping review and the focus group discussions informed the creation of a survey. This survey was designed to capture a wider array of data from a larger population of trainees, ensuring that the subsequent interventions to enhance EBM competencies are well-informed, representative, and address the broad spectrum of experiences and perceptions within the surgical community. This sequential exploratory design ensures that the survey instrument is grounded in the real-world experiences of trainees, therefore enhancing its validity.

1.5.4 Survey Study

The second part of the mixed-method study includes a survey study[78]. The aim of the survey was to understand the perceptions and attitudes of trainees at national level, identify the barriers and clarify the current landscape around EBM training and assessment. This phase provides quantitative breadth to complement the depth achieved through the focus group discussions. Additionally, it aligns directly with the research questions concerning attitudes towards EBM, current training provision, and the perceived challenges in developing EBM competence.

The decision to employ a cross-sectional survey is supported by its established utility in medical education research for examining patterns within large and dispersed trainee populations. Surveys allow for the systematic collection of data through a standardised approach, at a single point in time, enabling comparison across demographic and training variables. This design is congruent with the post-positivist epistemological stance underpinning the quantitative element of the research, which assumes that attitudes and experiences can be measured, albeit with inherent contextual limitations.

A further rationale for the survey is its capacity to translate qualitative insights into measurable constructs. The sequential exploratory design ensures that the survey instrument is grounded in the themes identified in the focus group discussions, providing content validity and enhancing relevance. This approach supports triangulation by allowing the convergence, complementarity, or divergence of quantitative findings with qualitative data.

Best practice in survey methodology emphasises the importance of clarity, brevity, and conceptual coherence in question design. Accordingly, validated instrument items were developed to reflect constructs relating to EBM exposure, confidence, competence, perceived barriers and facilitators, and the current landscape of EBM teaching and assessment within training programmes. The instrument also collected training demographic and training-related variables to allow subgroup analysis.

The target audience was general surgery trainees across the United Kingdom through an open approach via training programme directors, deanery networks, trainee associations, and professional organisations. This broad recruitment approach aims to achieve representation across different stages of training, geographical regions, and institutional types.

The findings from the survey will contribute triangulated evidence to inform the subsequent Delphi consensus process. In particular, the results will highlight areas of need, variation in practice, and domains of EBM competence that trainees perceive as underdeveloped or insufficiently supported within current training structures.

1.5.5 Delphi study

1.5.5.1 Stakeholder discussions

Following completion of the focus group discussions and the national survey, an intermediate exploratory phase was undertaken involving consultations with senior stakeholders in surgical education. This additional step served to strengthen the transition between the mixed-methods study and the Delphi consensus process. In curriculum development research, it is recognised that early engagement with individuals responsible for educational leadership enhances the relevance, feasibility, and ultimate implementability of proposed curricular components. Incorporating this phase was therefore consistent with the participatory orientation of the project and with best practice in the design of complex educational interventions.

Four senior general surgical education stakeholders were invited to participate, each occupying roles with direct influence over postgraduate surgical training, including curriculum governance, training programme leadership, or educational policy. Semi-structured interviews were selected as the method of engagement, allowing for both consistent coverage of key topics and the flexibility to explore issues arising from each stakeholder's expertise and organisational perspective. This approach ensured that both strategic considerations and pragmatic constraints could be articulated and incorporated into the curriculum development process.

The primary purpose of these consultations was to review and refine the extensive set of statements produced by Albarqouni et al., which represent a comprehensive international consensus on the essential components of EBM training. The original document, although authoritative, is lengthy, detailed, and conceptualised for generic health-professional education rather than a UK postgraduate surgical training context. It was therefore not feasible to present the full statement set to a Delphi panel of senior clinicians, given the practical constraints on time and cognitive load inherent in consensus studies involving busy experts. A summarised and contextually adapted version of the statements was required.

To achieve this, the researcher summarised the Albarqouni consensus statements[4] and adapted them for clarity, relevance, and applicability to General Surgery in the United Kingdom after discussion with the supervisory team (Professor of Medical Education and Professor of Surgery and General Surgeon respectively). Each statement was presented to stakeholders for detailed review. Stakeholders were asked to assess the overall coherence

of the statement set, the appropriateness of the content for surgical training, and the extent to which each item reflected the knowledge, skills, and behaviours expected of a General Surgery trainee developing competence in EBM.

Attention was also directed to anticipated challenges in implementation. Stakeholders provided insight into issues relating to faculty expertise, assessment feasibility, integration with established learning activities, regional variation in training environments, and alignment with the regulatory framework for surgical training in the United Kingdom. These discussions yielded rich contextual information that would not have emerged through trainee data alone. The process allowed clarification of statements that could be misinterpreted by a Delphi panel, identification of items requiring surgical-specific refinement, and recognition of potential organisational or logistical barriers.

The consultations served a methodological function as well. They enhanced the face and content validity of the proposed statements, supported the construct validity of the eventual Delphi instrument, and ensured that the forthcoming consensus exercise would be both relevant and manageable for expert participants. This bridging phase therefore acted as a form of pre-Delphi piloting.

The revised set of curriculum statements, shaped by these senior stakeholder consultations, formed the foundation of a first-round Delphi questionnaire. This ensured that the items presented for consensus were both evidenced by research (focus groups, scoping review and survey) and strategically grounded in the educational and organisational realities of UK General Surgery training.

1.5.5.2 Delphi study

The penultimate phase of this research project involved the development of a modified electronic Delphi study[79–82]. This method was employed with the goal of achieving a consensus on proposed components of an EBM curriculum tailored for general surgery training. It facilitated the creation of a consensus-driven set of curricular recommendations, which could integrate with the existing general surgery training curriculum.

Currently, there are no standard quality parametres to evaluate Delphi methods in healthcare research. Delphi methods' vital elements include anonymity, iteration, controlled feedback, and statistical stability of consensus. Published studies have used modified versions of Delphi, and details on methods like expert panel selection, defining consensus, or closing criteria for Delphi rounds are not explicit[81]. Therefore, the Delphi of this PhD aimed to adhere to available published standards as described in Diamond et al systematic review[80] and was reported in line with the DELPHISTAR checklist[83].

Delphi panellists were identified related to their role in the area. A diverse Delphi panel with geographical spread in the United Kingdom is essential for a successful Delphi in a broad research area[84], therefore participants included a diverse group of stakeholders, including General Surgery trainee representatives, surgeons and surgical educators. Recruitment was achieved through professional networks, academic institutions, and relevant medical organisations. It is hard to measure experience in surgical education, therefore this study relied on the educational role diversity of the panellists. The size of the panel can vary from

10-100 according to the literature, and this study aimed to recruit approximately 15 panellists. The participants were contacted to participate via email.

The identity of the panellists remained anonymous after the data of round 2 were collected and analysed. The panel consisted of approximately 30 experts to ensure diverse and comprehensive input. Panellists received controlled feedback after each round, summarising the group's responses and providing insights for the next round. The study consisted of 2 iterative rounds of questionnaires to refine and achieve consensus on the EBM curriculum. Consensus was defined using predetermined criteria such as a specific percentage of agreement among panellists. This was set *a priori* at 75%.

Data from each round were analysed using descriptive statistics to identify trends and levels of agreement. Thematic analysis was employed for qualitative responses (comments on statements) to provide deeper insights into participants' perspectives.

The Delphi study concluded when consensus was achieved on the proposed statements. It is anticipated that two rounds will be necessary to achieve consensus, though additional rounds may be conducted if needed. Should consensus on certain statements is not achieved at round 2, this was examined and consideration of non-consensus was undertaken. The initial questionnaire was be developed based on findings from the scoping review, focus group discussions and adapting the current General Surgical curriculum to Albarqouni et al consensus. It covered potential components of the EBM curriculum, perceived barriers, and implementation strategies.

1.5.6 Summary of method choice to answer the research question

A figure summarising the method choice to answer the research questions is provided in Figure 3. A pragmatic orientation underlies this research, supporting the use of diverse methods to address a complex educational problem situated within the multifaceted environment of surgical training. This stance recognises that EBM education comprises both structural features—such as curricula and assessment systems—and socially constructed elements, including attitudes, norms and professional identities.

A pluralist methodological stance is adopted, accepting that aspects of EBM training can be observed directly, whilst others require interpretive engagement. Post-positivist principles guide the quantitative component, allowing the identification of measurable patterns while acknowledging the influence of context and uncertainty. The qualitative work is informed by interpretivism, which seeks to understand meanings and experiences within the cultural and organisational setting of surgical practice. Social constructivism further supports this approach by emphasising the development of knowledge through interaction and shared understanding, consistent with the use of focus groups and participatory methods.

Utilised together, these philosophical positions provide justification for a sequential mixed-methods design, enabling quantitative breadth to be combined with qualitative depth and triangulation. This integrated approach offers a comprehensive foundation from which to inform the development of an EBM curriculum for General Surgery.

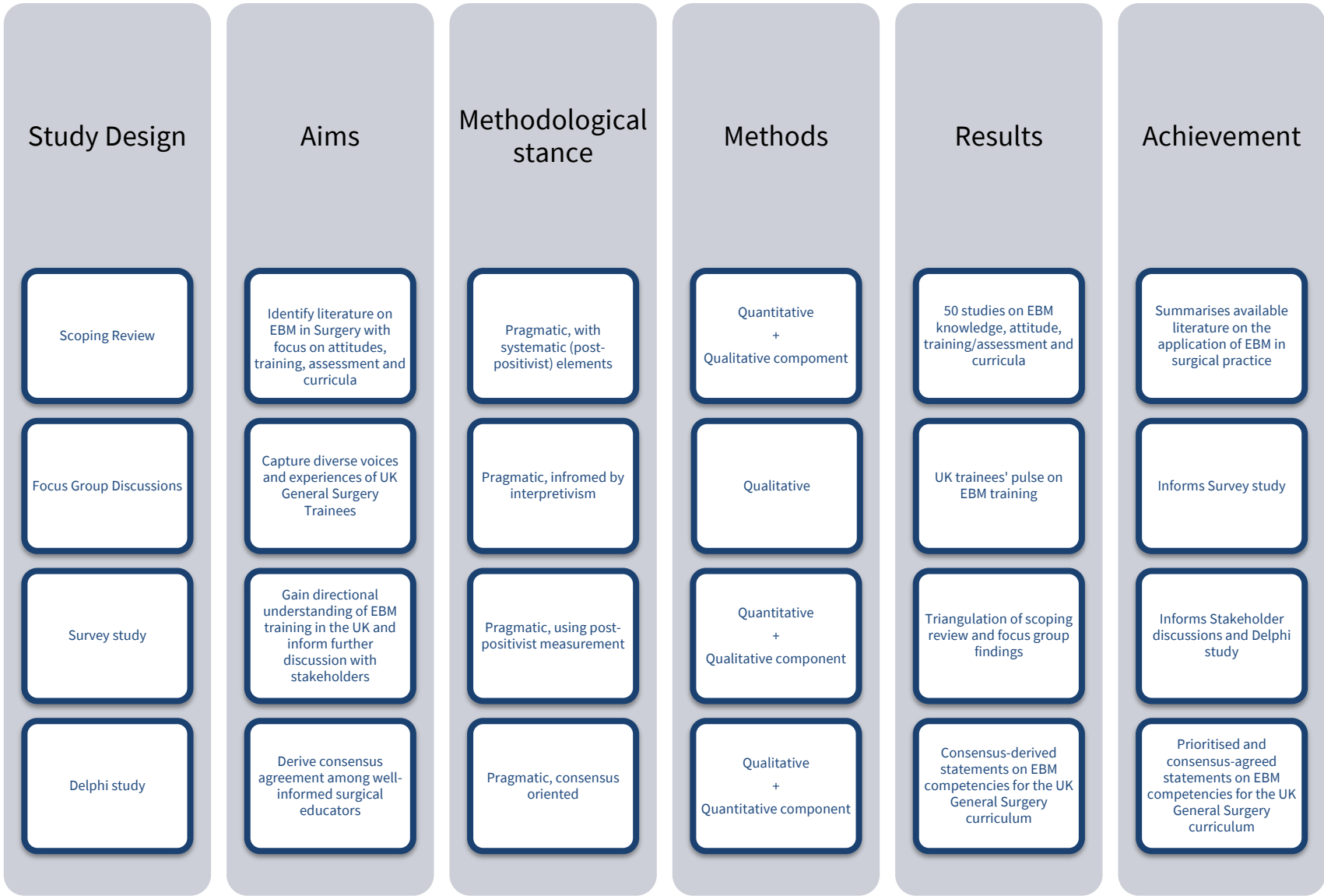


Figure 3 A summary of the thesis studies and their methodological stance and achievement

Chapter 2: Scoping review

This chapter presents the scoping review that constitutes the first phase of this research programme. The review addressed Research Question 1 by systematically mapping the available literature on EBM education within surgical training, with particular attention to attitudes, curricula, and competency assessment. The findings provided the conceptual and empirical foundation for the subsequent empirical phases of this thesis, establishing the fragmented nature of existing evidence, the limited applicability of available literature to UK General Surgery specifically, and the absence of a validated, specialty-specific EBM curriculum. A linking narrative synthesising the key findings and establishing the rationale for the mixed-methods study is presented in Section 2.6.

Evidence-based medicine within surgical practice and training: a scoping review.

E Tokidis[1,2], G Perin[4], P Vivekananda-Schmidt[1], SP Balasubramanian[1,3]

1. Division of Clinical Medicine, School of Medicine and Population Health, University of Sheffield
2. Doncaster and Bassetlaw NHS Foundation Trust
3. Sheffield Teaching Hospitals NHS Foundation Trust
4. Leeds Teaching Hospitals NHS Trust

Corresponding author: Evripidis Tokidis

Email: etokidis1@sheffield.ac.uk

We declare that we received no sources of funding for this publication. The lead author is currently a Clinical Research Fellow, self-funding his PhD.

Conflicts of interest

The authors declare no conflicts of interest

Data availability statement

The data used to produce this review are available upon reasonable request to the corresponding author.

2.1 Abstract

Background: Evidence-Based Medicine (EBM) is a fundamental element of modern surgical practice. However, its integration into surgical training remains challenging. Through a scoping review, this study mapped existing evidence on the practice of EBM in surgery, focusing on knowledge, attitudes, barriers, and curricula.

Methods: The literature was systematically searched through 3 databases and 2 registers. Fifty articles published over a 22-year period (2001 to 2023) were identified based on pre-defined eligibility criteria. These were reviewed using the Arksey and O'Malley's methodological framework. The review was checked against the PRISMA 2018 checklist for scoping reviews.

Results: There is evidence of awareness and appreciation of EBM principles among surgeons and surgical trainees. However, the understanding of EBM terminology varied. Attitudes towards EBM were predominantly positive, yet reliance on clinical experience over evidence-based guidelines was noted. Key barriers to EBM practice included time constraints, lack of structured training, and methodological challenges in surgical research. The review highlighted the lack of validated competency assessment tools and the need for structured EBM curricula. Various educational strategies, such as journal clubs and courses, were found to improve EBM knowledge, albeit with limited evidence on long-term practice change.

Conclusion: This scoping review underscores the need for a more detailed understanding of stakeholder views of EBM in surgical practice, the development, implementation, and assessment of educational interventions in this field, and tailored strategies to assess EBM competency in surgery.

Keywords: Evidence-Based Medicine, Surgery, Surgical Education, Postgraduate Education, Resident Education

2.2 Introduction

Evidence-based medicine (EBM) defined as 'the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient [1]' constitutes an inherent part of modern healthcare[85]. In 2018, Albarqouni et al[4] published a Delphi consensus on EBM competence which describes the set of competencies to be achieved by healthcare professionals. A year later, Thoma et al [86], followed with 'Evidence-based Surgery' as an aid to surgical practice. However, integrating evidence-based medicine competence training into surgical postgraduate curricula has been slow due to factors such as limited time within already demanding training schedules, insufficient faculty expertise in EBM, and lack of structured and standardised training frameworks [21].

Furthermore, surgical training has traditionally followed an apprenticeship model [87]. This hinder the integration of evidence-based surgery due to several factors including lack of integration of EBM principles into training curricula, limited availability of educational resources, time constraints faced by trainees and trainers, and the perception that

obtaining EBM competence is of lower priority compared to technical skills [48]. Furthermore, the complexity of surgical practice leads to methodological challenges in surgical studies [88]. At present, structured teaching, systematic training, and validated assessment tools for evaluating EBM competency remain inadequately developed in surgical education.

Key to integrating EBM in surgery is a comprehensive understanding of EBM related knowledge, attitudes, and educational needs within surgical practice alongside an examination of teaching methodologies and assessment tools [31] available to surgeons. This scoping review aims to identify the relevant literature on the topic and provide an overview of published evidence on the practice of EBM in surgery, with a particular focus on attitudes, training and curriculum in EBM, and assessment of EBM competencies.

2.3 Methods

This study is registered on the Open Science Framework (OSF) (doi:10.17605/osf.io/6vzm3). The five stage framework as described by Arskey and O'Malley for performing a scoping review [68] was followed. The scoping review has been checked against the 2018 PRISMA checklist for scoping reviews.

Framework stage 1: Identification of the research question

We aimed to address the following research questions:

1. What is the knowledge and understanding of EBM as defined by Sackett and outlined earlier in the introduction amongst surgeons and surgical trainees?

2. What are the attitudes of surgeons and surgical trainees towards EBM and their perceived barriers in the practice of EBM?
3. How are surgeons trained and assessed in EBM?

Framework stage 2: Identification of relevant studies

The terms *"evidence-based medicine, evidence-based surgery, evidence-based practice, surgery, surgical practice, training, teaching, perception, awareness, attitude, need, curriculum, assessment, utility, tool, critical appraisal, journal club"* were combined and searched in PubMed, Ovid Medline, Embase, ERIC and White Rose Research Online (research repository of University of Sheffield, Leeds and York; recommended as a search database by the university's doctoral development programme) on 20th January 2024. A further search of citations from two related systematic reviews [20,31] as well as hand search via 'PubMed similar articles' function was conducted (6.1 Appendix A – Scoping Review Database searches.).

Framework stage 3: Study selection

All published original or secondary research manuscripts in the English language; on knowledge, understanding, attitudes, barriers, teaching, training or assessment of EBM in surgery were included.

Framework stage 4: charting the data

All articles were downloaded to Rayyan software and after removing duplicate articles, the titles and abstracts were screened by two investigators (ET and GP) to identify relevant

articles. Manuscripts not addressing EBM in surgery, editorials and commentary papers and non-English language papers were excluded. One investigator (ET) reviewed full text of the selected articles to ensure eligibility and a sample of the full texts was reviewed by another investigator (GP) for additional validation.

Data from the included manuscripts were collected on an excel spreadsheet. Publication details, study characteristics, details on speciality and participants were included. Additionally, full texts were reviewed for the concepts that were defined at face value of the study's research questions stated at the Arskey and O'Malley framework stage 1. The data related to the concepts were organised based on the key findings of each study, followed by a narrative synthesis.

Reflexivity [89], understood as the potential influence of researchers' perspectives on the scoping process, was acknowledged. The lead author (ET) is a surgical trainee and postgraduate researcher. He led the review design and analysis. The second author (GP) is also a surgical trainee with significant experience in surgical research and running journal clubs. The review process was primarily conducted by these two authors (ET, GP), with regular oversight from senior surgical (SPB) and medical education (PVS) team members who provided feedback and ensured methodological rigour.

2.4 Results

Framework stage 5: collating, summarising and reporting

A total of 50 articles published across a period of 22 years (2001-2023) were included (Figure 4). The included studies and detailed study characteristics are listed in the supplementary material (Appendix A). The studies identified were primarily conducted in the United States of America, Canada and Netherlands (Figure 5) and conducted across most surgical specialties (Table 3).

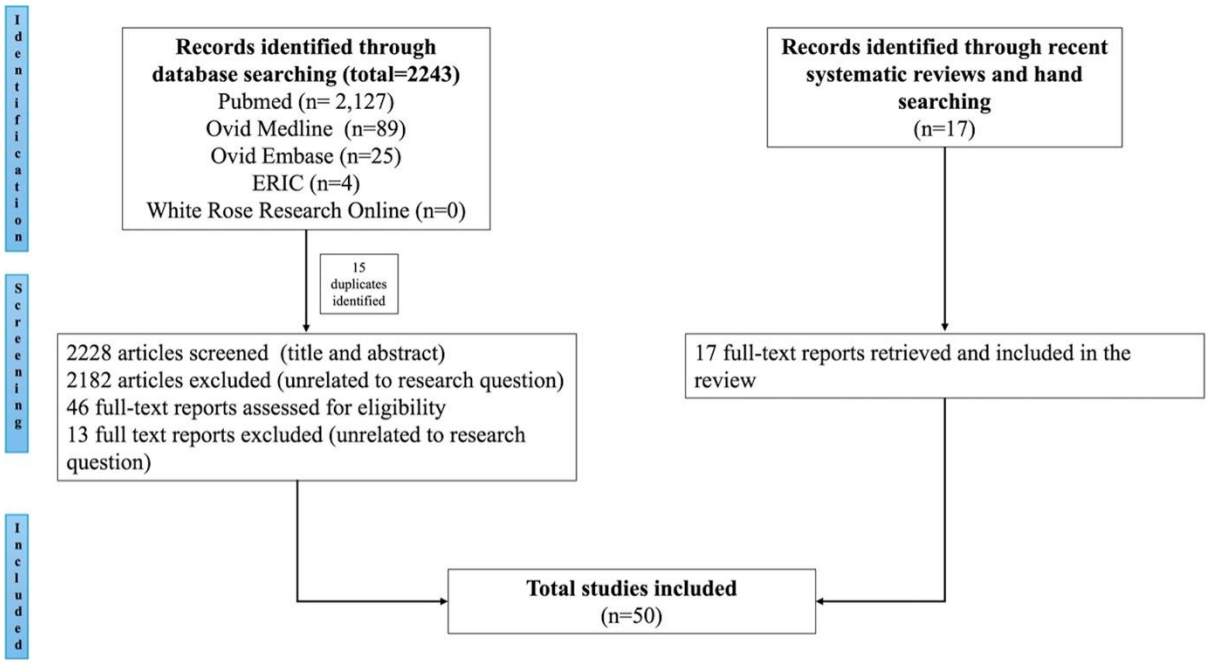


Figure 4 PRISMA flowchart describing search strategy

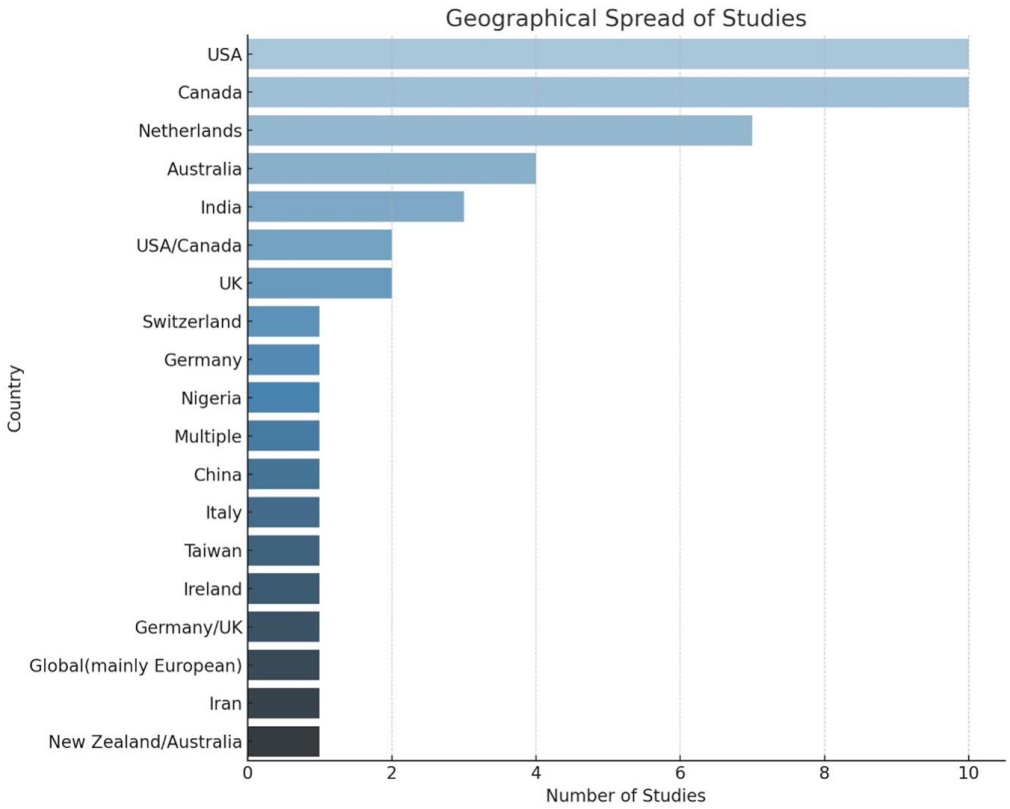


Figure 5 Geographical spread of the location of the primary authors of the included studies

Specialty	Number of studies	Percentage
Multiple Specialties	15	30%
General Surgery	13	26%
Trauma and Orthopaedics	5	10%
Urology	5	10%
Cardiothoracic Surgery	3	6%
Ophthalmology	2	4%
Plastic surgery	2	4%
Paediatric surgery	1	2%

Table 3 Distribution of the surgical specialty involved in the included studies

Most studies identified in this scoping review were mixed-method surveys (n=29), followed by studies of educational interventions (n=18) and qualitative studies (n=3). The response rate for the survey studies varied from 8.8% to 100%. There is significant overlap in the themes explored by the surveys reported by the different studies. These included knowledge and understanding of EBM, attitudes towards EBM, perceived barriers to the practice of EBM in surgery, training and assessment of competency in EBM and EBM curricula in surgery.

Knowledge and understanding of EBM

Thirteen studies investigated surgeons' and surgical trainees' knowledge and understanding of EBM. Eight studies[90–97] assessed the knowledge of participants by reviewing their familiarity with EBM terminology chosen by the authors of these studies. The knowledge of the terminology varied significantly amongst surveys. In a study of rural surgeons [98], EBM was perceived as 'the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient' [1]. Overall, surgeons and trainees demonstrated familiarity with EBM. However, only 25-75% of respondents were confident about the terminology related to EBM.

Only one study[99] used a validated measure of knowledge (numeracy), utilising the Schwartz-Woloshin tool[100]. Kumar et al [101] and Poolman et al [93] noted a positive association between respondents with a higher academic degree such as PhD and knowledge and

understanding of EBM concepts. Conversely, Lugano et al [92] did not identify this association in their survey. Awareness and usage of EBM resources were explored by 7 studies[90,91,93,95,97,101,102]. The resources included in the surveys were journals, specialty specific guidelines, and major databases such as PubMed or Cochrane. Guidelines and major databases were the main points of reference for most respondents.

Attitudes towards EBM

Twenty studies examined surgeons' and surgical trainees' attitudes towards EBM; 18 were mixed-method surveys. Kitto et al[98] and Weller et al[103] chose a solely qualitative approach (interviews) to capture attitudes. Certain studies[93,94,96,104,105] primarily used the McColl questionnaire[106], and others used validated[91,107] tools for assessing attitudes.

Overall, these studies show positive attitudes of surgeons and surgical trainees regardless of their surgical subspecialty. Rademaker et al[105] and Kumar et al[101] reviewed whether holding a higher academic degree (MD or PhD) influences attitudes. The latter found that those who have a higher degree of proficiency are less inclined to change their practice in response to new evidence, whereas the former found no differences in attitudes. Kitto et al[98] observed specific surgical practice traits that resembled 'entrepreneurs' who relied on experience over science and EBM, 'scientists' who were research and EBM focused and 'clinicians' who followed a more 'holistic approach'.

Weller et al[103] concluded that specialists primarily rely on their general knowledge and experience, rather than actively using information sources ('scientific publications',

1269 ‘guidelines or protocols’, and ‘presentations and meetings’). Distinct strategies were
1270 employed for complex clinical queries: consulting a colleague, actively searching the
1271 literature, and delegating the literature search[108]. Teunis et al[109] in their survey observed
1272 that variables such as confidence bias, trust in orthopaedic evidence base and statistical
1273 understanding are linked to inadequate detection of uncertainty.
1274
1275 Barriers to practice of EBM in surgery
1276 Barriers to EBM implementation were explored by 10 studies. The BARRIERS scale[110] was
1277 used in two of these[96,105]. The rest of the studies explored barriers based on survey findings
1278 on attitudes towards EBM or by analysis of qualitative data[48,107]. Time[48,91,92,101,104,105] and lack
1279 of EBM training[48,111,112] were identified by the majority of the included studies as major
1280 barriers for EBM implementation in practice. Hierarchical structures as a barrier to EBM
1281 were explored by Bhandari et al[48], Hajebrahimi et al[91] and Schnitzbauer et al[112]. Moreover,
1282 institutional barriers[48,91,112], methodological inadequacies[96,111,112] and access to evidence
1283 resources or evidence summary documents were common themes identified as barriers in
1284 the included studies. These are explained further in the discussion section.
1285
1286 Training in EBM and Assessment of EBM competency
1287 Table 4 outlines various studies on training in Evidence-Based Medicine (EBM) and the
1288 assessment of EBM competency in surgery. It categorises studies based on their use of
1289 validated or non-validated assessment methods. Studies using validated tools like the
1290 Fresno tool [113,114] and Berlin questionnaire [27,115] demonstrated statistically significant
1291 improvements in EBM knowledge and critical appraisal skills among surgical trainees and

residents. Studies using non-validated assessments [116–119] also showed positive outcomes, such as improved test scores. However, the data from studies lacking standardised measures provided less robust comparisons. Overall, the studies evaluated emphasise the effectiveness of structured EBM training in enhancing knowledge and application among surgical trainees.

Training in EBM and Assessment of EBM competency	Study	Method of Training	Assessment	Learners	Key Findings
Studies using validated assessment methods	Sprague et al.[114]	EBM course	Fresno tool	Surgical trainees	Participants showed a statistically significant improvement in EBM knowledge post-course, measured by the Fresno tool. The course was effective in transferring knowledge about EBM principles and application.
	Herur et al.[113]	Single session EBM journal club	Fresno tool	Surgical trainees	Journal club session led to a significant increase in the mean overall EBM scores and individual step scores in the EBM process, indicating enhanced understanding and application of EBM principles among participants.
	Ubbink et al.[115]	2-day critical appraisal course	Berlin questionnaire	Surgical residents	2-day critical appraisal course resulted in significant improvement in participants' post-test results using the Berlin questionnaire, demonstrating effectiveness in teaching critical appraisal skills.
	Fritsche et al.[27]	3-day critical appraisal course	Berlin questionnaire	Surgical residents	A 3-day critical appraisal course showed statistically significant improvement in post-test results, confirming the course's effectiveness in enhancing EBM knowledge and skills.

	MacRae et al.[28]	Exam test assessing EBM competency	MacRae tool	General surgery trainees	General surgery trainees with a strong background in critical appraisal performed significantly better in the exam test designed to assess EBM competency, highlighting the importance of prior knowledge and training in critical appraisal.
Studies using non-validated assessment methods	Santori et al.[117]	10 sessions on EBM	Session-specific MCQ	Surgical trainees	Throughout the curriculum, session-specific MCQs led to statistically significant improvement in post-test results, showing that frequent assessments can enhance learning and retention of EBM knowledge.
	Wolf et al.[118]	Training to grade level of evidence	Grading levels of evidence in 10 articles	Orthopaedic residents	Orthopaedic residents who participated in the study showed significant improvement in their ability to grade levels of evidence in 10 articles post-test, demonstrating the effectiveness of the training in improving critical appraisal skills.
	Komenaka et al.[119]	Training to critical appraise articles	Non-validated written exam (based on ABSITE)[120]	General surgery residents	Non-validated written examination correlated with ABSITE scores showed that the EBM curriculum positively impacted breast cancer knowledge and residents' satisfaction, suggesting a beneficial effect on their overall learning and performance.

	Fischer et al.[116]	Survey evaluating postgraduate surgical investigator course	No assessment tool	Postgraduate surgical investigators	Survey evaluating a postgraduate surgical investigator course indicated high retention of learning outcomes among participants, with 70.4% of course participants engaging in clinical trials as investigators, suggesting a long-term impact on research involvement.

1298

1299 *Table 4 Training in EBM and Assessment of EBM competency*

1300

EBM curricula in Surgery

The development and implementation of EBM curricula in surgical education is evaluated in Table 5 and Table 6 respectively. Across the studies, diverse methods such as structured curricula, journal clubs were employed to enhance EBM knowledge and critical appraisal skills among surgical trainees. While these approaches led to improvements in knowledge and engagement, they were often hindered by challenges like time constraints, limited attendance, and logistical issues. Surveys and programme evaluations underscored gaps in EBM training among surgical trainees, with some programmes being under-utilised or lacking formal assessment and structured feedback. Overall, the findings suggest that although certain EBM training activities are beneficial, there is a need for better integration, accessibility, and structure to maximise their effectiveness in surgical education.

EBM curricula in Surgery (1)	Study	Method	Learners	Key Findings
Curriculum development studies	Santori et al.[117]	10-session EBM programme	Surgeons and health personnel	The 10-session EBM programme led to improved MCQ scores among participants, although attendance was limited due to clinical commitments. The programme demonstrated effectiveness in enhancing EBM knowledge but faced challenges in engagement.
	Haines et al.[121]	Professor's rounds model	Neurosurgical trainees	The Professor's rounds model curriculum generated high self-reported interest in promoting EBM among neurosurgical trainees. Participants were keen on integrating EBM principles into their surgical practice, indicating a positive reception to the curriculum.
	Komenaka et al.[119]	Comprehensive evaluation of academic papers during breast surgery rotation	General surgery residents	During the breast surgery rotation, the comprehensive evaluation of academic papers significantly improved ABSITE scores and enhanced placement experience for general surgery residents. The curriculum was effective in improving EBM knowledge and satisfaction.

	Temple et al.[122]	Series of journal clubs with assigned homework	Plastic surgery residents	A series of journal clubs with assigned homework for plastic surgery residents showed a non-significant increase in knowledge levels post-test, suggesting limited efficacy in teaching critical appraisal skills through this format.
	Trickey et al.[49]	Structured curriculum with lectures, tutorials, and practice questions	General surgery residents	The structured curriculum, which included lectures, tutorials, and practice questions, resulted in significant improvement in post-curriculum test scores for general surgery residents. This approach was effective in enhancing EBM knowledge and application.
	Luc et al.[123,124]	Debate-style journal clubs	Cardiothoracic surgery trainees	Debate-style journal clubs received mixed feedback from cardiothoracic surgery trainees. While the format improved engagement and exam performance, it was time-consuming and faced logistical challenges. The approach was innovative but had practical limitations.
	Lao et al.[125]	Quebec Paediatric Surgery Journal Club	Paediatric surgery trainees	The Quebec Paediatric Surgery Journal Club received high satisfaction scores from participants, with statistically significant improvement in knowledge and understanding of session content. However, 'knowledge decay' was observed due to the infrequent nature of the sessions.
	Duong et al.[126]	Redesigned journal club series	Surgical residents	The redesigned journal club series, rotating between evidence-based, deep-dive, and landmark sessions, increased engagement and improved critical appraisal skills

				among surgical residents. However, participants felt it was insufficient for staying updated with new information.

1314

1315 *Table 5 EBM curricula in Surgery (1): Curriculum Development Studies*

1316

EBM curricula in Surgery (2)	Study	Method	Learners	Key Findings
Studies evaluating educational activity	Siegrist et al.[127]	Survey on curricular EBM training	Medical and surgical trainees	A survey on curricular EBM training revealed that surgical trainees reported almost no training in EBM, unlike their internal medicine counterparts, highlighting a significant gap in surgical education.
	Ahmadi et al.[128]	EBRS programme	General Surgery Residents	The EBRS program was useful for critical appraisal training among general surgeons, but only a small percentage of respondents utilized the full potential of the programme. This suggests the need for better integration and utilisation of EBM resources.

	Williams et al. [129]	Survey on journal clubs	Surgical residents	Monthly journal clubs, as reported in the survey, were affected by time constraints, impacting attendance and effectiveness. Participants indicated that the format was not optimal for teaching statistics, pointing to the need for improvements.
	Mullen and Sabri et al.[130]	Survey on ophthalmology programs	Ophthalmology residents	Survey on ophthalmology programmes identified journal clubs as crucial for clinical practice impact, emphasizing the importance of incorporating EBM knowledge into residency training to enhance clinical decision-making.
	Ibrahim et al.[131]	Survey on journal clubs in Nigeria	General, plastic, urological, and paediatric surgery residents	Survey on journal clubs in Nigeria highlighted the need for formal assessment of the quality of journal clubs. Residents expressed the need for structured feedback.

1317

1318 *Table 6 EBM curricula in Surgery (2): Studies Evaluating Educational Activity*

2.5 Discussion

This scoping review summarises available literature evidence on the application of EBM in surgical practice. The studies, provide a detailed insight of the surgical community's knowledge and understanding, attitudes, availability of current opportunities and tools and barriers relating to EBM.

Surgeons and surgical trainees value and understand elements of EBM as reflected in the studies evaluated. Most studies tried to quantify EBM knowledge by testing surgeons' awareness of EBM concepts. In none of the studies the included EBM concepts were derived systematically and validated, highlighting a need for a consensus curriculum for EBM within surgery. However, EBM concepts related to surgery [86,132] are innumerable, and any consensus on the curriculum needs to highlight overarching concepts and specify minimum standards instead of a detailed syllabus.

Overall, surgeons and trainees were positive towards EBM. The studies highlight ingrained practices such as asking (colleagues) for advice instead of evaluating available evidence [103,105]. Implementation of EBM curricula generally led to improvements in residents' skills and knowledge [121,119,125,126,49,123,124]. However, several barriers to the implementation of EBM into practice were highlighted, including time constraints [48,91,92,101,104,105] and a lack of an appropriate educational infrastructure [48,111,112].

Furthermore, hierarchical structures [48,91,112] of traditional, rank-based systems within surgical teams may discourage open dialogue or challenge to senior decision-making, thereby limiting the integration of EBM into daily practice. Institutional barriers [48,91,112] encompass challenges such as limited funding, insufficient personnel, lack of leadership support for EBM initiatives, and inadequate access to training resources. Methodological inadequacies [96,111,112] reflect the difficulty in designing surgical studies due to the complexity of surgical interventions, variability in patient populations, and practical constraints in conducting randomised controlled trials in surgical settings. Access to evidence highlights disparities in the availability of up-to-date evidence-based resources, such as journal access or EBM training, particularly in resource-constrained environments.

The structure of EBM curricula varied among the different studies, with all incorporating concepts relating to critical appraisal and biostatistics.

The scoping review identified a number of methods including journal clubs [113,122], lectures [117] and courses or workshops [27,114,115] for the teaching and training in evidence-based medicine. EBM can be assessed using various tools [31] that focus on different 'steps of EBM' [2]. The assessment tools utilised included the MacRae tool [28], the Berlin questionnaire [27] and the Fresno test [113] and some authors used non-validated tools [119,122]. None of the available tools in the current literature focus on the 'assess' step of EBM, described in the consensus document on postgraduate EBM curricula [4].

Overall, education interventions do appear to improve knowledge; however this decreases over time, a phenomenon described as 'knowledge decay' by Lao et al[125]. It is not clear whether this decay was in part due to the interventions not considering system factors and being integrated appropriately into the wider curriculum. This would involve considering factors that impact on learning as illustrated in the 3P-6Cs Systems Thinking Toolkit[133].

It is important to note that surgical education stakeholders primarily in the USA and Canada, sought to establish an EBM curriculum, mainly because of educational requirements at national level (ABSITE score improvement, Canadian curriculum 'scholar' indicators). Similar educational requirements are described in the Intercollegiate Surgical Curriculum Programme (ISCP) in the United Kingdom.

2.5.1 Limitations

The paucity of data in this field is a significant limitation of this review. Despite a systematic and comprehensive approach using an established framework[68], the studies retrieved were predominantly surveys, and heterogenous as to the population studied and the outcome measures included. Additional sources of heterogeneity included the differences in curricular structures, teaching and training methods. However, to our knowledge, this is the first study to review published evidence on evidence-based practice in surgical specialities.

2.5.2 Conclusion

This scoping review highlights several areas for future work to advance the incorporation of EBM into surgical practice. Evidence suggests that effective strategies should not only address knowledge acquisition but also focus on practical application in clinical settings, aligning with the 'shows how' stage of Miller's pyramid[134]. Interventions such as case-based

learning, simulation, and decision-making workshops may help bridge the gap between theoretical knowledge and clinical implementation. Additionally, addressing cultural and systemic barriers, including hierarchical structures, time constraints, and attitudes towards EBM, will be key to its broader acceptance and integration.

Future research should prioritise the development and evaluation of structured, context-specific EBM training programmes and assessment tools for surgical trainees and trainers. Identifying ways to incorporate EBM into existing curricula without increasing the workload of surgical training is also critical. Furthermore, research into the role of leadership and institutional support in enabling EBM implementation could inform strategies to embed EBM as a routine part of surgical practice. These efforts can, in turn, nurture the proactive use of EBM in practice to become the norm.

Author contributor roles

Conceptualisation: Evripidis Tokidis, Saba P Balasubramanian, PVS?

Data curation: Evripidis Tokidis, Giordano Perin

Validation: Giordano Perin, Pirashanthie Vivekananda-Schmidt, Saba P Balasubramanian

Writing-original draft: Evripidis Tokidis

2.6 Key point summary of scoping review and linking narrative to the mixed-method study

The preceding scoping review provided a structured overview of the literature addressing EBM within surgical training and highlighted the fragmented nature of existing evidence. Although the review identified several relevant themes—such as variability in educational provision, conceptual ambiguity surrounding EBM competence, and a paucity of research specifically focused on General Surgery—it also demonstrated that current knowledge is largely derived from heterogeneous studies with limited applicability to the UK. A particularly notable finding was the near absence of studies focused on General Surgery within the UK context, despite EBM competence being an explicit requirement of the national surgical curriculum. As a result, the literature alone cannot offer a sufficiently detailed or contextually grounded foundation for developing a curriculum that reflects the realities of General Surgery training. To move beyond the descriptive findings of the review and generate contextually grounded evidence, it is necessary to engage directly with those involved in the delivery and experience of training.

In response to this, the next stage of this PhD adopts a sequential mixed-methods design to generate empirical data to address the gaps identified in the evidence base. Mixed-methods research is well suited to approach medical education problems, as it enables qualitative exploration of trainees' lived experiences alongside quantitative mapping of national patterns; two forms of evidence that neither method could generate alone. In this case, the approach allows exploration not only of what is known about EBM in surgical training but also of how it is interpreted, prioritised, and enacted by trainees and key stakeholders.

The mixed-methods study comprises a sequence of interrelated substudies, each contributing a distinct form of evidence. The first qualitative phase involved focus group discussions with General Surgery trainees. These discussions provided an opportunity to examine in detail the lived experiences, challenges, and expectations associated with developing EBM competence. This qualitative exploration offered insight into how trainees interpret EBM within the surgical environment, the perceived influence of local training cultures, and the practical barriers encountered when attempting to integrate EBM principles into everyday clinical decision-making.

The second phase involved a cross-sectional, snapshot, exploratory UK-wide survey informed by the themes emerging from the focus groups. This quantitative component extended the inquiry from depth to breadth, capturing patterns and variability across a wider trainee population. The survey enabled examination of the prevalence of key attitudes, the consistency of training experiences, and the degree to which the issues raised in qualitative discussions are reflected nationally. By grounding the survey instrument in trainee-derived insights, this phase enhances conceptual relevance and strengthens the validity of the measures employed.

Collectively, the sub studies in Chapter 3 form a mixed-methods programme that advanced the research from evidence mapping to evidence generation. The triangulation of qualitative, quantitative perspectives provides a multi-perspective evidential foundation for the later Delphi consensus process, which will synthesise these findings into a set of statements for EBM in General Surgery.

Chapter 3: Mixed Method Study

This chapter presents the mixed-methods study that constitutes the second phase of this research programme. It comprises two interrelated substudies — a qualitative focus group study and a national survey — which bridge the mixed-method empirical findings with the Delphi consensus process. The focus group study addressed Research Question 2 by exploring General Surgery trainees' perceptions, attitudes, and barriers towards EBM. The survey (Section 3.2) extended these qualitative findings to a broader trainee population. Together these substudies provided the empirical foundation for the Delphi consensus study presented in Chapter 4. Linking narratives connecting each substudy to the next are provided at the end of each section.

3.1 Focus Group Discussions

A focus group discussion study exploring General Surgery trainees' views on EBM during their training programme in the United Kingdom.

E Tokidis[1,2], P Vivekananda-Schmidt[1], SP Balasubramanian[1,3]

1. University of Sheffield, Sheffield, United Kingdom, Division of Clinical Medicine, School of Medicine and Population Health
2. Doncaster and Bassetlaw NHS Foundation Trust, Doncaster, United Kingdom
3. Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom

Corresponding author:

Evripidis Tokidis, etokidis1@sheffield.ac.uk ORCID ID: 0000-0001-8594-0007

Contact details of authors:

Pirashanthie Vivekananda-Schmidt, p.vivekananda-schmidt@sheffield.ac.uk

ORCID ID: 0000-0003-1629-6574

Saba Balasubramanian, s.p.balasubramanian@sheffield.ac.uk ORCID ID: 0000-0001-5953-2843

3.1.1 Abstract

Introduction

Evidence-based Medicine (EBM) is fundamental to modern healthcare and its integration into postgraduate curricula is strongly advocated. Despite its relevance, incorporating EBM in postgraduate training, specifically in general surgery, is fraught with challenges. This study aims to explore the perceptions of general surgical trainees regarding EBM, focusing on the process of achieving competency, assessment and its associated challenges.

Methods

Four semi-structured focus group discussions were conducted, involving participants with varying experience in general surgery. Sessions were audio-recorded, de-identified and transcribed verbatim to facilitate data analysis. Thematic analysis was employed to identify recurring patterns and themes within the dataset, ensuring rigour and reliability in the findings. Saturation was achieved when no new themes or codes emerged from the data.

Results

Eighteen trainees at different levels of training, academic experience and from different regions of the UK took part. The discussions were thematically analysed. Four key themes were identified: 'Knowledge and understanding of EBM', 'Developing EBM competencies', 'Assessment in EBM', and 'Barriers for EBM'. Thematic saturation was achieved by the fourth focus group.

Conclusion

This study provides insights into the landscape of EBM in general surgery in the United Kingdom. Trainees demonstrated knowledge and understanding of EBM and the process of achieving relevant competencies. EBM assessment was perceived to be part of their training. Nevertheless, systemic barriers and inherent challenges appear to hinder the development of EBM competencies within postgraduate general surgical training. Achieving this requires a participatory approach to engage stakeholders to further develop the existing competency-based curriculum.

Keywords: Evidence-Based Medicine, Evidence-Based Practice, General Surgery, Focus Group Discussion, Thematic analysis, Qualitative Research

3.1.2 Introduction

Evidence-based medicine (EBM)[1] aids clinicians in making informed decisions regarding patient care by integrating the best available research evidence with clinical expertise and patient values.[2] The lack of attention to EBM in surgical education and training is currently evident[9,21] and has been demonstrated by a scoping review by the researchers.[135] The consequences of inadequate education and training in EBM for surgeons are significant[9]. Surgeons, like other doctors,[9,21,39,40] make critical decisions regarding patient care, which in turn have a significant impact on their outcomes. The 'apprenticeship model' of surgical training[87] and additional challenges such as time constraints and lower prioritisation of EBM concepts, obstruct the acceptance of EBM.[48]

Within the field of surgery, regardless of subspecialty, in the United Kingdom (UK),[36] there is currently no formal route of education towards competency in EBM.[21] While there is evidence of the utility of undergraduate medical school EBM curricula[37] and advocacy for a specific competency framework in postgraduate training,[4,38,136] surgery is not the focus of these studies.

It is essential to involve stakeholders in surgical education to develop a universally accepted curriculum, fostering a culture where the application of evidence-based medicine in clinical practice becomes standardised and actively promoted.

Following an initial interpretivist approach,[66] this study aims to capture the diverse voices and experiences of general surgery trainees in the UK, with a particular focus on the process involved in achieving EBM competency, its assessment, and the barriers to integrating EBM principles into general surgical practice.

3.1.3 Methods

Semi-structured focus group discussions were conducted between December 2023 and January 2024 involving trainees in general Surgical training in the UK. Candidates were invited to participate from closed groups via social media, WhatsApp and email circulation via all available deanery stakeholder communication portals (6.2.3 Focus Group Discussion Invitation Letter). Responses of interest were received from 18 trainees in England. Participation in the discussions was incentivised with a free EBM course for trainees, provided by CRAMSURG.[137]

Ethics approval for this study was granted by The University's Ethics Committee (Reference Number 056808). Participants read an information sheet (6.2.1 Focus Group Discussion Participant Information Sheet) and signed an electronic consent form before participation (6.2.2 Focus Group Discussions Consent Form). The training programme directors (overseers of the trainees) were not informed of the focus group participation. Additionally, the transcripts were not made available to training programme administrators or directors. Methods are reported based on the COREQ Guidelines (6.3 Appendix C– COREQ Checklist).[138]

Six key questions (Table 7) were part of the focus group topic guide and included additional prompting questions. All participants of each focus group were invited to discuss each of the key questions. The topic guide for the focus group was designed by ET and based on the scoping review recently performed by the researchers.[135] The questions were reviewed and

iteratively revised by other authors with qualitative (PVS), clinical (SPB), and under- and postgraduate medical education (PVS, SB) skillset. Training of the primary researcher (ET) in qualitative research methodology was obtained through university postgraduate education portals.

Focus group discussions (45 minutes per group) were conducted via Google Meet™ video conferencing system by ET (primary researcher) and supervised by PVS (supervisor). Researchers established their relationship with participants at the point of recruitment. Participants were made aware of the clinical and educational background of the interviewer (general surgery trainee, PhD student), and of their interests in the topic (EBM enthusiast). The focus group discussions were recorded, de-identified and transcribed. Field notes were taken during the discussions by ET. Transcripts were anonymised before analysis and the data was stored in a secure University cloud storage space.

Focus Group Questions
1. What do you understand by EBM and why is it important to you as a surgeon? a) Do you feel it adds to your practice? b) If so, how?
2. What sources of information or resources have you found most helpful in your efforts to learn about EBM?
3. Are there specific areas or aspects of EBM that you feel confident in or areas where you would like more guidance?
4. Could you describe how EBM is currently integrated into your surgical training programme? a) Are there specific courses, workshops, or methods used to teach you EBM?

5. EBM can sometimes be challenging to apply to daily practice. a) What barriers or obstacles have you encountered when trying to implement EBM principles in your clinical practice?
6. Should trainees be assessed on EBM knowledge and practice? a) What do you think of how trainees are currently assessed with regards to EBM knowledge and practice? b) What would be reasonable alternative ways to do this assessment?

Table 7 Focus Group Questions

Reflexivity ('the inherent bias carried by the conduct of the researcher in interviews or interpretation of transcripts')[89] was acknowledged. The topic is focused and unique, therefore an enthusiast but less experienced researcher on the subject was considered suitable to design and moderate these discussions. To minimise bias, transparency was established with participants; the lead author (ET) did the interviews and PVS (supervisor) sampled some of the interview process for quality and offered feedback. The data was subject to thematic analysis.[77,139] This method provides a flexible, accessible, and efficient approach to qualitative research, suitable for early career researchers, that effectively highlights participant perspectives.[140] Choosing this method allows for easier communication of the study's findings to researchers not necessarily familiar with qualitative research.[140] For the analysis of the transcripts, NVivo software (Application, Copyright© 1999-2023 QSR International Pty Ltd)[141] was used to read and generate codes from the different focus group transcripts. An initial code matrix was used,[142] and these further populated four major themes. Focus groups continued until saturation of themes occurred and new codes were no longer appearing in the discussions.[143]

3.1.4 Results

A total of four focus group discussions were held. The first group included 3 participants (2 from Yorkshire and 1 from London), the second group had 4 participants (3 from Yorkshire and 1 from the Southwest), the third group had 6 participants (3 from Yorkshire, 2 from the Southwest, and 1 from the Northwest), and the fourth group had 5 participants (3 from Yorkshire, 1 from the West Midlands, and 1 from the East Midlands). The demographics of the focus group discussion participants are summarised in Table 8. The major themes, subthemes and representative quotes are illustrated in Table 9.

Participants	N=18
Gender	Male:10 Female: 8
Training Level	ST3:2 ST4:2 ST5:3 ST6:2 ST7:5 ST8: 4
Research degrees	PhD:4 MD: 3
Research in progress	Out of Programme Research: 7
UK Deaneries	Yorkshire and the Humber: 11 Southwest:3 London:1 Northwest:1 EastMidlands:1 West Midlands: 1
Subspecialty Focus	Colorectal:10 UpperGI:4 Hepatobiliary:3 Undecided: 1

Table 8 Focus Group Discussion Participants

Theme	Subtheme	Representative Quotes
Knowledge and Understanding	Definition of EBM	'…what is out there…' (FGP3, FGP18) '…isn't this a thing you do by default?' (FGP3, FGP6) '…it's about being able to critically appraise…reflect your practice…make decisions…rather than I've been told to do so…" (FGP12) '…data driven practice rather than experience driven…' (FGP11) 'protocolised medicine' (FGP17) '…taking into account patient views and individual patient characteristics…' (FGP17) '…trying to care for patients in a justified manner…' (FGP11)
	EBM Resources • Guidelines • Society information • Journal clubs • Publications • Social media • Bite-sized evidence • Mobile apps	'…guideline based medicine…' (FGP4) '…what is provided by our societies…' (FGP3) '…isn't journal club a resource…' (FGP4) '…published trials…' (FGP8) '…social media for example X-formerly known as Twitter…' (FGP1) '…bite sized evidence rather than whole journal reading…' (FGP5) '…I do use an app occasionally for this…' (FGP2)
Developing EBM Competencies	Pathway of EBM competence	'…traditionally you start from textbooks…then dive into the evidence…then summarise the evidence…' (FGP2) '…continuously making advances…' (FGP7) '…EBM used to be part of candidate selection for general surgery training but that is not the case anymore…' (FGP5)
	Curricular EBM adjuncts • Portfolio assessments • FRCS exam preparation • Audit • Journal clubs • Regional Teaching	'…discuss a paper you read with your consultant and evidence it on ISCP…' (FGP8) '…So get into the habit of just reading more (means reading more evidence during exam prep) and quickly being able to assimilate it…' (FGP4) '…audit is a training requirement and you have to be able to synthesise the evidence to do an audit…' (FPG2) '…certain hospitals have journal clubs…' (FGP6) '…occasionally regional teaching provides the opportunity for EBM updates…' (FGP7)

	<u>Extra-curricular EBM adjuncts</u> • Courses • Statistics Training • Social media • Higher academic degree	'…try and go to courses…' (FGP8) '…understand more of the papers you read when you received statistics training…' (FGP2) '…keeping up to date with EBM from twitter…' (FGP3) '…done an MD…then done an RCT and systematic reviews…having done that no there isn't really anything that I think I need but maybe if I haven't had the research experience then it would have been difficult…' (FGP14) '…I am doing a PhD so I've got access to lots of papers very easily…' (FGP8)
Assessment of competence in EBM	<u>Curricular EBM assessment</u> • Exams • Audit	'…you need to be competent in Evidence-based practice in the exam in order to CCT…' (FGP12) '…you have to be able to synthesise the evidence for at least the standards for something in order to do that' (FGP13)
	<u>Extra-curricular EBM assessment</u> • Higher academic degree • Publications	'…I have done an MD and I think as part of your Viva for your MD it is an assessment of your ability to analyse the data and evidence…' (FGP14) '…aren't you EBM competent if you have published articles relevant to your work?' (FGP10) '…doesn't publishing a systematic review make you EBM competent…' (FGP10)
	Informal assessment in daily practice	'…the best way really is just getting senior colleagues and Consultants to grill you on specific cases…' (FGP7)
Barriers for EBM	<u>EBM nature barriers</u> • Complex Statistic • Contrast of EBM vs Evidence-based Surgery	'…I just finished my PhD and on some of those as I needed to involve a statistician because there was no way that I would be able to manage all that data or read and understand and be correct…' (FGP3 FGP15) '…surgery feels different to medicine when it comes to implementing a new intervention as it is operator dependent…' (FGP2)
	<u>Systems barriers</u> • Equality of access to EBM resources • Financial and Managerial • Type of Hospital • Relationship with academia • Surgical Dogma	'…I am doing a PhD so I have got access to lots of papers very easily…most people do not have this' (FGP8) '…it is not always possible due to resources you have available…' (FGP13) '…the centre I currently work in for a long time seem to actively enjoy the fact that it was not considered a particularly academic centre compared to the larger hospital down the road…' (FGP17) '…So surgery has this kind of weird relationship where scientific research is an incredibly important thing that we must all do and understand largely by pushing out papers it seems but also we can just ignore it because at the end of the day we know what to is right or wrong…'

	• Lack of time • Portfolio burdens • Hierarchy	(FGP12) "…the evidence suggests that we should do this and your bosses like no I refuse to do that because I've been doing this for a hundred years and my way…" (FGP8) '…it is more the time constraints and the effort that are the problem…' (FGP9) '…you want to add more stuff to our ISCP?...' (FGP14) '…come up against quite a big hierarchy step in surgery when you mention EBM…' (FGP18)

1612 *Table 9 Themes and subthemes of the focus group discussions with representative quotes*

Knowledge and Understanding

Participants discussed 'Knowledge and Understanding' extensively over the course of the four focus groups. Further sub-themes have been produced (definition/EBM resources). General surgical trainees' definitions of EBM varied. Trainees demonstrated a sense of intuition about defining EBM and their responses focused on the 'critical appraisal' aspect of EBM. A contrast between evidence-based and practice-based medicine was illustrated. The concept of 'guideline-based medicine' recurred with a trainee attempting to distinguish it from evidence-based medicine, trying to include individualised patient treatment into the definition which resembles the original definition of EBM from Sackett et al[1] in the early 90s.

Trainees valued the EBM content of various resources such as guidelines, conference and surgical society meeting discussions; local meeting discussions such as journal clubs featured in this theme and recurred in all focus groups. Published scientific findings i.e. clinical trials and recent articles were mentioned, with trainees emphasising the use of social media in their responses. Additionally, two trainees mentioned mobile phone applications for accessing evidence.

Developing EBM Competencies

This is the second of the four main themes generated from the discussions branching into 3 sub-themes. Participants generally agreed that EBM competence development starts at

medical school and develops over the years in its more refined state near the completion of training. Additionally, preparing for speciality interviews was part of developing critical appraisal skills at an early stage. Throughout their training, the trainees have aids for EBM competence development; these can be extra-curricular as well as curricular adjuncts.

A single trainee mentioned that the emphasis in the curriculum is moving away from having to do extra-curricular activities such as a higher degree as a 'tick box' exercise to demonstrate EBM activity. Nevertheless, most trainees (14/18) mentioned having or being in the process of obtaining a higher research degree (MD or a PhD) as a means for achieving and demonstrating EBM competence. This seemed to provide them with confidence in being competent in EBM or because their regulatory body (i.e. deanery) considered it appropriate to demonstrate EBM competence for certification. Additionally, trainees' perception was that this route provided them with access to academic resources, compared to colleagues not doing higher degrees. Preparation for specialty exams (FRCS) was also universally considered to be a way of acquiring EBM competence.

<u>Assessment of competence in EBM</u>

Trainees report that EBM competency is partly evaluated through various assessments such as the Annual Review of Competence Progression (ARCP), where EBM application may not be directly interrogated but is implied through assessments like audits. The significance of the FRCS exams was highlighted from the focus group data, indicating that a level of EBM competency is expected to achieve Certification of Completion of Training (CCT).[36]

Furthermore, the integration of EBM within the portfolio assessments[144] underscores its embeddedness within the certification pathway.

Extra-curricular activities are perceived as self-driven endeavours that augment trainees' EBM competence. Higher degrees such as an MD or PhD were seen as an informal yet rigorous form of assessment. Publications, while no longer a requirement in the new curriculum, previously served as an informal marker of EBM application and expertise.[51] On-the-job assessments, although informal, are an intrinsic part of daily medical practice[145] and play a role in EBM proficiency. Discussions with senior colleagues and consultants often revolve around evidence application in specific cases. These interactions, though not formally graded, seem to contribute to a culture of continuous learning and application of evidence-based medicine.

Barriers for EBM

Barriers for practicing EBM within general surgery were explored through the discussions. Several codes were generated that were combined into multiple sub-themes as shown on Appendix A (supplementary material). Trainees expressed a palpable sense of being overwhelmed by the complexity of statistical analysis necessary for interpreting research. This complexity acts as a barrier, necessitating support for those not specialised in research methodologies.

Trainees highlighted inconsistencies in access to training resources and literature necessary for EBM. Even within the same region, access can vary, affecting the ability to stay up to date. Economic and resource constraints and institutional capacity to provide appropriate equipment to implement the best evidence-based practices were also quoted as barriers. The type of hospital — whether it is a smaller, less academic centre or a larger, research-oriented institution — influences the trainees' EBM competencies. Moreover, there is a noted ambivalence towards academia, with scepticism about academic surgeons' practical experience.

Established practices and 'surgical dogma' heavily influence decision-making[146], often at the expense of newer evidence-based approaches. However, the incorporation of EBM into clinical practice is not without challenge for the trainees. Several participants noted the varying levels of evidence application across different hospitals, which can be influenced by the consultants' engagement with current research and their willingness to update practice.

There are concerns about further burdening surgical portfolios with EBM requirements, which could add to the already substantial workload of trainees and trainers alike. Additionally, there was an acknowledgment of the role of hierarchy and seniority in surgical practice. Younger surgeons may be more inclined to adopt new evidence-based approaches, however there can be a reluctance among more senior surgeons to deviate from their longstanding practices.

Thematic saturation and meaning saturation

Code generation has been decreasing gradually throughout the focus group discussions and no new codes were generated in group 4 (Figure 6). This demonstrates thematic saturation by group 4 given that no more codes were generated. This meant that thematic saturation was achieved for all themes.

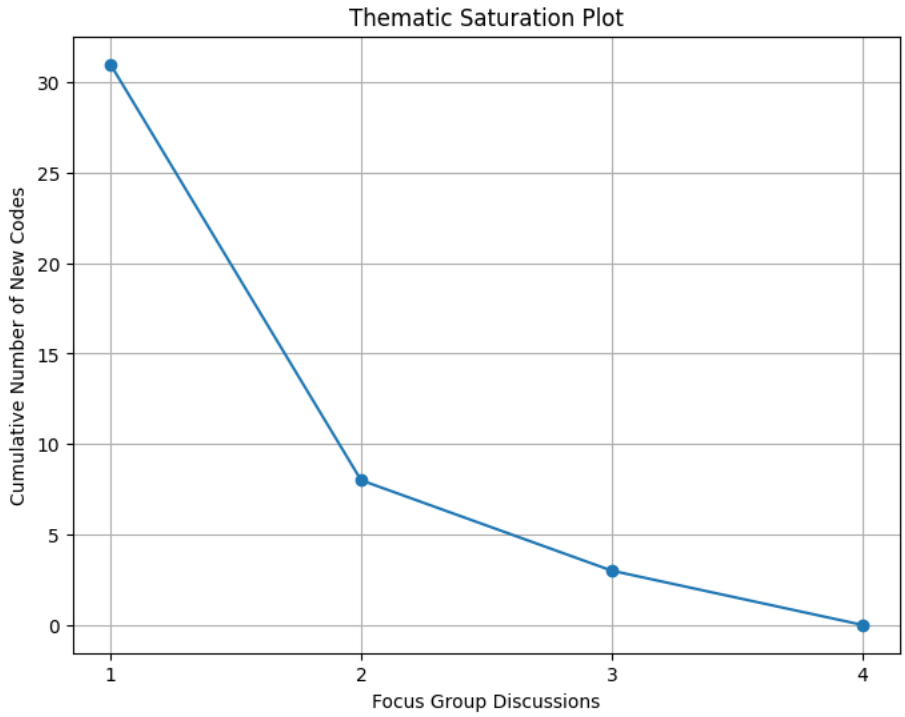


Figure 6 Chart demonstrating code saturation

3.1.5 Discussion

The focus group discussions provided insights into trainees' experiences with evidence-based medicine (EBM), demonstrated the critical role that EBM plays in surgical training and clinical practice[87,9,40,39,21] and highlighted the barriers[20] that impede its integration into the curriculum.

Trainees acknowledged the importance of EBM in improving patient outcomes and the quality of healthcare.[147] They collectively defined EBM by the available literature.[1] There was a consensus that EBM principles were essential to modern surgical practice and decision-making. Participants' attitudes towards EBM were generally positive, suggesting

a shift towards a more evidence-informed practice. However, there was an apparent dichotomy between the theoretical value placed on EBM and the practical difficulties in its application, reflecting the complexities of integrating EBM into a system with established practices and beliefs.[148]

Curricular and extra-curricular ways of developing EBM competencies were described, however, trainees' views varied as to the necessity of those. The role of possessing a higher academic degree was discussed in most focus groups, with the majority of higher degree holders feeling that it enhanced their EBM competence. Additionally, trainees underscored the importance of end-of-training exams (FRCS-Fellowship of the Royal College of Surgeons) in achieving EBM competencies.

The application of EBM is integral to clinical practice and intersects with daily surgical procedures and decision-making.[149,150] Participants in the focus groups underscored the dynamic nature of surgical practice[151] and the need for continuous updates to align with evolving evidence, as captured by two trainees' reflections ("…medicine and surgery do not stay the same and we are continually making advances…"), ("…the evidence changes…"). This sentiment echoes the perception that evidence-based practice is not static,[152] emphasising the importance of adaptability and ongoing education in surgery.[153] The application of EBM was further highlighted as crucial for patient safety and optimal care. Participants elaborated on the necessity of challenging institutional norms[154] when they diverge from evidence-based recommendations[48] ("…it is ultimately about what is the best and safest thing for our patients and that is not always going to be what the done thing is

in your institution...”). The discussions pointed towards the utility of EBM not only for passing exams but also as a foundational element in everyday clinical practice.

Nevertheless, the actual application of EBM in clinical settings was varied, with several barriers reported in its implementation. Complex statistical methodologies and the contrast between Evidence-based Surgery[153] (EBS) and EBM were cited as substantial barriers. These issues could stem from the gap between the statistical literacy required to interpret surgical research and the training provided, however, there is no available evidence to support this. Additionally, surgery's distinct nature from medical specialities poses unique challenges,[155] potentially extending to EBM application within surgery.[9]

System barriers, particularly related to training resource accessibility, financial and managerial support, and the relationship with academia, were recurrent themes. Participants expressed that access to EBM resources was inconsistent, with disparities noted across different hospital settings and the level of engagement from their supervising consultants. This inconsistency was perceived to be exacerbated by financial constraints and bureaucratic barriers or organisational inertia in adopting new practices. These barriers, not specific to surgery, are well described in a recent systematic review on the topic[20] and have been investigated since the 1990s when McColl et al introduced their attitude questionnaire on EBM for General Practitioners.[106]

Surgery-specific barriers, such as the ingrained surgical dogma, time constraints due to the demanding nature of surgical training, and the perceived additional burdens of EBM-

related portfolio requirements, were prevalent.[21] These challenges reflect a culture within surgical training that at times prioritises traditional methods and experiential learning over the incorporation of new evidence into practice.[48,156] The culture within surgical fields presents unique challenges, often characterised by varying degrees of acceptance of EBM. Surgeons may question the applicability of broader medical evidence to their specific field, citing methodological differences, surgical expertise, and individual patient demographics that may not align perfectly with the evidence presented.

Furthermore, the transition from evidence to clinical practice can be hindered by resistance to change, particularly from established practitioners. This highlights a generational paradigm in the acceptance and integration of new evidence into surgical practice.[21] The time required to stay abreast of the latest research and integrate it into practice is a significant barrier, particularly given the demanding nature of surgical training and practice.[20] The apprenticeship model of surgical training[87], while valuable, sometimes hinders EBM practice.[48] Identifying the equilibrium between valuing the experiential knowledge of surgical experience and embracing novel evidence-based practices that enhance patient care could be a future direction of EBM training in general surgery.

Given these findings, fostering an environment that supports the learning and application of EBM principles from the outset of surgical training, is of the essence. This may involve curricular reforms that integrate EBM more comprehensively, dedicated time for EBM activities, and a cultural shift that values ongoing education and adapts to evolving evidence. Furthermore, assessment strategies need to be refined to validate EBM

competencies more effectively, always considering medical education interventions' complexity.

3.1.6.1 Limitations

This is a single-method study with a small number of participants, and the majority were from a single geographic location in the UK. However, the data reached saturation indicating the views captured were sufficiently comprehensive. Qualitative studies are not about generalisability but about building insight into a problem; this study achieves that. The plan is to build on this study by developing a survey to collect UK-wide data, informed by the focus group discussions. Selection bias is recognised given that a significant proportion of the participants are academically oriented. However, it was not possible to better understand the characteristics of non-responders.

3.1.7.2 Conclusion

In conclusion, this study provides a snapshot of the current landscape of EBM within UK general surgery training. Despite the limited number of participants, meaningful conclusions could be reached that echo emerging literature on the topic and highlight the need for future surgical education research in the field. While trainees recognise the importance of EBM, significant barriers remain that require systematic approaches to overcome. Efforts to enhance the integration of EBM into surgical training should be prioritised to ensure that future surgeons are equipped to deliver high-quality, evidence-based care. Future research should aim to understand the themes in depth, and we are currently developing additional work to do this.

3.1.8 Linking narrative: from qualitative findings to UK-wide snapshot survey

The focus group study provided qualitative insight into how General Surgery trainees in the UK understand, experience, and engage with EBM within their training. Four key themes emerged (knowledge and understanding of EBM, competency development, assessment, and barriers to integration), alongside a consistent finding that cultural and hierarchical factors shape EBM engagement as much as formal teaching provision.

However, qualitative methods are designed to generate depth of understanding rather than breadth of coverage. With eighteen participants drawn predominantly from one geographic region, the focus groups could not determine whether these themes reflected patterns across UK General Surgery training as a whole or were specific to the local training context. To address this limitation and extend the findings more widely in the UK, a cross-sectional snapshot survey was developed directly informed by the qualitative themes and distributed nationally. This sequential approach — using qualitative findings to shape the subsequent steps of developing this survey— helps to support the content validity of the survey instrument and ensures it reflects the lived realities of trainees rather than researcher assumptions.

3.2 Survey study

Title: EBM training in General Surgery in the UK: An exploratory snapshot survey study

Evripidis Tokidis[1,2], Saba P Balasubramanian[1,3], Pirashanthie Vivekananda-Schmidt[1]

4. University of Sheffield, Sheffield, United Kingdom, Division of Clinical Medicine, School of Medicine and Population Health
5. Doncaster and Bassetlaw NHS Foundation Trust, Doncaster, United Kingdom
6. Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom

Corresponding author: Evripidis Tokidis

Email: etokidis1@sheffield.ac.uk

This paper is not based on a previous communication to a society or meeting.

Conflicts of interest

The authors declare no conflicts of interest

Data availability statement

The data used to produce this review are available upon reasonable request to the corresponding author.

Clinical Trial Number

Not applicable

Human Ethics and Consent to Participate declarations

Ethical approval was granted by the University of Sheffield (reference: 056808). The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Funding declaration

The authors declare that they have not received any funding for this research. In view of acceptance for publication, we will be declaring that the University of Sheffield will be supporting open access publication via the University of Sheffield Institutional Open Access fund. For this condition to be met, the paper must be published under a CC BY License.

3.2.1 Abstract

Background and Aim

This study aims to identify UK general surgical trainees' perceptions, attitudes, and perceived barriers to EBM training and assessment so that interventions by general surgery educators to improve integration of EBM are informed by stakeholder data.

Method

A mixed-method survey was developed by adapting the validated McColl and BARRIERS questionnaires, informed by a scoping review and focus group discussions. Ethical approval was obtained (University of Sheffield - 056808). The survey was distributed through social media, surgical society newsletters, and deanery mailing lists, adhering to the CHERRIES checklist.

Results

The survey yielded 101 responses, 53 of which were complete (65% male, 35% female). A quarter of the 101 respondents did not hold higher academic degrees. Most participants (61%) worked in district general hospitals, with the highest response rates from Yorkshire and West Midlands. Attitudes towards EBM were predominantly positive from trainees (50.3%), with most of the respondents indicating their ability to understand and explain EBM terminology. However, they perceived their senior colleagues to be less enthusiastic about EBM (41.5%). Barriers to developing EBM competencies included lack of time, excessive evidence volume, limited access to resources, inadequate critical appraisal skills and limited opportunities for application during clinical practice. Existing postgraduate assessment strategies were deemed adequate for EBM by most of the trainees.

Conclusion

The surveyed UK General surgical trainees exhibit positive attitudes towards EBM but face barriers in its application within their training. One way of addressing this issue is through research informed targeted curricular interventions.

3.2.2 Introduction

General surgical training is characterised by intensive clinical responsibilities and cultural norms that collectively shape the practice.[157] Within this environment, the routine integration of EBM[1] defined as the "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" remains elusive.[60,158] Attitudes and barriers to EBM have been examined in the past using mixed

method survey research which produced validated questionnaires (McColl questionnaire/BARRIERS scale).[106]

Although formally recognised as integral to modern surgical training,[52] implementation of the principles of EBM is often overshadowed by the complexities of clinical service and professional socialisation, indicating that several factors prevent its adoption as demonstrated in recent work[60,158]; a complex array of cultural, structural, and pedagogical barriers were revealed by the scoping review,[60] while the focus group discussions with trainees further confirmed their systemic impact[158]. Interpreting these findings in isolation, however, risks overlooking subtle but crucial interconnections. Therefore, to achieve triangulation,[63] the survey method[159] in addition to focus group discussions can help expand upon the previously identified themes with a larger group of stakeholders and thereby to better understand how to facilitate EBM Practice amongst trainee surgeons.

This survey aims to triangulate previous qualitative research findings by gaining a directional understanding of the factors limiting EBM uptake for surgical trainees and, in doing so, guide the creation of informed strategies that align with the realities of surgical education. The objectives include refining the conceptual model of these barriers developed through previous work,[60,158] identifying points for discussion with surgical education stakeholders to develop curricular reform, and ultimately advancing EBM integration within general surgical training.

3.2.3 Methods

A mixed-methods survey[63] was undertaken to explore the perspectives of general surgery trainees in the United Kingdom on integrating EBM into their training. General Surgery trainees were selected as the primary participants due to their direct involvement in surgical education and their status as the primary beneficiaries of an EBM-focused curriculum. Surgeons not in an established general surgical training programme i.e. locally employed doctors[160], were excluded to maintain the survey's relevance to its target audience.

A survey tool was developed (6.5.5 Survey Tool) by adapting the McColl questionnaire[106] based on previous findings from a scoping review and focus group discussions from the research team.[60,158]

Two examples illustrate how prior phases directly shaped the survey instrument. First, the scoping review identified time constraints and lack of protected teaching as consistently reported barriers to EBM integration across the international literature[60]. This informed the retention and emphasis of time-related barrier items within the adapted BARRIERS scale, ensuring these were captured with sufficient granularity for the UK surgical context. Second, focus group discussions revealed that trainees predominantly relied on higher academic degrees — MDs and PhDs — as their primary route to EBM competence development, a finding specific to UK surgical training culture not captured by the original McColl questionnaire[158].These adaptations ensured the survey instrument reflected the

empirically grounded priorities of the preceding qualitative work rather than reproducing a generic EBM attitudes tool.

The draft questionnaire was piloted with ten general surgery trainees from different training grades. The pilot assessed clarity of wording, face validity, and feasibility of completion. Feedback over email or via in-person discussion led to minor revisions in the phrasing of items and streamlining of the layout, after which the survey was finalised by the authors. Pilot responses were used only to refine the instrument and were not included in the main analysis.

Dissemination was facilitated through professional societies, deaneries, and training networks, as the lead author did not have direct access to participants' contact details. It is estimated that approximately 1,000-1,600 general surgical trainees work in the UK (General Medical Council data) however, a Freedom of Information request was not requested for this study. Key organisations, including the Association of Coloproctology of Great Britain and Ireland (ACPGBI) trainees club (The Dukes' Club), and the Association of Surgeons of Great Britain and Ireland, distributed the survey via newsletters, mailing lists, and WhatsApp groups (6.5.2 Survey invitation). A reminder was issued via the above communications to improve response rates. Several social media shares were issued to improve engagement. While efforts were made to engage all deaneries in the United Kingdom, not all participated in dissemination, which limited the ability to achieve full national coverage.

The raw data for this study was generated using Qualtrics^{XM} software (Copyright © 2025 Qualtrics. Qualtrics and all other Qualtrics product or service names are registered trademarks or trademarks of Qualtrics, Provo, UT, USA. https://www.qualtrics.com). Data were managed according to an established data management plan with the University of Sheffield (Ethics reference: 056808) and analysed using Microsoft Excel™ and Jamovi.[161] The CHERRIES (Checklist for Reporting Results of Internet E-Surveys) checklist[162] was adhered to throughout the design (6.5.4 Cherries checklist), dissemination, and reporting phases to enhance the survey's rigour, transparency, and reproducibility. All participants provided electronic consent (6.5.1 Survey study consent form) after reading a participant information leaflet (6.5.1 Survey Participant Information Sheet) to participate in the survey.

The response rate (complete responses divided by all potential eligible cases, including an estimated fraction of unknown eligibles) and cooperation rate (the number of completed interviews divided by all contacted and confirmed eligible units) were calculated following the American Association for Public Opinion Research (AAPOR) standardised formulas.[163,164] All survey data were analysed using non-parametric methods appropriate for ordinal and non-normally distributed variables. Associations between trainee characteristics and survey outcomes were explored using the Kruskal–Wallis test. *Attitude to EBM* (5-point ordinal scale), *confidence in EBM terminology* (10 items on a 4-point Likert scale), and *perceived barriers to EBM* (15 items on a 4-point barrier-severity Likert scale) were summarised as medians with interquartile ranges (IQRs) and compared across hospital type, training grade, and higher-degree possession. Free-text responses were analysed thematically and subsequently mapped to Kirkpatrick's four-level framework[165] for training evaluation to provide an educational lens for categorisation.

National-level demographic data describing the general surgery trainee population by deanery, training grade, or hospital type are not publicly available. As such, it was not possible to assess the representativeness of respondents against the wider trainee cohort beyond the approximate total population estimate of trainees derived from GMC workforce reports. We therefore present detailed descriptive characteristics of the 53 respondents to allow readers to judge the distribution of the sample, while recognising that findings should be interpreted as indicative of this respondent group rather than generalisable to all UK trainees.

3.2.4 Results

A total of 53 trainees returned a completed survey (5.4% response rate). Among the 101 invitees who clicked on the survey, those same 53 completed responses yield a cooperation rate of 52.4%. The survey respondents were predominantly male (65%), with a median age of 34.5 years (SD 3.89). A large number of participants were employed in district general hospitals (34/53, 64.2%), while 19/53 (35.8%) who worked in larger centres. Among the 53 complete responses, 11 trainees (20.8%) indicated they were out of programme for research. Of those in training, the distribution across training levels was as follows: ST3 –14 (26.4%), ST4 – 5 (9.4%), ST5 – 9 (17.0%), ST6 – 3 (5.7%), ST7 – 4 (7.5%), and ST8 – 8 (15.1%). Approximately a quarter of respondents (24%) indicated that they did not have a doctoral degree such as an MD or PhD. Nevertheless, 35% of the respondents completed a Masters or Education degree.

Participants in the survey demonstrated an overall positive attitude towards EBM, as reflected in the results of the modified McColl questionnaire. Of the 53 respondents, 24 (45.3%) indicated they were “extremely welcoming” towards EBM, while 16 (30.2%) described themselves as “somewhat welcoming.” A neutral attitude was reported by 11/53 respondents (20.8%). When asked about their perceptions of their fellow trainees' attitudes towards EBM, participants reported similar sentiments to their own. However, when queried about their consultants’ attitudes, 22/53 respondents (41.5%) perceived these as either “neutral”, “somewhat unwelcoming” or “extremely unwelcoming”. Nevertheless, 32/53 trainees (60.4%) rated their consultants’ attitudes to EBM as “somewhat welcoming” or “extremely welcoming”. The attitudes were not associated with either the level of

training/research background or hospital, as confirmed by non-parametric analysis (Kruskal-Wallis test, $p > 0.20$ for the above comparisons-Table 10).

Most of the participants expressed confidence in their ability to understand and explain EBM terminology. Despite this, there was variation in familiarity with specific EBM terms. "Odds ratio" exhibited the greatest variability in self-reported familiarity—respondents' ratings spanned all four categories from "not helpful" through to "can explain to others"—whereas "systematic review" showed the least variability. Those respondents with an academic degree showed more confidence in explaining certain terms, particularly systematic review, odds ratio, meta-analysis, and publication bias, compared with trainees without a higher degree. However, these differences did not reach statistical significance on non-parametric testing (Kruskal–Wallis, $p > 0.10$ for all comparisons-Table 12). Confidence in EBM terminology increased significantly with level of training for systematic review ($p = 0.022$), odds ratio ($p = 0.018$), meta-analysis ($p = 0.007$), and publication bias ($p = 0.018$).

The majority of trainees reported regular use of EBM resources, such as PubMed and the Cochrane Database. The survey highlighted several barriers to EBM implementation, with the most frequently reported being time constraints and the overwhelming volume of evidence, both cited as a moderate or major barrier by 39 of 53 trainees (73.6%). A lack of formal critical appraisal skills was similarly reported as a moderate or major barrier by 39 participants (73.6%), while complex statistics were perceived as a barrier by 37 (69.8%). Other commonly identified challenges included limited institutional support (median = 3,

IQR 2–3), difficulty accessing full-text resources (median = 3, IQR 2–3), and the influence of surgical dogma (median = 3, IQR 2–3). Overall, the median severity of reported barriers was high (median = 3.4, IQR 3.1–3.7), indicating that trainees perceived substantial obstacles to practising EBM. Distributions of barrier severity were broadly similar across hospital types, training grades, and academic backgrounds, with no statistically significant subgroup differences identified by non-parametric testing (Kruskal–Wallis, $p > 0.20$ for all comparisons-Table 11).

Trainees' perceptions of existing EBM training were mixed. Many respondents noted some exposure to EBM education through journal clubs, regional teaching sessions, and deanery-led workshops. However, these opportunities were not consistently available across all settings, and their perceived effectiveness varied among participants, indicating a need for more structured and universally accessible training methods. When asked how EBM training could be enhanced, participants suggested regional teaching sessions (10/53, 18.9%), workshops (4/53, 7.5%), and journal clubs (7/53, 13.2%).

Survey Question	**Response distribution n (%)**	**Comparison across hospital type**	**Comparison across level of training**	**Comparison by higher degree**
Do trainees welcome EBM learning and practice?	Extremely unwelcoming n=1 (1.9%) Somewhat unwelcoming n=2 (3.8%) Neutral n=10 (18.9%) Somewhat welcoming n=16 (30.2%) Extremely welcoming n=24 (45.3%)	0.285	0.891	0.115
Do trainees feel that their fellow trainees welcome EBM learning and practice?	Extremely unwelcoming n=1 (1.9%) Somewhat unwelcoming n=5 (9.4%) Neutral n=13 (24.5%) Somewhat welcoming n=24 (45.3%) Extremely welcoming n=10 (18.9%)	0.794	0.102	0.059
Do trainees feel consultants welcome EBM learning and practice?	Extremely unwelcoming n=1 (1.9%) Somewhat unwelcoming n=8 (15.1%) Neutral n=12 (22.6%) Somewhat welcoming n=21 (39.6%)	0.297	0.415	0.334

	Extremely welcoming n=11 (20.8%)			

Table 10 Trainees' attitudes to EBM; compared against hospital type, level of training and higher degree qualifications. Data are presented number (n) and percentage (%) of respondents. The final three columns display p-values calculated using the Kruskal–Wallis test to assess differences across hospital type, level of training, and possession of a higher degree.

Barrier	**Response distribution n (%)**	**Comparison across hospital type**	**Comparison across level of training**	**Comparison by higher degree**
Lack of time	No barrier n=2 (3.8%) Minor n=10 (18.9%) Moderate n=25 (47.2%) Major n=16 (30.2%)	0.798	0.714	0.984
Complex Statistics	No barrier n=3 (5.7%) Minor n=11 (20.8%) Moderate n=17 (32.1%) Major n=22 (41.5%)	0.857	0.381	0.264
Lack of critical appraisal skills	No barrier n=8 (15.1%) Minor n=15 (28.3%)	0.951	0.468	0.729

	Moderate n=14 (26.4%) Major n=16 (30.2%)			
Lack of good quality evidence	No barrier n=5 (9.4%) Minor n=18 (34.0%) Moderate n=17 (32.1%) Major n=13 (24.5%)	0.855	0.382	0.197
Access to EBM resources	No barrier n=8 (15.1%) Minor n=22 (41.5%) Moderate n=14 (26.4%) Major n=9 (17.0%)	0.191	0.862	0.844
Lack of investment by health authorities in EBM	No barrier n=5 (9.4%) Minor n=13 (24.5%) Moderate n=19 (35.8%) Major n=16 (30.2%)	0.303	0.142	0.858
No financial gain in using evidence-based medicine	No barrier n=19 (35.8%) Minor n=11 (20.8%) Moderate n=16 (30.2%)	0.860	0.405	0.370

	Major n=7 (13.2%)			
Surgical Dogma	No barrier n=7 (13.2%) Minor n=8 (15.1%) Moderate n=21 (39.6%) Major n=17 (32.1%)	0.620	0.447	0.166
Evidence not related to context of clinical practice	No barrier n=8 (15.1%) Minor n=15 (28.3%) Moderate n=22 (41.5%) Major n=8 (15.1%)	0.982	0.510	0.567
Too much evidence	No barrier n=11 (20.8%) Minor n=17 (32.1%) Moderate n=16 (30.2%) Major n=9 (17.0%)	0.121	0.015	0.098
Availability and access to EBM resources	No barrier n=7 (13.2%) Minor n=20 (37.7%) Moderate n=16 (30.2%) Major n=10 (18.9%)	0.384	0.709	0.938

Patients' expectations	No barrier n=11 (20.8%) Minor n=25 (47.2%) Moderate n=10 (18.9%) Major n=7 (13.2%)	0.333	0.554	0.352
Patients demanding ineffective treatment	No barrier n=17 (32.1%) Minor n=19 (35.8%) Moderate n=9 (17.0%) Major n=8 (15.1%)	0.674	0.730	0.496
The need for length discussions with patients	No barrier n=16 (30.2%) Minor n=18 (34.0%) Moderate n=13 (24.5%) Major n=6 (11.3%)	0.388	0.647	0.927
Attitudes of colleagues towards EBM	No barrier n=8 (15.1%) Minor n=18 (34.0%) Moderate n=20 (37.7%) Major n=7 (13.2%)	0.269	0.420	0.650

Table 11Barriers to EBM; compared against hospital type, level of training and higher degree qualifications. Data are presented number (n) and percentage (%) of respondents. The final three columns display p-values calculated using the Kruskal–Wallis test to assess differences across hospital type, level of training, and possession of a higher degree.

EBM terminology	Response distribution n (%)	Comparison across hospital type	Comparison across level of training	Comparison by higher degree
Relative Risk	Do not understand and would like to n= 3 (5.7%) Some Understanding n=27 (50.9%) Understand and could explain n=23 (43.4%)	0.499	0.645	0.084
Absolute Risk	Do not understand and would like to n= 5 (9.4%) Some Understanding n=23 (43.4%) Understand and could explain n=25 (47.2%)	0.540	0.562	0.157
Systematic Review	Some Understanding n=16 (30.2%) Understand and could explain n=37 (69.8%)	0.096	0.464	0.026
Odds Ratio	Do not understand and would like to n=7 (13.2%) Some Understanding n=26 (49.1%) Understand and could explain 20 (37.7%)	0.820	0.267	0.031
Meta-Analysis	Do not understand and would like to 4 (7.5%) Some Understanding n=17 (32.1%)	0.331	0.233	0.006

	Understand and could explain 32 (60.4%)			
Clinical Effectiveness	Do not understand and would like to n=7 (13.2%) Some Understanding n=24 (45.3%) Understand and could explain n=22 (41.5%)	0.487	0.738	0.437
Number Needed to Treat	Do not understand and would like to n=3 (5.7%) Some Understanding n=19 (35.8%) Understand and could explain n=31 (58.5%)	0.330	0.253	0.554
Confidence Interval	Do not understand and would like to n=3 (5.7%) Some Understanding n=14 (26.4%) Understand and could explain n=36 (67.9%)	0.821	0.538	0.356
Heterogeneity	Do not understand and would like to n=2 (3.8%) Some Understanding n=18 (34.0%) Understand and could explain n=33 (62.3%)	0.230	0.636	0.135
Publication Bias	Do not understand and would like to n=1 (1.9%) Some Understanding n=15 (28.3%) Understand and could explain n=37 (69.8%)	0.725	0.145	0.017

Table 12 Trainees' understanding of EBM terminology; compared against hospital type, level of training and higher degree qualifications. Data are presented as number (n) and percentage (%) of respondents. The final three columns display p-values calculated using the Kruskal–Wallis test to assess differences across hospital type, level of training, and possession of a higher degree.

2074

Kirkpatrick Level	Themes	Example trainee suggestions
Level 1: Reaction (engagement & satisfaction)	Flexible, engaging delivery formats	Regional/national teaching programme with online delivery and flexible access
		Regional journal clubs online with annual research-themed teaching
		Live high-quality RCTs app/website with podcasts
Level 2: Learning (knowledge & skills acquisition)	Structured educational content	Mandatory annual teaching on research methods/critical appraisal
		Deanery training days focused on EBM
Level 3: Behaviour (application in practice)	Embedding into practice & assessment	Add EBM summary as a component of WBAs on ISCP
		Encourage involvement in collaborative research
Level 4: Results (organisational/system outcomes)	Policy & curricular change	Formalised delivery via deaneries
		Incorporate research requirements into CCT
		Lobby deaneries for stronger academic/EBM integration

2075 *Table 13 Suggestions of trainees categorised as per Kirkpatric level of curricular development*

2076

Free-text responses suggested a range of strategies for strengthening the integration of EBM into surgical training. When mapped against Kirkpatrick's framework, these spanned all four levels of training evaluation, from engaging delivery methods and structured teaching to embedding EBM in assessments and influencing policy at deanery and curriculum level (Table 13). A large proportion of participants supported mandatory annual EBM training sessions, with many advocating for workshops on research methods and critical appraisal skills. Some respondents suggested incorporating EBM into work-based assessments (WBAs) within the ISCP framework. Adding an EBM-focused section to WBAs was proposed as a way to formalise EBM evaluation within regular trainee assessments.

3.2.5 Discussion

This survey complements and corroborates the previous focus group study's [158] conclusions on the current landscape of EBM within general surgical training in the United Kingdom. The survey captured perspectives from trainees at different hospital environments, levels of training and engagement with higher research degrees; hence increasing the generalisability of both the previous (3.1 Focus Group Discussions

A focus group discussion study exploring General Surgery trainees' views on EBM during their training programme in the United Kingdom.) and the current study's conclusions. The key messages from the survey are that trainees generally hold positive attitudes towards EBM and recognise its value in improving surgical outcomes. However, barriers remain in embedding EBM into training; particularly in terms of applying EBM competencies in

practice. This emphasises the need for targeted educational interventions to enhance its integration within the surgical curriculum.

The positive attitudes towards EBM observed are encouraging and suggest a growing acceptance of its principles across the surveyed trainees. Most respondents reported confidence in understanding and explaining EBM terminology (as provided by the McColl questionnaire[106]), reflecting a baseline level of familiarity with the terms examined. However, the variability reported in understanding specific terms might indicate inconsistencies in training due to differences in exposure and variable opportunities across training regions and hospital types. This supports the need for a more standardised and structured approach to EBM education, particularly at the postgraduate level.[20,60]

Most trainees reported regular use of online EBM resources. However, this reliance on self-directed resource use indicates that while trainees recognise the utility of these tools, formal training on their optimal use may not be uniformly provided across all training settings. It is important to note that the resources included in our survey were modified based on the McColl questionnaire,[106] which does not have room for EBM training-specific resources.

Barriers to implementing EBM were multifaceted and reflected the systemic, cultural, and logistical challenges inherent in surgical training. Time constraints, overwhelming volume of evidence and lack of formal critical appraisal skills were the most notable barriers. Cultural factors, such as surgical dogma, even though prominent in previous qualitative work,[158] were not perceived as significant barriers in this survey. This could be due to survey

format being a limiting factor or it might reflect a trainee cultural shift not yet adopted by their senior colleagues.

Critical appraisal skills were identified as a key area for improvement, with many of the surveyed trainees acknowledging gaps in their ability to evaluate the quality and applicability of evidence. This aligns with previous research.[20] Addressing this deficit through general surgery specific educational interventions is therefore necessary.[4]

Many respondents emphasised the importance of regional and national initiatives to support EBM education. Despite these challenges, trainees expressed a desire for improved EBM education. Suggestions included developing annual, deanery-led teaching programmes, establishing online asynchronous critical appraisal modules tailored to surgical cases. Additionally, some trainees suggested utilisation of existing journal clubs, and access to educational resources. Initiatives such as journal clubs are not uncommon[166] and previous studies report short term success of these interventions,[119,167] however long-term 'knowledge decay' was observed.[125]

Furthermore, work-based learning[168] was identified as a potential assessment modality for EBM. Incorporating EBM-focused sections into existing portfolios[144] could provide trainees with regular opportunities to engage with evidence-based principles and reinforce their application in clinical practice. Additionally, education stakeholders can work together to clarify the extent of EBM in professional exams and existing CCT requirements.

3.2.5.1 Limitations

The response rate is low. Though this is consistent with similar surveys of medical professionals[169]; it restricts the generalisability of the findings. Selection bias is also possible[170], as trainees with a pre-existing interest in EBM may have been more likely to participate. As with all self-reported data, there is the possibility of response bias, whereby participants may have provided socially desirable rather than fully accurate responses though to minimise this issue, no personal information was collected. The geographical distribution of respondents was uneven, with some deaneries more strongly represented, which may affect applicability to regions with different training structures. It is however, reassuring that the survey conclusions corroborate with the previous focus group study[158] and the mix of methods between the two studies increase the confidence in the conclusions.

3.2.5.2 Conclusion

This survey demonstrates that UK general surgery trainees who responded, report generally positive attitudes towards EBM yet face persistent barriers to its consistent application in training and practice, particularly limited time, the volume of evidence, and variable appraisal skills. These in particular limit opportunities to apply EBM competencies in clinical practice. While the low response rate constrains the generalisability of the findings, the survey adds value by offering a snapshot of these barriers and mapping confidence across key EBM competencies. When integrated with our prior research,[1,2] these results provide both breadth and depth, informing subsequent structured discussions with senior surgical education stakeholders. This sequential approach has aided the design of a

Delphi consensus study aimed at generating actionable recommendations through a consensus curriculum for EBM competencies within general surgery.

3.2.6 Linking Narrative: From Mixed-Methods Findings to Delphi Consensus

Focus group findings summary

The qualitative phase explored General Surgery trainees' perspectives on EBM through four focus group discussions involving 18 trainees of varying training grades and academic backgrounds. Four key themes emerged: knowledge and understanding of EBM, development of EBM competencies, assessment of EBM, and barriers to its integration. Participants broadly recognised the importance of EBM in modern surgical practice, though understanding varied and was frequently framed in terms of critical appraisal rather than the full five-step EBM process. Competency development was described as largely self-directed, with higher degrees and FRCS examination preparation identified as the primary formal milestones. EBM assessment was perceived as partially embedded in existing processes such as ARCPs and workplace-based assessments, but without clarity or consistency. Significant barriers were identified, including the complexity of statistical methods, inconsistent access to resources, and entrenched cultural and hierarchical norms within surgical practice. These findings suggested that EBM engagement in surgery is shaped as much by local culture, supervisory relationships, and professional identity as by formal teaching provision — a pattern consistent with a social constructivist account of professional learning.

Survey findings summary

The UK-wide survey extended these qualitative findings across a broader trainee population, providing additional verification and an extent of generalisability to the themes identified in the focus groups. Respondents demonstrated broadly positive attitudes towards EBM — 75% described themselves as welcoming or somewhat welcoming — yet significant gaps were identified in structured teaching provision, with trainees reporting heavy reliance on informal and self-directed learning. Mapping onto the four focus group themes, the survey confirmed: limited and inconsistent knowledge development (most trainees had no formal EBM teaching beyond exam preparation); competency development that remained largely self-directed rather than curriculum-driven; assessment that was poorly defined, with widespread uncertainty about what was expected at each training stage; and persistent barriers including time constraints, variable consultant engagement, and limited access to critical appraisal training. Cultural factors such as surgical dogma, while prominent in the focus groups, were rated as less significant barriers in the survey — a divergence that itself informed the Delphi by highlighting the gap between qualitative perception and quantitative self-report. The survey findings corroborated and quantified the qualitative themes, strengthening confidence in their national relevance.

Synthesis and rationale for the Delphi study

The mixed-methods findings suggest the following: EBM is valued by General Surgery trainees, expected by the curriculum, but without a clear set of core EBM consistencies. It is currently inconsistently taught, poorly assessed, and culturally constrained. The evidence identifies what the barriers are and where they operate but it does not, on its own, determine what a curriculum should contain or how it should be structured. That requires

a different form of inquiry which could produce agreement among those responsible for delivering and governing surgical training.

A modified Delphi consensus study was therefore selected as the next phase. This method is suited to curriculum development contexts where evidence exists, but well-informed stakeholders' judgement is required to translate findings into potentially actionable recommendations. The Delphi approach enables systematic engagement with a diverse, well-informed, educational stakeholder panel, facilitating iterative refinement of proposed curriculum components while maintaining anonymity and minimising the influence of hierarchy. This was an important consideration given the cultural dynamics identified in the preceding phases. The mixed-methods findings directly informed the content of the first-round Delphi questionnaire, ensuring that the items presented for consensus were grounded in empirical evidence and relevant to the lived realities of UK General Surgery training. For example, the scoping review's finding (that existing EBM curricula focused predominantly on critical appraisal, and neglected question formulation and evidence acquisition) informed the inclusion of Delphi statements covering all five EBM steps rather than appraisal alone. Similarly, survey findings (showing that trainees relied heavily on informal learning and identified regional teaching as the most accessible structured opportunity) directly informed the inclusion of statements about preferred delivery modes, including regional teaching days and journal clubs. These connections ensured that items presented for consensus were grounded in the empirical realities of UK General Surgery training rather than derived from generic EBM curriculum frameworks alone[60,158,171].

Chapter 4: Delphi study

This chapter presents the Delphi consensus study that constitutes the third empirical phase of this research programme. Linking directly to the findings of the scoping review and mixed-methods study, this Delphi addressed Research Question 4 by engaging a panel of General Surgery educators, who acted as well-informed individuals, to achieve stakeholder consensus on the proposed core components of an EBM curriculum for UK postgraduate General Surgery training. The study is currently under review for publication. The consensus statements produced through this process form the curricular foundation of this thesis and are discussed in the context of the wider programme of research in Chapter 6.

Integrating Evidence-Based Medicine into UK General Surgical Training: A Modified Delphi Consensus Study

Evripidis Tokidis[1,2] Saba P Balasubramanian[1,3] Pirashanthie Vivekananda-Schmidt[1]

Affiliations

1. Department of Clinical Medicine, School of Medicine and Population Health, The University of Sheffield
2. Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust
3. Sheffield Teaching Hospitals NHS Foundation Trust

Corresponding author

Name: Evripidis Tokidis

Institution: Department of Clinical Medicine, School of Medicine and Population Health

Address: The Medical School, The University of Sheffield, Sheffield, S10 2TN

Email: etokidis1@sheffield.ac.uk

Sources of funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The primary researcher (ET) is a self-funded PhD student at the University of Sheffield, working as a clinical research fellow at Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust.

Manuscript category

Original Article

Previous presentation

This work has not been presented previously at a scientific meeting.

Conflict of interest statement

The authors declare no conflicts of interest relevant to this work.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon request.

4.1 Abstract

Background

Recent research has highlighted inconsistent teaching and application of Evidence-Based Medicine (EBM) within General Surgery. Existing international EBM competency frameworks are not tailored to the specific requirements of surgical training, and no specialty-specific curriculum currently exists. This study aims to establish stakeholder agreement on core components of an EBM curriculum in General Surgery and explore potential implementation strategies.

Methods

A modified Delphi study was conducted electronically with surgical educators involved in postgraduate General Surgery training. Participants rated their agreement to 21 adapted statements using a five-point Likert scale and provided commentary. Consensus was pre-defined as ≥75% agreement. Quantitative findings were summarised using percentage agreement, medians, and interquartile ranges; qualitative commentary was retained verbatim after round 1 and analysed thematically after round 2 when the study concluded.

Results

Thirty-six and twenty panellists completed rounds 1 and 2 respectively. Consensus was reached on key EBM competencies including question formulation, evidence retrieval, critical appraisal, and application of evidence in clinical decisions; and on preferred teaching approaches. Qualitative feedback emphasised the value of EBM while identifying feasibility, supervisory capacity, and resource constraints. One statement proposing assessment of EBM through existing Workplace-Based Assessments did not reach consensus across two rounds. Response stability, supported by panel diversity and consistency and 55.5% retention rate informed the decision not to proceed to a third round.

Conclusion

The study establishes consensus on core EBM competencies for General Surgery. These findings provide a foundation for curriculum development and highlight areas such as assessment that require further consideration before implementation.

4.2 Introduction

Evidence-based Medicine (EBM) is the cornerstone of contemporary clinical practice,[1] yet its integration into General Surgical training in the United Kingdom remains inconsistent and poorly defined[60,158]. Despite emphasis on EBM within UK General Surgery postgraduate education, trainees often encounter fragmented teaching, limited workplace application and unclear expectations regarding acquiring competence[158]. General Surgery is characterised by the need for rapid, decision-making in time-pressured clinical environments, variability in supervision and traditional apprentice model of work[172]; all of which could influence how EBM is enacted in practice[48]. This echoes current literature which shows wide variation in how EBM is conceptualised and delivered across many surgical training programmes, with few interventions tailored to the structure or demands of the surgical workplace[60].

Although a survey of UK General Surgery trainees has shown EBM is valued, they experience lack of coherence and consistency with EBM teaching and application within the specialty. Cultural and hierarchical influences, trainees' research background and limited access to resources were revealed as factors shaping how EBM is learnt. There was also uncertainty regarding expected levels of EBM competence at different stages of training and inconsistent opportunities for trainees to develop these skills within their training programmes[158,171]. International efforts have produced a consensus framework describing generic EBM competencies[4]. While this framework is valuable for defining the broad domains of EBM practice, it was developed for health professionals in general and is not specific to specialties or aligned to the needs of UK postgraduate level training.

Furthermore, General Surgery training in the UK lacks an EBM-specific training programme or curriculum. To establish the components of such a curriculum, consensus agreement among well-informed General Surgical educators is required. This modified Delphi study[79,173,174] therefore aimed to derive a consensus for the EBM curriculum in General Surgery and explore potential implementation strategies.

4.3 Methods

This study employed a modified Delphi methodology that used a previously published set of EBM required contextual adaptation rather than generation of items de novo[173]. The study followed guidance (DELPHISTAR)[83] for designing and reporting Delphi studies in health and social sciences (6.4 Appendix D - Delphistar Checklist). Rather than adopting existing competencies[4] verbatim or generating Delphi items de novo, we undertook an adaptation process to contextualise them for UK postgraduate General Surgical training. Four senior stakeholders, each holding educational leadership positions within General Surgery (2 training programme directors from 2 different UK regions, the president of a General Surgical association and the national lead for the online General Surgical teaching), participated in online meetings with the lead researcher.

Stakeholder Discussion Questions
Could you provide some feedback on the proposed statements for the Delphi study?
What teaching methods and formats do you think are most appropriate for integrating EBM into the General Surgery curriculum?
Which specific EBM competencies (e.g., critical appraisal, applying evidence in decision-making) should be prioritised, and how should they be assessed effectively?
How can EBM competencies be incorporated into existing assessment modalities such as ARCPs, FRCS exams, or portfolio supervisory reviews?
What resources (e.g., access to literature, statistical tools, training support) are essential to facilitate the learning and application of EBM in surgical training?

How can we address barriers like time constraints and cultural resistance to ensure EBM becomes a practical and valued component of surgical education?

Table 14 Stakeholder discussion table

During this phase, stakeholders reviewed the EBM competencies proposed by Albarqouni et al[4] in relation to the structure and requirements of UK General Surgery training. Findings from earlier trainee-focused studies[158] were presented to the stakeholders to inform this process (Table 14). Three areas of agreement emerged: the original framework was considered educationally robust but difficult to operationalise within routine surgical training; competencies required contextualisation to reflect surgery-specific clinical practice; and additional statements addressing assessment within UK postgraduate training structures were needed, as these were not included in the original international consensus. On this basis, the competencies were synthesised into broader, General Surgery-specific statements through an iterative process of consolidation, contextualisation, and addition. For example, several Albarqouni competencies addressing distinct aspects of evidence appraisal were consolidated into single, broader statements reflecting the time constraints and scope of surgical training — where granular step-by-step appraisal competencies were considered impractical to assess separately. Additionally, new statements that were not present in the original framework were drafted to address assessment within UK postgraduate training structures, including ARCP and workplace-based assessments, which stakeholders identified as a critical gap. This resulted in 21 statements (Supplementary Material), which formed Round 1 of the modified Delphi study.

Participants in this study were defined as well-informed persons rather than experts. While expertise in Evidence-Based Medicine can be conceptualised in general terms, identifying individuals with recognised expertise in EBM within the specific context of General Surgery training is challenging and potentially exclusionary[175]. Moreover, EBM teaching and supervision in surgical training are typically delivered by trainees' supervisory teams rather than by a small group of designated experts. Clinical and educational supervisors, Royal College tutors, members of General Surgery specialty committees and training programme directors were considered well-informed individuals for the purposes of this study.

Invitations were distributed electronically via email to identified stakeholder groups, including training programme directors (via the chair of the General Surgery Specialty Advisory Committee), Royal College of Surgeons of England tutors (via publicly available contact details on the College website), and General Surgery specialty committee members (via publicly available professional society email addresses). In addition, the study was promoted through professional social media platforms (LinkedIn) to reach other relevant stakeholders involved in surgical training. Participation was voluntary.

After providing informed consent, participants were asked to report their role(s) in postgraduate surgical training, their General Surgical subspecialty and whether they wished collaborative acknowledgement in the study. This information was collected to describe the composition of the Delphi panel, ensure representation across clinical and supervisory contexts and assess panel breadth and stability across rounds rather than to undertake subspecialty or role specific comparative analyses.

The Round 1 Delphi questionnaire comprised structured statements presented with a five-point Likert scale (1-strongly disagree to 5-strongly agree) to measure levels of agreement. Each statement was accompanied by a free-text field to allow participants to elaborate on their responses. For composite questions, sub-elements were rated individually, with qualitative feedback captured through a shared comments field. Participants were instructed to rate statements independently in the first round without consultation with other respondents. The second round provided feedback from the first-round results to the panellists who completed Round 1 as well as a summary of the round. Additionally, the statements that did not reach consensus in the first round were provided for rating similarly to Round 2.

The data was collected via the Qualtrics^{XM} software (Copyright © 2025 Qualtrics. Qualtrics and all other Qualtrics product or service names are registered trademarks or trademarks of Qualtrics, Provo, UT, USA. https://www.qualtrics.com). Data were managed according to an established data management plan with the University of Sheffield (Ethics reference: 065891) and analysed using Microsoft Excel™ and Jamovi[161].

For each Delphi statement, the following metrics were calculated:

- Frequency counts for each statement's Likert agreement scores (1-5)
- Median agreement scores for each statement's Likert agreement scores (1-5)
- Interquartile range (IQR) of each statement's Likert agreement scores (1-5) as an index of response dispersion

Pre-specified consensus criteria were set at ≥75% agreement, defined as the proportion selecting “somewhat agree” or “strongly agree”. Free-text responses were extracted and retained verbatim. Free-text responses were analysed descriptively and organised deductively using the Kirkpatrick Model[165] to contextualise quantitative agreement patterns. A deductive approach was appropriate here because the purpose of the qualitative analysis was not exploratory meaning-making but rather to map expert commentary onto an established curriculum development framework, enabling structured interpretation of how panellist views related to teaching, learning, behaviour, and outcomes. Verbatim qualitative comments were shared with panellists; however, analytic synthesis was deferred until study completion to prevent researcher interpretation from influencing subsequent Delphi rounds. After round 2, the participants were thanked and a summary of the results was provided to them via email.

4.4 Results

The flow of this modified Delphi study can be found on Figure 7.

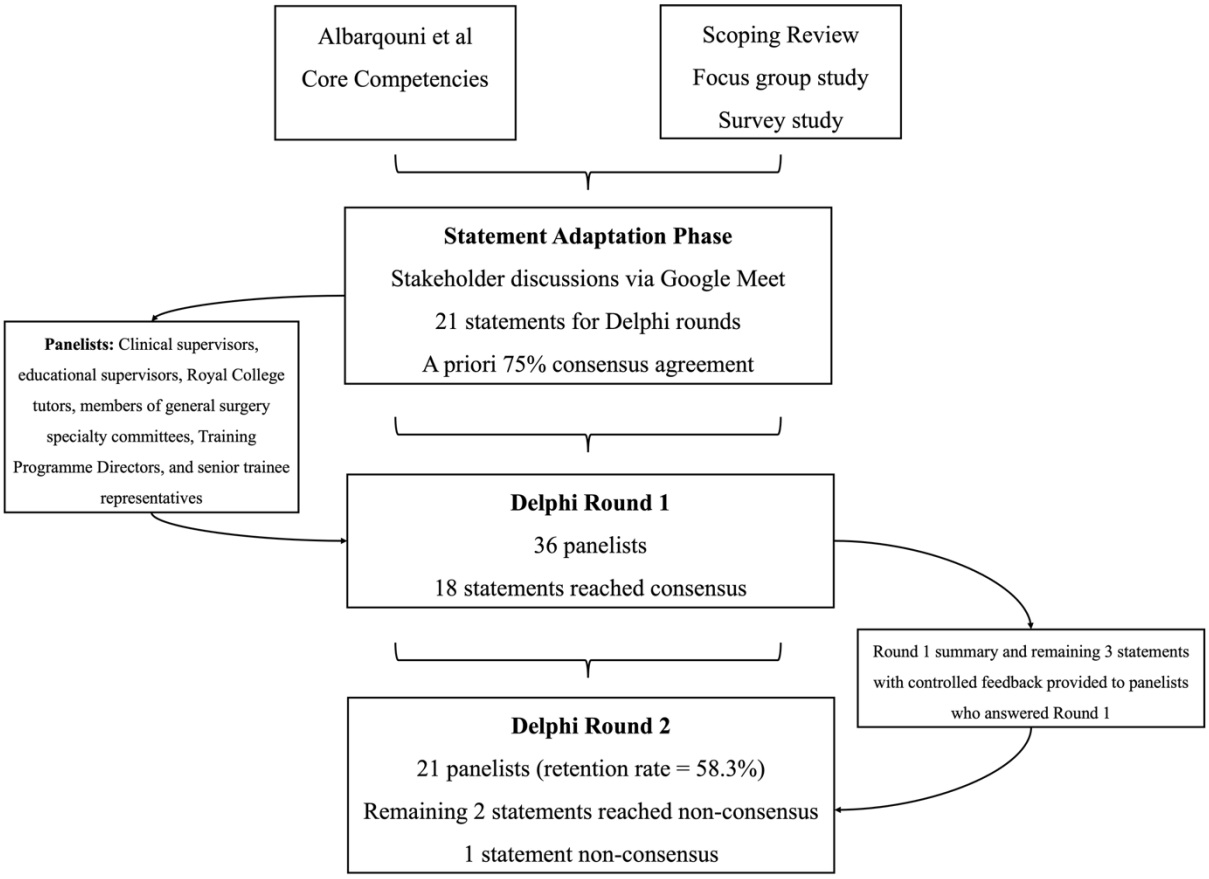


Figure 7 Delphi study flow

Thirty-six participants completed Round 1 of the modified Delphi process. All participants were actively involved in postgraduate General Surgery training and reported one or more educational or supervisory roles, including clinical supervisor (n = 31), educational supervisor (n = 28), Royal College tutor (n = 11), surgical society committee member (n = 5), surgical trainee representative (n = 4), training programme director (n = 2), and Specialty Advisory Committee member (n = 1). Additional roles were reported in free-text responses (i.e. examiner for the specialty's exit exams). Round 1 panellists were predominantly colorectal surgeons (n = 17), with representation from upper gastrointestinal (n = 10), breast (n = 3), emergency general surgery only (n = 3), hepatobiliary (n = 2), and transplant surgery (n = 1).

The results of Round 1 are summarised in Table 15. Consensus (≥75%) was achieved for 18 of 21 statements. Panellists agreed that EBM should be integrated within the ST3–ST8 General Surgery curriculum and delivered longitudinally across training. Agreement was also achieved for core EBM competencies, including formulation of structured clinical questions, access to EBM resources, construction and execution of literature search strategies, critical appraisal of multiple study designs, application of evidence in clinical decision-making, and communication of evidence-based decisions to patients and colleagues. All proposed modes of EBM delivery—regional teaching, national teaching, courses or workshops, and journal clubs—met the consensus threshold.

Three statements (statement 18,19 and 21) did not meet the predefined 75% agreement threshold in Round 1 and were therefore progressed to Round 2. These related to the assessment of EBM competencies through predefined GMC General Professional

Capabilities and ARCP processes, summative assessment in FRCS Part 1 MCQ format, and assessment of EBM practice through existing workplace-based assessments. These statements demonstrated greater response dispersion and lower median agreement scores compared with statements addressing curriculum content and teaching delivery.

Statement number	Statement (verbatim)	Agreement (%)	Median (IQR)	Consensus achieved
1	EBM training should be integrated into the ST3–ST8 General Surgery curriculum.	94	5 (1)	Yes
2	The “explain” component of the Core EBM competencies Consensus (table 2, page 7–8) should be taught during General Surgery training.	89	4 (1)	Yes
3	The “mention” component of the Core EBM competencies Consensus (table 2, page 7–8) should be taught during General Surgery training.	78	4 (1)	Yes
4	EBM should be taught throughout the six years of General Surgery training.	97	5 (1)	Yes
5	Should a relevant General Surgery clinical question arise in the trainees’ surgical practice, they should be able to convert it into structured, answerable formats (i.e. Patient–Intervention–Comparison–Outcome [PICO]).	81	4 (1)	Yes
6.1	EBM teaching should be facilitated through regional teaching.	86	5 (1)	Yes
6.2	EBM teaching should be facilitated through national teaching.	81	4 (1)	Yes
6.3	EBM teaching should be facilitated through courses/workshops.	86	4 (1)	Yes
6.4	EBM teaching should be facilitated through journal clubs.	94	4.5 (1)	Yes
7	The surgical trainee should be able to formulate clinical questions based on the clinical situation such as treatment, diagnosis, prognosis, or aetiology.	97	5 (1)	Yes
8	The trainee should be able to easily access EBM resources.	100	5 (0)	Yes
9	Surgical trainees should be able to construct and execute search strategies for clinical questions and obtain adequate answers.	100	5 (1)	Yes
10	The surgical trainee should be able to critically appraise and interpret systematic reviews and meta-analyses.	94	5 (1)	Yes
11	The surgical trainee should be able to critically appraise and interpret treatment studies.	95	5 (1)	Yes
12	The surgical trainee should be able to critically appraise and interpret diagnostic accuracy studies.	89	5 (1)	Yes
13	The surgical trainee should be able to critically appraise and interpret qualitative studies.	83	4.5 (1)	Yes
14	The surgical trainee should be able to apply critically appraised evidence in clinical decision-making.	92	5 (0)	Yes
15	The surgical trainee should be able to communicate evidence-based decisions effectively to patients.	92	5 (0)	Yes
16	The surgical trainee should be able to communicate evidence-based decisions effectively to colleagues.	94	5 (0)	Yes

17	The surgical trainee should be able to evaluate the outcomes of applied evidence and adjust practice accordingly.	92	5 (1)	Yes
18	EBM competencies should be assessed within the predefined General Medical Council (GMC) General Professional Capabilities by the supervisory team and reviewed at Annual Review of Competence Progression (ARCP).	64	4 (2)	No
19	EBM competencies should be summatively assessed in Multiple Choice Question (MCQ) format in the FRCS Part 1 examination.	72	4 (2)	No
20	EBM competencies should be summatively assessed in OSCE/Viva format in the FRCS Part 2 examination.	78	4 (1)	Yes
21	Practice of EBM should be assessed through existing work-based assessments in the surgical trainees' portfolio by their supervisory team and reviewed at ARCP by the ARCP panel.	58	4 (1)	No

2461 *Table 15 Delphi Round 1 statement consensus*

In Round 2 (Table 16), two out of three statements subsequently reached the predefined consensus threshold of ≥75% agreement (statements 18 and 19) by 20/36 (55.5% retention rate) panellists (only the initial 36 were invited). The statement proposing assessment of EBM practice through existing workplace-based assessments (WBAs) and review at Annual Review of Competence Progression (ARCP) did not reach consensus following a second round of rating. Levels of agreement remained below the 75% threshold, with responses distributed across agreement, neutrality, and disagreement categories, and minimal change in median scores between rounds. This response stability indicated that further iteration was unlikely to alter the consensus position. Accordingly, in line with established Delphi methodology, the item was retained as a non-consensus outcome, and no additional Delphi rounds were undertaken.

Statement number	Statement (verbatim)	Agreement (%)	Median (IQR)	Consensus achieved
18	EBM competencies should be assessed within the predefined GMC General Professional Capabilities by the supervisory team and reviewed at Annual Review of Competence Progression (ARCP).	91	4 (1)	Yes
19	EBM competencies should be summatively assessed in MCQ format in the FRCS Part 1 examination.	81	4 (1)	Yes
21	Practice of EBM should be assessed through existing work-based assessments in the surgical trainees' portfolio by their supervisory team and reviewed at ARCP by the ARCP panel.	64	4 (1)	No

Table 16 Delphi Round 2 Statement Consensus

Qualitative comments provided contextual insight into the responses to all statements regardless of agreement. These comments are mapped to the Kirkpatrick framework in Table 17. Comments relating to curriculum inclusion and core competencies predominantly reflected positive perceptions of relevance and value (Kirkpatrick Level 1) and anticipated benefits for learning and clinical practice (Levels 2 and 4). In contrast, comments concerning assessment focused on feasibility, variability in supervisory expertise, limitations of existing assessment structures, and challenges in evidencing EBM behaviours in routine practice (Levels 2–3).

Kirkpatrick level	Focus	Representative verbatim comments
Level 1: Reaction	Perceived relevance, acceptability, and feasibility of EBM within surgical training	"This is essential." "I don't think this is controversial." "Fundamental." "Not sure if this is required." "Cannot see any value in this." "There is already a lot to teach trainees, so this needs to be tempered by what can realistically be applied to the curriculum." "With an overcrowded curriculum the emphasis should be on technical skill acquisition."
Level 2: Learning	Knowledge acquisition and skills development	"This is a difficult skill that takes time to learn and get right." "Some knowledge is important." "Learning how to MeSH is essential." "Specificity/sensitivity is a bare minimum." "Qualitative studies are poorly understood amongst medics." "Need to define at what level but some understanding is essential."
Level 3: Behaviour	Application of EBM in clinical and educational practice	"This is important for incorporating findings into clinical practice." "This can be complex in day-to-day life." "Limitations as has to follow hospital guidelines/protocols and their trainer choice." "Barrier is independence of practice as a trainee." "How else will you be able to introduce new practices without convincing your colleagues."

Level 4: Results	Impact on patient care, training quality, and professional outcomes	"Required for improving clinical practice." "This is essential for high quality patient focussed care." "This provides strong evidence for what we do." "This is the whole point." "This will set up residents for their future learning as a consultant."
Cross-cutting (assessment and systems)	Assessment feasibility and training system constraints	"Portfolio assessments remain broadly poorly delivered." "Introducing more WBAs is not the best way to do this." "Supervisors would not know their Chi-2 from the t-tests." "MCQs are not high fidelity enough." "Viva seems a sensible method for assessment." "Keen to see how a WBA assessment would be introduced and how it would be assessed in a small DGH where there is no research portfolio"

Table 17 Qualitative comment mapping to the Kirkpatric framework for curriculum development

4.5 Discussion

This Delphi study sought to establish consensus on the integration, delivery, and assessment EBM competencies within General Surgical training in the UK. The findings demonstrate agreement across the panel on the centrality of EBM training in General Surgery and the importance of providing trainees with structured opportunities to formulate clinical questions, retrieve evidence, critically appraise research, and apply findings in clinical decision-making. These areas achieved consistently high levels of consensus and low response dispersion, indicating a shared professional understanding of the relevance and necessity of EBM within the surgical curriculum.

Retention between rounds was 55.5% and although higher retention is preferable, particularly where changes in group opinion are anticipated, evidence suggests that meaningful inferences can still be drawn when the characteristics of retained respondents remain representative of the initial sample.[82] In this study, the composition of participants across rounds was stable, with no disproportionate attrition from any single professional role or supervisory category. The consistency of participant profiles mitigates concerns regarding panel attrition–related variability and supports the validity of the consensus patterns observed[176].

Most statements achieved strong consensus across both rounds, reflecting clear professional expectations regarding EBM-related knowledge, skills, and behaviours. Notably, consensus was achieved for all components relating to critical appraisal of

treatment, diagnostic, prognostic, and systematic review evidence, as well as integration of evidence into shared decision-making. Qualitative comments further underpinned these findings, emphasising the perceived importance of EBM not only for examination preparation but also for improving clinical decision-making and patient outcomes.

However, consensus was not reached on the statement:

"Practice of EBM should be assessed through existing Work-Based Assessments in the surgical trainees' portfolio by their supervisory team and reviewed at the trainees' Annual Review of Competence Progression (ARCP)."

Agreement levels remained below the pre-specified threshold across both rounds, and the change in percentage agreement from Round 1 to Round 2 was minimal (e.g., from approximately 57% to 58%), indicating response stability without meaningful movement toward consensus**.** The narrow shift in ratings between rounds suggests that further iteration would be unlikely to produce substantial convergence. This interpretation aligns with methodological literature emphasising the importance of stability in Delphi responses as an indicator of saturation, rather than the pursuit of consensus for its own sake[80].

Given the 50% retention rate, the demonstrated stability of responses, and the absence of substantive change between rounds, a third round was not undertaken. Re-surveying the reduced panel risked further attrition, and the evidence suggested diminishing returns. In this context, maintaining the item as a documented non-consensus statement was methodologically appropriate[177]. Retaining this divergence is also educationally valuable;

qualitative comments revealed concerns related to supervisor capability, workload, inconsistency in WBA delivery, and the already considerable assessment burden on trainees. These insights highlight legitimate and currently unresolved tensions within the training system,[178,179] making the non-consensus finding a meaningful outcome rather than a methodological limitation. This is in line with existing literature that does not conclude on successful EBM assessment methods in surgery and medicine in general[31,60].

The findings of this Delphi study offer a supportive framework for embedding EBM within higher General Surgical training; however, successful implementation will require careful consideration of training structures, supervisory capability, and the practical feasibility of delivery within routine surgical practice. Although consensus was achieved on 20 out of 21 statements, qualitative feedback underscored practical constraints to be addressed during curriculum development.

Overall, the study's findings provide a stakeholder-informed foundation for developing an EBM curriculum for General Surgery. The endorsed components could be incorporated into curricular design, while the non-consensus statement about assessment requires further consultation, piloting, or local adaptation. Future work may involve mapping the agreed competencies to existing training structures,[36] exploring faculty development needs, and evaluating implementation strategies through pilot programmes or quality-improvement approaches.

4.6 Limitations

Although participants represented multiple educational roles and subspecialties, recruitment was voluntary and purposive, so selection bias and non-response bias remain possible. Different consensus methods such as the nominal group technique[180] were not deemed feasible given the time constraints of surgeons, whose demanding schedules preclude the synchronous participation required for structured group meetings. Attrition between rounds (36 to 20 panellists) may have affected Round 2 estimates of agreement, even though the second-round panel remained representative. The study was undertaken within UK general surgery, and transferability to other surgical specialties cannot be assumed; however, given broadly comparable workplace constraints and curricular structures across surgical specialties, the agreed domains may be informative beyond general surgery and should be tested in other contexts. Finally, free-text comments were organised descriptively using the Kirkpatrick framework to support curriculum development rather than to generate an exhaustive qualitative account; this purposeful approach provides utility to surgical educators. However, the qualitative account was not explored for differences by role or subspecialty.

4.7 Future considerations

Implementation should prioritise integration of EBM within existing ST3–ST8 educational structures rather than the addition of new curricular components, utilising established regional teaching, national online provision, and routine clinical learning opportunities. The study supports a progressive, scaffolded approach in which foundational EBM skills are introduced early and developed longitudinally, aligning with existing models of surgical

skill acquisition. Qualitative findings highlight variability in supervisory capability and access to evidence resources, indicating the need for targeted faculty development and more equitable resource provision across training sites. Participants also identified time pressures, service demands, and hierarchical clinical cultures as barriers to behavioural change, suggesting that implementation strategies should embed EBM within everyday clinical activities and explicitly model evidence-based reasoning. The absence of consensus regarding workplace-based assessment indicates that early implementation should favour low-stakes, formative approaches while assessment infrastructure and supervisor readiness are developed[181]. Coordinated use of national and regional educational resources may support consistency while allowing local flexibility. Finally, pilot implementation could be evaluated using contemporary frameworks for complex interventions, with attention to contextual influences, implementation fidelity, mechanisms of change, and educational impact across training environments[182–184].

4.8 Conclusion

The findings of this study provide a stakeholder-informed foundation for an EBM curriculum development in General Surgery in the UK, while highlighting assessment through workplace-based mechanisms as an unresolved area requiring further evaluation before implementation.

4.9 Summary of Delphi findings and linking narrative to the Discussion chapter

The modified Delphi study achieved consensus on 20 of 21 proposed curriculum statements across two rounds, involving 36 panellists in Round 1 and 20 in Round 2. Consensus was

reached on the integration of EBM across the full ST3–ST8 General Surgery training period and on core competencies including the formulation of structured clinical questions, access to EBM resources, construction and execution of literature search strategies, critical appraisal of multiple study designs including systematic reviews, treatment studies, diagnostic accuracy studies, and qualitative research, and the application of critically appraised evidence in clinical decision-making. Consensus was also achieved on the communication of evidence-based decisions to both patients and colleagues, and on the evaluation of outcomes following the application of evidence. All proposed modes of EBM delivery — regional teaching, national teaching, courses and workshops, and journal clubs — met the predefined consensus threshold. These findings reflect a clear and shared professional understanding of the relevance and necessity of EBM within the surgical curriculum.

One statement, proposing that EBM practice should be assessed through existing workplace-based assessments and reviewed at ARCP, did not reach consensus across either round. Agreement levels remained below the 75% threshold in both rounds, with minimal change between them, indicating response stability rather than movement toward consensus. This finding is itself meaningful: while the panellists reached clear agreement on what EBM competencies should be taught and how they should be delivered, assessment through existing training infrastructure remains an unresolved question. Qualitative commentary from panellists illuminated the reasons for this divergence — concerns about supervisory capability, variability in WBA delivery, assessment burden, and the practical challenges of evidencing EBM behaviours in routine surgical practice. These

tensions are not incidental; they reflect structural and cultural features of surgical training that this research programme has identified consistently across all empirical phases.

Collectively, the Delphi findings link directly on the preceding phases of this research. The scoping review (Chapter 2: Scoping review) established the absence of a specialty-specific EBM curriculum and the fragmentation of existing evidence. The focus group discussions (3.1 Focus Group Discussions) revealed how cultural and relational factors shape EBM engagement in ways that formal teaching alone cannot address. The survey (3.2 Survey study) quantified these patterns across a broader trainee population and corroborated the qualitative findings. The stakeholder consultations aided the adaptation of the proposed curriculum statements for surgical relevance and feasibility. The Delphi integrates these inputs into a structured, expert-derived consensus — advancing the research from problem characterisation and empirical description to a coherent curriculum proposition grounded in the realities of UK General Surgery training.

The discussion chapter that follows synthesises findings across all phases of this research programme, addresses each research question in turn, and considers the conceptual, empirical, methodological, and practical contributions of this work. It examines the implications of the findings for policy, practice, and curricular reform in UK postgraduate surgical education, reflects on the methodological strengths and limitations of the overall programme, and identifies relevant future research directions.

Chapter 5: Discussion

5.1 Integration of Findings Across All Research Phases

5.1.1 Answers to the research questions

A visual representation of how the research questions have been answered in this thesis is provided in Figure 8 and explained and evaluated further below.

Research question 1: What is the evidence underpinning the practice of EBM in the context of surgical training, with particular focus on attitudes, training and curricula in EBM, and assessment of EBM competencies?

This question was addressed through the scoping review presented in Chapter 2. The review mapped a fragmented and heterogeneous body of literature, predominantly derived from North American and European contexts with limited representation from the United Kingdom. Evidence on EBM attitudes suggested broad endorsement in principle, though surgical communities have historically found adoption challenging due to perceived limitations of trial designs in operative contexts and the dominance of tradition-based practice. Studies addressing EBM training and curricula were small-scale, locally developed, and only some were evaluated using validated measures; despite that, EBM knowledge was not retained by the surgical trainees. Assessment of EBM competencies was shown to rely predominantly on tools focused on critical appraisal and knowledge acquisition, with an absence of instruments capable of evaluating the application of evidence to clinical decision-making or its impact on practice. The review established a conceptual and empirical gap: no structured, specialty-specific EBM curriculum exists for

postgraduate General Surgery, and existing evidence provides insufficient guidance for developing one[60].

Research question 2: What are the perceptions, attitudes and barriers towards developing EBM competencies amongst General Surgical trainees (and stakeholders) in the UK?

This question was addressed through the focus group discussions and national survey presented in Chapter 3 and through the stakeholder discussions (as part of the Delphi study) in Chapter 4. Trainees broadly recognised the importance of EBM and reported positive attitudes towards its principles. However, a consistent gap emerged between valuing EBM in theory and enacting it in practice. Barriers operated at multiple levels: individually, trainees reported limited confidence in statistical methods and critical appraisal; structurally, they described inconsistent access to teaching, protected time, and resources; and culturally, hierarchical norms, consultant preferences, and the dominance of experiential reasoning shaped what was modelled, valued, and expected. These findings were consistent across qualitative and quantitative phases, and were corroborated by senior stakeholders, who acknowledged variability in provision and the practical constraints on embedding EBM within existing training structures. Overall, the evidence suggests that barriers to EBM competence in General Surgery are systemic and cultural as much as they are educational and cannot be resolved through curriculum content alone[158,171].

Research question 3: To what extent does the current General Surgery curriculum in the United Kingdom support the structured development and assessment of EBM competencies?

This question was addressed across Chapters 2, 3 and 4. The findings indicate that EBM competencies are not formally developed or assessed through any structured, designated curriculum within UK postgraduate General Surgery training. The ISCP specifies that trainees must demonstrate capability in research and scholarship, including evidence appraisal and application, but provides no pedagogical framework, progression model, or supporting resources to operationalise these requirements. In practice, trainees reported that EBM competencies develop informally — through journal clubs, higher degree study, FRCS examination preparation, and individual engagement with clinical guidelines — in ways that are heavily dependent on local training environments and supervisory relationships. Assessment is similarly unstructured, with EBM-related competencies partially embedded in ARCPs and workplace-based assessments but without explicit criteria or standardised expectations. This results in significant regional variation and widespread uncertainty among trainees about what is expected of them and how competence should be demonstrated. Delphi panellists echoed these observations in their qualitative commentary, noting that while EBM is expected of trainees, the mechanisms through which it should be taught and assessed remain undefined and inconsistently applied. The failure of one Delphi statement (relating to assessment of EBM through existing workplace-based assessments) to reach consensus across two rounds further illustrates that in terms of practicalities, assessment of EBM competence remains a

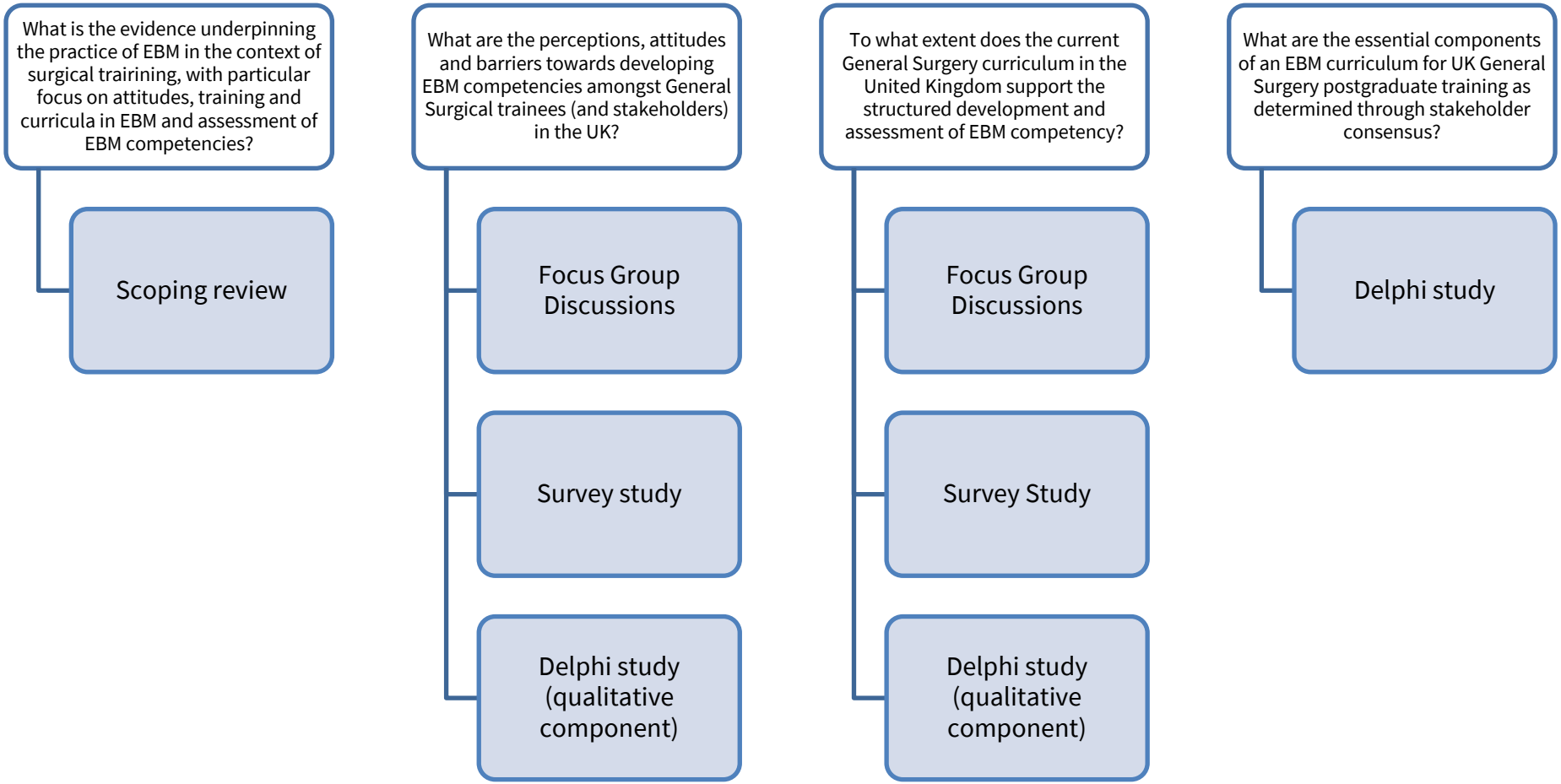
genuinely unresolved issue within the profession. In summary, these findings reveal significant regional variation and widespread uncertainty among trainees, trainers, and educational leaders about what is expected and how the competencies should be demonstrated.

Research question 4: What are the essential components of an EBM curriculum for UK General Surgery postgraduate training, as determined through stakeholder consensus?

This question was addressed through the Delphi consensus study presented in Chapter 4. Through two iterative rounds involving thirty-six and twenty panellists respectively, consensus was achieved on the majority of proposed curriculum statements, defining the core components of an EBM curriculum tailored to UK General Surgery postgraduate training. Consensus was reached on key competencies including question formulation, evidence retrieval, critical appraisal, and the application of evidence to clinical decision-making. In terms of pedagogical approach, panellists favoured workplace-based and case-based learning formats, reflecting the realities of surgical training environments and the need for EBM to be enacted in clinical rather than purely academic settings. Implementation strategies identified through qualitative commentary emphasised the importance of faculty development, protected teaching time, and nationally coordinated delivery.

One statement — relating to the assessment of EBM through existing workplace-based assessments — did not reach consensus across two rounds, indicating that while the competence and teaching components of the curriculum achieved broad agreement,

assessment design requires further deliberation before implementation. This finding is itself significant: it suggests that what to teach is clearer to the profession than how to assess it, and that assessment development represents the most pressing next step in curricular reform. Together, the consensus statements provide a coherent, evidence-informed, and contextually grounded framework that can serve as a foundation for curricular development within the existing ISCP structure.



2749

2750 *Figure 8 A map of how the various studies answer the research questions*

2751

5.1.2 Synthesis of key findings

Across the sequential phases of this research, a set of interlinked findings emerged that collectively illuminate the current position of EBM within General Surgery training in the UK and the conditions that could lead to curricular reform. The scoping review established the fragmented and variably conceptualised nature of EBM education in a surgical context, revealing a lack of discipline-specific guidance, limited alignment with postgraduate training structures, and minimal empirical work centred on General Surgery. This initial mapping suggested that, while EBM is widely endorsed in principle, its practical integration into surgical training remained inconsistent and poorly defined[60].

The qualitative exploration linked the review's observations to the reality of UK general surgery training by revealing how trainees themselves understand and experience EBM within everyday surgical practice. Focus group discussions identified several recurrent themes, including uncertainty about what constitutes EBM competence, limited structured teaching, variability in faculty expertise, and cultural influences—particularly hierarchy, consultant preferences, and service pressures—that shaped learning opportunities. Trainees consistently described EBM as important yet difficult to enact in environments where tacit knowledge, experiential reasoning, and tradition frequently dominated clinical decision-making. These insights clarified the contextual barriers that underpinned the gaps identified in the literature[158].

The survey data extended these qualitative findings to a broader trainee population, suggesting that the issues raised in discussions were not isolated to regions or units but reflected broader patterns in UK General Surgery training. Quantitative results corroborated the limited availability of structured teaching, the reliance on informal learning opportunities such as journal clubs, and the substantial variation in trainees' confidence and perceived

competence. The survey also highlighted widespread uncertainty regarding assessment expectations and a lack of clarity about the evidence base underpinning curriculum requirements. These findings provided empirical weight to the qualitative themes and illustrated the scale and consistency of the identified challenges[171].

The consultations with senior stakeholders added an additional layer of insight by contextualising the trainee-derived findings within the organisational and regulatory landscape of surgical education. Stakeholders acknowledged the variability in EBM provision, the pressures on trainers, and the difficulty of embedding EBM within existing curricula without clear and concise guidance. Their contributions helped refine the scope and language of proposed curriculum statements, ensuring these were feasible, actionable, and aligned with broader curricular governance.

Finally, the Delphi process integrated the empirical, experiential, and strategic perspectives into a structured consensus, resulting in an agreed set of curriculum statements specific to EBM in General Surgery. The consensus achieved reflects not only the accumulated evidence across all preceding phases but also the collective judgement of those responsible for training design and delivery. This iterative refinement—from literature to trainee voice, to national patterns, to education stakeholder expertise, and ultimately to consensus—produced a framework that addresses both the conceptual gaps identified in the scoping review and the structural (lack of time), cultural (hierarchy) and pedagogical barriers (absence of an EBM-specific assessment modality) to EBM integration of postgraduate training identified in the mixed-method chapter.

In conclusion, these findings reveal a clear and consistent narrative: EBM is valued, necessary, and required within General Surgery, yet inadequately supported by current educational

structures; stemming from surgical culture, supervisory relationships and curriculum design. Trainers and stakeholders recognise these limitations, and a consensus-driven curriculum provides an achievable pathway to address them. This synthesis forms the foundation for the subsequent sections of the discussion and for the recommendations that follow.

5.1.3 Quality

Quality and rigour were considered throughout this programme of research using criteria appropriate to each methodological approach. The scoping review followed the Arksey and O'Malley methodological framework[68], with reporting informed by the principles of the 2018 PRISMA guidance for scoping reviews[185]. Title and abstract screening were undertaken by two reviewers, with secondary review of a sample of full-text decisions, supporting consistency and transparency. As the purpose of the review was to map the available evidence rather than assess intervention effectiveness, formal methodological quality appraisal of individual included studies was not undertaken. The full database search strategies are provided in Appendix A.

For the focus group study, quality was considered through trustworthiness, including credibility, dependability, confirmability and transferability[140]. Credibility was supported through an evidence-informed topic guide, recorded and transcribed discussions, representative quotations and achievement of thematic saturation. Dependability and confirmability were supported through transparent documentation of the analytical process, reflexivity and supervisory peer debriefing. Transferability was facilitated by description of participants and study context, although the relatively small and geographically concentrated sample limits application beyond comparable training settings. Reporting followed the COREQ checklist[138], provided in Appendix C (Section 6.3).

For the survey study, quality was considered in relation to validity, reliability, representativeness and generalisability. Content validity was strengthened by developing the questionnaire from the preceding review and focus group findings and by adapting established EBM measures[106]. Face validity and feasibility were assessed through piloting with ten General Surgery trainees. Standardised electronic administration and pre-specified analytical procedures supported consistency, while reporting followed the CHERRIES checklist[162], provided in Appendix E (Section 6.5.4). Formal psychometric revalidation and test–retest reliability were not undertaken. The low response rate, uneven regional participation and inability to compare respondents formally with the national trainee population limit representativeness and generalisability; the findings are therefore interpreted as an exploratory snapshot.

For the modified Delphi study, quality was supported through purposive recruitment of well-informed stakeholders, anonymity, iterative rounds, controlled feedback and a pre-specified consensus threshold. The study followed published Delphi methodological guidance and was reported according to the DELPHISTAR checklist[83], provided in Appendix D (Section 6.4). Face and content validity were further supported through stakeholder review of the proposed statements before the Delphi, while stability of responses across rounds informed the stopping decision. Attrition between rounds and purposive recruitment nevertheless limit the breadth and transferability of the consensus.

These methodological strengths and limitations informed interpretation of each study. Their integration across the programme provided an additional source of rigour, considered further in the following section on triangulation[63].

5.1.4 Triangulation

Triangulation was a central feature of the research design, enabling the integration of multiple data sources to generate a more comprehensive, credible, and contextually rich understanding of EBM within General Surgery training. Rather than treating each research phase as discrete, triangulation allowed the findings to be examined in relation to one another, highlighting areas of convergence, complementarity, and divergence[63,186].

It should be noted that convergence across phases is strengthened but not fully confirmed by independent samples, given the shared recruitment channels across the qualitative and quantitative phases. Nonetheless, the consistency of findings across methodologically distinct approaches i.e. literature mapping, focus group discussion, and survey, lends weight to their validity. The scoping review identified inconsistency, limited curricular structure, and conceptual ambiguity in the existing literature. These themes were echoed in the focus group discussions, where trainees described practical difficulties in accessing structured teaching, unclear expectations regarding EBM competence, and the influence of local clinical culture on learning opportunities. The survey extended these insights, suggesting that these issues were not confined to specific units or regions but reflected patterns consistent with broader experiences across UK general surgery training. Senior stakeholder consultations, conducted as part of the Delphi, independently endorsed the trainee-derived themes, particularly the variability in EBM provision, the absence of structured curricular guidance, and the cultural constraints on EBM engagement. These were again supported by the Delphi responses in the panellists' commentary. The consistency across these phases reinforced the validity of the findings and underscored the need for a more coherent educational framework.

Complementarity between qualitative and quantitative strands of this thesis strengthened the explanatory depth of the overall analysis. The survey highlighted patterns—such as the prevalence of informal learning opportunities and variability in perceived competence—while the focus groups provided insight into why these patterns existed, revealing the cultural and organisational factors that influenced trainees' engagement with EBM. Similarly, focus group data explained the mechanisms underpinning survey findings, such as why certain EBM elements were inconsistently taught or why confidence levels varied substantially. This interplay between numerical trends and contextualised reasoning enriched the interpretation of both datasets and supported a more nuanced understanding of the training environment.

Triangulation also highlighted areas of constructive divergence, where different data sources revealed distinct perspectives that informed subsequent methodological decisions. For example, trainees emphasised uncertainty about expectations and the practical challenges of integrating EBM into high-pressure clinical settings, while senior stakeholders focused on issues of feasibility, curricular alignment, and the need for concise, implementable curriculum components. These differing perspectives were not contradictory; rather, they provided a multi-layered view of the structural, cultural, and strategic dimensions of EBM training. The deliberate integration of these perspectives shaped the refinement of the curriculum statements prior to the Delphi process, ensuring that the final consensus reflected both trainee experience and institutional realities.

Finally, triangulation informed and strengthened the consensus-building phase. The Delphi statements were developed through an iterative synthesis of insights from all previous data sources. Literature-derived concepts were reinterpreted through trainee experiences, calibrated against national patterns, and refined through stakeholder consultation. The high levels of agreement achieved in the Delphi rounds suggest that this triangulated approach

produced curriculum statements that are both evidence-informed and acceptable to experts across the field.

Overall, triangulation enhanced the rigour and coherence of the research by allowing each phase to interrogate, enrich, and inform the others. It ensured that the emerging curriculum was grounded not in a single perspective but in a systematically integrated body of evidence reflecting the complexity of General Surgery training.

5.1.5 Participatory approach

A participatory orientation underpinned the design and conduct of this research, reflecting the principle that curriculum development in postgraduate medical education is most effective when shaped by those who deliver, experience, and govern training. Engaging stakeholders across multiple levels of the surgical training system ensured that the emerging curriculum reflected not only theoretical and empirical evidence but also the realities of clinical practice, organisational structures, and professional expectations[187].

Participation was embedded from the earliest stages. Trainees, as the primary recipients of the curriculum, contributed directly through focus group discussions, which captured their experiences, priorities, and perceived challenges in developing EBM competencies. This provided insight into how training was understood and enacted at the point of practice and ensured that trainee perspectives formed an essential foundation for subsequent methodological phases.

The survey extended this participatory dimension by involving a wider cohort of General Surgery trainees across the United Kingdom, broadening the breadth of trainee input beyond

the qualitative phase. Trainee-derived data therefore informed both the content and focus of the curriculum statements under consideration.

Beyond trainee engagement, senior stakeholders—including training programme leaders, curriculum developers, and educational supervisors—played a critical role in shaping the direction and feasibility of the curriculum. Their involvement in the pre-Delphi consultations enabled the refinement of the proposed curriculum statements and ensured alignment with regulatory expectations, service pressures, and existing curricular frameworks. This level of engagement was essential in this context, given that the stakeholders consulted, occupy positions capable of influencing curricular policy, resource allocation, and implementation strategy within UK General Surgery training.

The Delphi process further strengthened participatory principles by facilitating structured contributions from a diverse expert panel. This method provided a systematic mechanism for integrating informed judgement, discipline-specific expertise, and collective deliberation, enabling consensus on the design and scope of an EBM curriculum appropriate for General Surgery. The iterative nature of the Delphi rounds allowed panellists to reflect on aggregated group feedback, promoting a balanced and considered approach to decision-making.

In conclusion, these participatory elements ensured that the research did not operate at a theoretical or detached level but was grounded in a collaborative process involving those most affected by, and most responsible for, the integration of EBM within surgical training. This approach strengthened the legitimacy, acceptability, and practicality of the resulting curriculum. It aligns with contemporary principles of co-design and partnership working in medical education[188,189], which emphasise shared ownership and the value of distributed expertise in shaping educational reform.

5.2 Contribution to Knowledge

This research makes several interrelated contributions to the fields of surgical education, evidence-based practice, and curriculum design. These contributions extend beyond the production of a specialty-specific curriculum for EBM in General Surgery, providing new conceptual clarity, empirical insight, and methodological innovation that collectively advance understanding within this domain.

5.2.1 Conceptual Contributions

A central contribution of this work lies in clarifying the nature of EBM competencies within a surgical context. The scoping review revealed ambiguity around EBM definition, operationalisation, and teaching in postgraduate surgical education[60]. Furthermore, the empirical phases of the research revealed that trainees often lack clear directions as to what constitutes EBM competencies, how it should be developed, or how it aligns with the expectations of supervisors and curriculum bodies[158,171]. This thesis therefore advances conceptual understanding by:

1. Identifying the specific components of EBM most relevant to General Surgery, including critical appraisal, clinical decision-making under uncertainty, interpretation of surgical outcomes data, and integration of evidence with procedural expertise.
2. Clarifying the cultural and organisational forces that shape how EBM is understood and used in surgical environments, including hierarchy, service pressures, and the dominance of tacit and experiential reasoning over evidence-based approaches.
3. Providing evidence that EBM competence in surgery is not merely a set of cognitive skills, but a socially negotiated practice that depends on supervisory modelling, local culture, team expectations, and access to evidence resources.

This conceptual depth adds a layer of theoretical sophistication to existing literature, which has tended to treat EBM as a transferable clinical skill rather than a discipline-specific, context-dependent form of professional judgement.

5.2.2 Empirical Contributions

This is the first post-doctoral research programme to the researcher's knowledge to examine EBM within UK General Surgery using a sequential, multi-phase mixed-methods design. The combination of qualitative, quantitative, and stakeholder-derived evidence provided a richer picture of the educational landscape than any single method could achieve. Key empirical contributions include:

1. A detailed depiction of UK trainee experience, revealing consistent gaps in structured teaching, considerable variation in training opportunities, and widespread uncertainty about expectations.
2. Empirical evidence of cultural and contextual barriers, including consultant preference, time pressure, and limited faculty expertise—factors that have been anecdotally acknowledged but rarely analysed systematically within General Surgery.
3. Insight into stakeholder perspectives, showing alignment between trainee needs and organisational priorities, but also highlighting operational constraints and resource considerations that should inform curriculum design.

Together, these findings provide a data-driven foundation for reform, moving beyond assumptions about surgical culture to an evidence-based understanding of the barriers and facilitators shaping EBM development.

5.2.3 Methodological Contributions

Methodologically, this thesis illustrates the value of a triangulated, participatory mixed-methods approach applied sequentially to curriculum development in surgical education. This is significant in three respects:

1. Sequential exploration from literature to lived experience to national patterns to expert consensus represents an innovative approach in surgical educational research, where curriculum initiatives are often based either on expert opinion alone or on isolated pilot studies.
2. Integration of senior stakeholder consultation prior to the Delphi study was novel and enhanced the feasibility, clarity, and disciplinary relevance of the consensus statements. Integration of senior stakeholder consultation prior to the Delphi rounds is an under-reported methodological step that enhanced the feasibility, clarity, and disciplinary relevance of the consensus statements.
3. Use of multiple philosophical lenses—pragmatism, post-positivism, interpretivism, and social constructivism—within a coherent design, illustrating how complex educational problems can be studied through pluralistic epistemological foundations.

These methodological contributions extend the toolbox available to surgical education researchers and provide a model for future curriculum reform efforts in other specialties.

5.2.4 Contributions to Educational Theory

Beyond empirical findings, this research offers theoretical insights relevant to broader debates in medical education. First, this thesis reinforces the social constructivist account of learning in clinical environments, where competence emerges through participation in supervised practice and alignment with community norms[190]. The empirical findings suggest that EBM in surgery is relational and negotiated, rather than solely cognitive, highlighting the role of workplace culture in shaping learning. Secondly, the findings support theories and implementation of situated learning and communities of practice[55]. Trainee engagement with EBM was heavily influenced by the local learning climate and by consultant-level modelling, proposing that EBM competence develops most effectively when embedded in social and organisational structures rather than taught in isolation[191,192]. Thirdly, the participatory design aligns with contemporary co-production and learner-centred curriculum theory, illustrating

the value of involving both trainees and senior educators in curriculum creation[193]. This approach challenges traditional top-down models of surgical curriculum development[194]. Finally, the iterative integration of findings across methodological phases provides insight into how implementation theory—including feasibility, acceptability, and contextual fit—can inform curriculum design from the outset rather than being considered retrospectively[195].

5.2.5 Practical and Policy Contributions

Although more fully explored in Section 6.3, it is important to note here that the research contributes directly to practice by producing:

- the first General Surgery stakeholder EBM training consensus, to the author's knowledge
- empirically grounded recommendations that align with the GMC, ISCP, and JCST expectations
- insights into how training structures and assessment frameworks may need to adapt to support development of EBM competence.

These outputs represent a material contribution to postgraduate surgical training and provide a foundation for regional and national implementation.

5.3 Implications for Policy, Practice, and Curriculum Reform

The findings of this research have implications for postgraduate surgical education in the United Kingdom, particularly regarding policy development, curricular design, training provision, and the support structures required to embed EBM meaningfully within General Surgery. The research indicates that while EBM is formally embedded within regulatory expectations and professional standards, current training environments do not consistently enable trainees to develop or apply the necessary competencies. Addressing these discrepancies requires coordinated action at multiple levels, from national policy bodies to local training units.

A key policy implication concerns the alignment between regulatory expectations and the practical realities of postgraduate training. The General Medical Council and the Intercollegiate Surgical Curriculum Programme articulate explicit requirements relating to research and scholarship, yet these standards have not been consistently operationalised within training programmes[5,36,196]. The findings highlight a need for clearer translation of these high-level expectations into defined curricular outcomes, structured learning activities, and transparent assessment strategies. By providing a consensus-derived set of curriculum statements tailored to General Surgery, this research offers a possible mechanism through which national bodies can strengthen the coherence and specificity of EBM-related requirements. Incorporation of these statements into ISCP could enhance the clarity of trainee expectations and reduce the current variability in interpretation across training regions.

The work also has implications for the organisation of training at the deanery and programme level. Variability in EBM teaching provision across the United Kingdom indicates the need for a more standardised and equitable approach. Training programme directors, regional education leaders, and local educational providers may need to review existing schedules,

teaching structures, and resource allocation to ensure that opportunities for developing EBM competence are embedded within routine practice rather than reliant on individual trainers or ad hoc teaching sessions. The findings suggest that consistent opportunities for supervised appraisal, discussion of current evidence, and integration of research findings into clinical decision-making may be important for effective learning. Programme-level action could include the development of standardised journal club formats, protected teaching time, and formalised mentorship in EBM-related skills[55].

A further implication is the need for more cohesive national-level teaching provision. While deaneries maintain responsibility for organising regional training, the variability identified across the United Kingdom indicates that reliance on local initiatives alone is insufficient to ensure equitable access to high-quality EBM education. National organisations—including the surgical royal colleges, the Joint Committee on Surgical Training, NHS England's Workforce, Training and Education Directorate, and relevant trainee associations—are well placed to coordinate centralised teaching that complements and strengthens local provision. During the Delphi process, participants identified the creation of a free, nationally delivered mandatory course as a potential solution to current inconsistencies. Such a course could provide a uniform baseline of EBM knowledge, ensure that all trainees receive structured instruction aligned to the national curriculum, and offer an efficient mechanism for disseminating expert-led teaching at scale. Beyond a single course, a broader national strategy might include standardised EBM modules, cross-regional webinars, centrally curated online learning resources, and nationally facilitated journal clubs. These initiatives would reduce duplication of effort, mitigate regional disparities, and promote consistency in pedagogy, terminology, and assessment expectations. Centrally coordinated provision would also enable recognised experts in surgical EBM, research methodology, and outcomes analysis to contribute

systematically to postgraduate training, thereby enhancing both educational coherence and the visibility of EBM as an integral component of surgical professionalism.

Faculty development emerges as a further practical priority[181]. Trainees frequently noted variation in faculty confidence and expertise in EBM, which limited opportunities for modelling, guidance, and feedback. Given that EBM competence in surgery develops through social and relational processes, faculty expertise is not merely a desirable feature of training but a structural prerequisite for effective EBM learning. Policy-level strategies to support trainers may include the development of faculty development programmes focused on EBM pedagogy, critical appraisal, and evidence-based surgical decision-making. Ensuring that trainers have access to relevant training materials, digital resources, and institutional support would enable them to deliver more consistent and high-quality teaching. The development of a digital platform, as explored in this research, or subscribing to an asynchronous learning environment[55] may offer a scalable mechanism for disseminating such resources nationally.

The findings also highlight broader implications for educational culture within surgical practice. Hierarchy, service pressures, and entrenched reliance on experiential reasoning were identified as key factors shaping engagement with EBM. Addressing these cultural influences requires not only curriculum reform but also initiatives aimed at strengthening learning culture, promoting psychological safety, and encouraging open discussion about evidence and uncertainty[197]. National bodies could consider embedding expectations around EBM-oriented supervisory behaviour into trainer accreditation processes, while local departments might promote practices such as incorporating evidence review into morbidity and mortality meetings or multidisciplinary decision-making.

The research also points towards assessment considerations. While competence in research and scholarship is required at certification, trainees reported uncertainty about how their EBM skills should be demonstrated or assessed. The curriculum statements developed through the Delphi process offer a basis for designing assessment tools that are aligned with defined outcomes and reflective of real-world practice. Policy and curriculum organisations may therefore need to review existing assessment frameworks to ensure that they capture a range of EBM-related competencies, including knowledge, reasoning processes, and applied clinical judgement. Opportunities also exist to embed assessment within workplace-based settings, facilitating more authentic evaluation of how evidence is integrated into clinical decision-making.

There are also implications for implementation strategy. Successful adoption of a new curriculum requires attention to feasibility, acceptability, and sustainability. The digital platform approach piloted in this research could provide a mechanism for accessible and flexible curriculum delivery, supporting geographically dispersed training regions and enabling iterative updates. Licensing, support, and maintenance arrangements would need to be considered at organisational levels to ensure long-term sustainability. Furthermore, engagement with national bodies such as the surgical royal colleges, and trainee associations would be essential to ensure coordinated implementation and to support diffusion across training programmes.

Finally, the findings carry implications for broader discussions about workforce development, academic engagement, and the place of evidence within surgical professionalism. Reinforcing EBM as a core professional expectation may encourage greater engagement with research, increase the visibility of evidence in clinical decision-making, and contribute to a more

analytically grounded surgical culture. Such changes may also support national strategic priorities related to patient safety[198] and clinical outcomes[199].

In summary, the research provides a detailed evidential foundation for policy makers, curriculum designers, and training leaders seeking to strengthen the role of EBM within General Surgery. By highlighting gaps, clarifying expectations, and proposing an actionable curriculum, this work offers a pathway for both educational and organisational reform that is aligned with contemporary regulatory standards and responsive to the lived realities of trainees and trainers.

5.4 Methodological Strengths and Limitations

This research employed a sequential, multi-phase mixed-methods design that offered several methodological advantages while also presenting inherent limitations. Addressing these explicitly is essential for maintaining transparency, reflexivity, and rigour. The following subsections outline the strengths and limitations associated with each principal methodological component, followed by a consideration of cross-cutting limitations at the level of the overall research programme.

5.4.1 Scoping review

The scoping review provided a systematic and structured overview of the literature related to EBM within surgical training. A key strength of this method lay in its capacity to allow examination of a broad, heterogeneous body of evidence without imposing the constraints associated with traditional systematic reviews. This allowed the identification of conceptual ambiguities, emerging themes, and gaps in the current evidence base. The use of an established methodological framework ensured consistency and reproducibility, while the inclusion of multiple study designs facilitated mapping of the field[60].

However, scoping reviews have inherent limitations. They do not involve critical appraisal of study quality, meaning that the conclusions drawn from the mapped literature are influenced by the methodological robustness of the included studies. The heterogeneity of available evidence — both in terms of content and methodological standards — limited the degree to which definitive claims could be made about effectiveness or best practice[200].

The search strategy was limited to peer-reviewed publications in English, excluding grey literature, dissertations, and non-English language sources. In a field where EBM curricula are frequently delivered through institutional programmes that may not generate peer-reviewed outputs, this restriction may have excluded practically relevant material. Future reviews should seek to address this through broader source inclusion. The studies retrieved were predominantly surveys, and heterogeneous as to the population studied and parameters measured, limiting the synthesis of results. Most studies were performed in North America and Europe, with a notable absence of UK-focused research — a finding that itself justified the subsequent empirical phases of this thesis.

Despite these constraints, the scoping review effectively fulfilled its purpose by mapping the field, identifying the UK-specific gap, and providing the conceptual and empirical basis for the studies that followed.

5.4.2 Focus Group Discussions

The focus group discussions offered valuable qualitative insight into trainees' experiences, expectations, and perceived barriers to developing EBM competence. A major strength of this method was its alignment with social constructivist principles, enabling the co-construction of meaning through interaction and allowing collective reflections to surface that may not emerge in individual interviews. This approach was particularly appropriate in a discipline such as surgery, where shared norms, hierarchies, and professional identity strongly influence

learning[158]. The use of thematic analysis provided a structured mechanism for identifying key patterns and generating a detailed understanding of contextual influences on EBM engagement[77].

This was a small study with the majority of participants drawn from a single geographic region. However, thematic saturation was achieved by the fourth focus group, indicating that the views captured were sufficiently comprehensive for the exploratory purpose of the study[143]. This limitation was subsequently addressed through the national survey presented in Chapter 3, which extended the findings to a broader trainee population. Selection bias is acknowledged given that a significant proportion of participants held higher academic degrees and were academically oriented; it was not possible to assess the characteristics of non-responders.

Participation was voluntary, creating the potential for self-selection bias, with individuals more interested in EBM or more engaged in educational activities potentially overrepresented. Group dynamics may also have influenced responses: dominant participants may have shaped discussion, while hierarchical sensitivities may have constrained dissenting views.

The focus groups were moderated by the lead researcher, who occupies an insider position as a General Surgery trainee with a declared interest in EBM reform. While this provided contextual access and credibility with participants, it also carried a risk of moderator influence on discussion dynamics and interpretation of findings. This was managed through supervisory peer debriefing, reflexive journalling, and transparent acknowledgement of positionality, as discussed in detail in Chapter 5.5. Formal member checking was not undertaken; given the focus on collective rather than individual meaning-making in focus group methodology, trustworthiness was instead supported through supervisory peer debriefing and thematic saturation[201]. Research findings were disseminated via professional social media channels

throughout the research period, providing an informal opportunity for participants to encounter and engage with the conclusions.

Despite these limitations, the focus groups provided rich, contextually nuanced insight that was essential for the development of the survey instrument and subsequent phases.

5.4.3 Survey study

The survey generated quantitative data that extended the reach of the qualitative findings across a broader trainee population. Its strengths lie in its capacity to capture patterns in attitudes, exposure, and perceived competence across different training grades and hospital types. The sequential exploratory design strengthened the instrument's validity by ensuring it was grounded in trainee-derived concepts from the focus groups. Dissemination through professional networks and surgical societies supported wide reach across UK training regions[171].

Nevertheless, surveys are subject to recognised limitations. The response rate was 5.4%, yielding 53 completed responses from an estimated population of 1,000–1,600 UK General Surgery trainees. While this is consistent with response rates reported in similar surveys of medical professionals, it restricts the generalisability of the findings. The survey should therefore be understood as an exploratory snapshot that supports and extends the qualitative findings rather than as a representative national census of trainee experience. Findings are presented as indicative of this respondent group rather than generalisable to all UK General Surgery trainees.

Selection bias is possible, as trainees with a pre-existing interest in EBM may have been more likely to participate. The self-reported nature of the data introduces the possibility of social desirability bias, particularly in areas relating to confidence or perceived competence;

3250 although no personal information was collected to minimise this risk. As a cross-sectional
3251 design, the survey captures a single time point and cannot account for temporal changes in
3252 training provision or individual development. The geographical distribution of respondents
3253 was uneven, with some deaneries more strongly represented than others.

3254 A further limitation concerns the independence of samples across the qualitative and
3255 quantitative phases. Both studies were recruited through similar professional networks,
3256 meaning the samples may share characteristics — particularly the over-representation of
3257 academically engaged trainees. Where findings converge across phases, this reflects
3258 consistency across methodologically distinct approaches rather than fully independent
3259 samples. It is nonetheless reassuring that the survey findings corroborate the focus group
3260 study, and the combination of methods increases confidence in the overall conclusions

3261 ### 5.4.4 Delphi study
3262

3263 The Delphi study enabled structured expert consensus regarding the content of an EBM
3264 curriculum for General Surgery. Its strengths include anonymity, iterative reflection, and
3265 controlled feedback, all of which encourage balanced consideration of diverse views while
3266 minimising the influence of hierarchy which is an important consideration in surgical fields.
3267 The integration of Delphi findings with prior empirical phases ensured that the resulting
3268 statements were both evidence-informed and contextually grounded. The pre-Delphi
3269 stakeholder consultations further enhanced the face and content validity of the consensus
3270 instrument.

3271 However, Delphi methodology carries inherent limitations. Attrition between rounds was
3272 notable, with 36 panellists completing round 1 and 20 completing round 2, representing a 44%
3273 reduction. While response stability was confirmed and this level of attrition represents a
3274 limitation, this is acknowledged when interpreting the breadth of consensus achieved[80,176,202].

The consensus threshold of 75%, was set a priori and in line with previous Delphi studies; this may influenced which statements are ultimately retained or excluded. The composition of the panellists' group, although role-diverse, may not represent the full range of views within the profession — in particular, views of surgeons who do not engage with societies and colleges, may not have been sufficiently captured.

A further consideration concerns the panel composition. The empirical phases of this research identified consultant and senior educator behaviour as a key cultural influence on trainees' EBM engagement. Some Delphi panellists occupied similar roles, creating a potential tension: the empirical phases found that consultant attitudes and behaviours could inhibit trainees' EBM engagement, yet these same senior figures were now being asked to define what EBM training should look like. There is a risk that panellists might unconsciously favour curriculum components that reflect their own practice and values, or underestimate the cultural and hierarchical barriers that trainees experience. This was managed through the anonymised iterative structure of the Delphi, which minimises hierarchical influence, though future consensus work might consider more explicitly weighting trainee representation within the panel.

The Delphi items were adapted from the Albarqouni et al international consensus framework[4] rather than generated de novo. While this adaptation was guided by supervisory expertise and refined through the pre-Delphi stakeholder consultations, the adaptation process itself was not subject to formal validation. This is acknowledged as a methodological limitation.

Finally, the consensus statements address the knowledge, skills, appraisal components of EBM competence. Future curriculum iterations should ensure that shared decision-making and patient-centred evidence use are addressed as explicit competency domains. This is research work that is currently underdeveloped in the literature[203].

Despite these limitations, the Delphi provided a transparent and evidence-grounded mechanism for producing consensus-driven curriculum content that is contextually relevant to UK General Surgery training.

5.4.5 Broader thesis limitations

Beyond the limitations specific to each methodological component, several cross-cutting limitations merit acknowledgement at the level of the overall research programme. First, the absence of patient outcome data represents a fundamental limitation. The research establishes a curriculum framework and achieves stakeholder consensus on its components but does not demonstrate that implementation will improve clinical decision-making or patient outcomes. This is an inherent limitation of curriculum development research at this stage of the evidence cycle[204]. Establishing what should be taught, grounded in empirical evidence and expert consensus, is a necessary precondition for intervention research — without a defined curriculum, outcome studies would be evaluating an undefined intervention[205]. The pathway from curriculum to competence to clinical judgement to patient benefit requires longitudinal research[134] that is beyond the scope of this thesis.

This research did not include formal patient and public involvement. Given that the primary focus was on trainee and educator perspectives in curriculum design, and that patient involvement in surgical education curriculum development remains rare in the existing literature, this was considered beyond the scope of the current thesis. Future curriculum development and implementation work should seek to incorporate patient perspectives, particularly regarding shared decision-making and the integration of patient values into evidence-based surgical decisions, to ensure the curriculum reflects the full scope of Sackett's original EBM framework[206].

Second, all data in this thesis are self-reported or derived from well-informed educators. No observational, behavioural, or objective competency data were collected. The survey captures perceived competence and attitudes rather than demonstrated ability[207]; the focus groups capture expressed views rather than enacted behaviour; and the Delphi captures informed opinion rather than empirical evidence of educational effectiveness. This reliance on self-report and expert judgement is appropriate for curriculum development research but limits the conclusions that can be drawn about actual EBM practice in surgical training.

Third, the research was conducted entirely within a UK context and is designed specifically for the UK postgraduate General Surgery training system. The curriculum statements produced are grounded in UK regulatory frameworks — including the ISCP, GMC standards, and CCT requirements — and in the organisational and cultural realities of UK surgical training[208]. Their applicability to other countries or training systems should not be assumed without contextual adaptation.

Fourth, the participatory design — while a methodological strength — means the resulting curriculum reflects the values and priorities of those who participated. Trainees who declined to participate, consultants not recruited to the Delphi, and training regions underrepresented in the survey may hold different views. The curriculum should therefore be understood as reflecting the perspectives of engaged stakeholders rather than the profession as a whole[209].

Finally, this thesis does not include a formal implementation or evaluation phase. The curriculum statements produced through the Delphi process have not been piloted, taught, or assessed in a real training environment. Their feasibility, acceptability, and educational impact in practice remain to be tested[195]. These limitations collectively define a clear and coherent agenda for future research, as outlined in Section 5.5.

5.5 Recommendations for Future Research

The programme of research presented in this thesis offers a detailed understanding of the current position of evidence-based practice within postgraduate General Surgery training. It highlights conceptual and structural deficiencies in existing provision, identifies cultural and organisational influences that shape learning, and establishes a consensus-driven foundation for curriculum development. At the same time, it reveals several areas where further inquiry is necessary to strengthen the evidence base and support the sustainable implementation of an EBM curriculum. The following recommendations propose a research agenda informed by the findings of this doctoral work.

A key priority for future research is the piloting and evaluation of the proposed EBM curriculum. The Delphi panel has produced a set of curriculum statements that now require translation into educational practice. Small-scale implementation studies within selected training programmes would allow detailed examination of feasibility, acceptability, and perceived relevance[195]. Such work should explore how trainees and supervisors interact with the curriculum in the realities of clinical environments, the extent to which the learning activities integrate with operative workflow, and the organisational conditions that influence implementation. These early studies would enable iterative refinement and support alignment with the processes used by national bodies to review and update surgical curricula[184].

Another important avenue for future research concerns the development of an assessment tool that reflects the specific demands of surgical practice. The literature demonstrates that existing tools predominantly evaluate appraisal skills or knowledge acquisition, while tools capable of assessing the application of evidence to clinical decision-making or evaluating impact in practice remain underdeveloped[31]. A validated, context-specific instrument for

General Surgery would address a critical gap[60]. Future work should therefore engage with modern validity frameworks, incorporate rigorous psychometric testing, and consider multimodal formats, including workplace-based assessments, structured case-based exercises, and digital tasks[210]. Given the role of consultants in assessing trainees, further attention to assessor training and reliability will be required[181].

Future research should also examine the longitudinal development of EBM competence across the duration of surgical training. The cross-sectional survey undertaken as part of this thesis provided a national overview, but it could not capture how skills develop, fluctuate, or consolidate over time[171]. Longitudinal cohort studies would allow examination of the trajectory of EBM learning, including periods of rapid improvement or stagnation, and the extent to which skills decay[125] when not regularly practised. Such work would support the optimisation of timing and sequencing within the curriculum and highlight the conditions that best support sustained engagement[211].

The role of supervisors in shaping EBM learning warrants further investigation. Supervisors exert considerable influence on how evidence is interpreted and applied, yet little empirical work has interrogated their beliefs, confidence, or educational needs[212]. Future studies could examine supervisor readiness, the ways in which they model or discourage evidence use in clinical encounters, and how their own EBM competence affects trainee learning. There is also value in evaluating faculty development interventions designed to enhance supervisory capability[181]. Understanding these factors would inform strategies for improving consistency across regions and supporting supervisors as key stakeholders in curriculum delivery.

Further research is needed into the organisational and cultural contexts influencing EBM uptake. This thesis has demonstrated that learning is shaped not only by educational

structures but also by the norms of surgical teams, the implicit expectations of operative practice, and the broader professional culture. Ethnographic, observational, or socioculturally informed studies could provide deeper insight into how evidence is discussed on ward rounds, in theatres, and in multidisciplinary settings[192]. Such approaches would illuminate the social dynamics that enable or constrain EBM integration and inform efforts to embed EBM at cultural and systemic levels.

Given the interest expressed by stakeholders in a nationally coordinated approach to EBM education, future research should evaluate national teaching interventions, including a free, mandatory course or the use of a digital platform to deliver curriculum components. Investigations should examine their acceptability, scalability, usability, and educational impact, and compare national delivery with regionally led approaches[195]. The digital platform proposed in this thesis particularly warrants evaluation in terms of user experience, adaptability, and integration with existing systems such as the ISCP.

Finally, future research should consider downstream outcomes of improved EBM training. While direct causal links between EBM education and patient outcomes are difficult to establish, studies could examine intermediate indicators such as decision-making quality, adherence to high-quality evidence, reduction of decision-making variation, or enhanced multidisciplinary alignment[213,214]. These outcomes would provide insights into the broader impact of strengthening EBM competence within surgical teams and inform national policy discussions on the value of investing in EBM education.

Together, these areas of inquiry provide an agenda for future research based on this thesis. They emphasise the importance of continued collaboration between trainees, supervisors, educators, curriculum developers, and regulatory bodies. Advancing the teaching and practice

of EBM in General Surgery will require not only curricular refinement but also sustained attention to assessment, culture, supervision, and national coordination. The recommendations outlined here aim to guide this ongoing effort and ensure that future research contributes meaningfully to the development of safe, effective, and evidence-informed surgical practice.

Finally, future research should examine the downstream patient impact of improved EBM training. While direct causal links between curriculum and patient outcomes are difficult to establish and require longitudinal study designs, intermediate indicators offer a feasible starting point. These might include the quality of evidence-based decision-making in clinical encounters, trainee ability to integrate patient values with best available evidence in shared decision-making conversations, adherence to high-quality guidelines in areas of known unwarranted variation, and ultimately patient-reported outcomes following surgical decisions informed by evidence-based reasoning. Establishing these links would complete the evidence chain that this thesis begins.

5.6 Reflections, reflexivity and positionality

This section offers a critical reflection on the research process underpinning this doctoral thesis. It examines the development of my understanding of EBM within the context of surgical education, together with the personal, professional, and epistemological shifts that occurred throughout the project. The purpose of this reflection is not autobiographical; rather, it is to articulate how my positionality as a surgical trainee and educational researcher shaped the conceptualisation, conduct, and interpretation of the research, and how these influences intersect with wider processes of knowledge production within surgical training.

At the outset, my thinking about EBM education was grounded in my experiences as a clinician navigating the tension between empirical evidence and established surgical traditions. This insider standpoint provided direct access to trainee perspectives and experiential insight into organisational dynamics, but it also carried a risk of preconception. The scoping review, as the initial stage of the research, challenged some of these assumptions by demonstrating that the challenges associated with embedding EBM were not merely local or anecdotal, but reflected broader structural variation and conceptual inconsistency across the literature. This required me to shift from an implicit assumption that the issue lay primarily in curriculum design to an appreciation that the foundations of the problem were cultural, systemic, and distributed across multiple levels of surgical training.

The qualitative phase further developed this insight. Listening to trainees articulate their experiences revealed nuances of surgical culture that my own professional background had normalised to the point of invisibility. Hierarchical practices, patterns of supervision, and unspoken expectations emerged as prominent determinants of whether EBM was valued, modelled, or enacted. This prompted an epistemic transition from a primarily pragmatic orientation—seeking curricular solutions—to an interpretive stance that prioritised understanding meaning, identity, and context. This shift was reinforced through engagement with educational theory. Immersion in constructivist, sociocultural, and adult learning perspectives reoriented my view of EBM teaching from a process of information transmission to one of guided participation in professionally situated reasoning. This theoretical broadening reshaped my methodological choices and deepened my appreciation of reflexivity as an essential feature of educational research rather than an optional adjunct.

Maintaining a reflexive journal and engaging in repeated supervisory dialogue were pivotal in identifying how my disciplinary background influenced interpretation, particularly when analysing focus group data from peers and senior colleagues. My dual identity as trainee and

researcher required careful navigation. These reflections alerted me to the potential for over-identification with trainee perspectives or excessive deference to senior views. Acknowledging these tendencies allowed me to engage more critically with the data and strengthened the transparency and trustworthiness of the analytic process. The experience underscored that reflexivity is not static but an iterative practice requiring attention to how one's role, assumptions, and social positioning intersect with data collection and interpretation.

Methodologically, moving through sequential research phases demanded adaptability. Translating qualitative findings into survey constructs illuminated the tension between capturing experiential nuance and generating generalisable data. This balancing act highlighted the value—and challenge—of mixed-methods research in medical education. The stakeholder consultations were a further point of reflection. As a relatively junior member of the profession, engaging in dialogue with senior educational leaders required deliberate management of role boundaries, communication clarity, and professional confidence. Yet these interactions also revealed the extent to which EBM education is shaped by strategic considerations, resource constraints, and curricular governance structures that are often opaque to trainees. This expanded my understanding of the multi-layered nature of educational change.

Ethical reflection was an integral component of the research journey. Conducting research within my own professional community required careful deliberation regarding anonymity, consent, and power dynamics. Attention was necessary when participants were colleagues or supervisors. This experience deepened my understanding of ethical practice as an ongoing negotiation rather than a static set of procedural obligations. It reinforced the importance of transparency, respect, and reflexive awareness in fostering a safe and credible research environment.

At a personal and professional level, this doctoral programme has been formative in ways that extend beyond the research outputs themselves. Prior to embarking on this thesis, my identity was primarily that of a surgical trainee, someone trained to act decisively, to acquire technical skill, and to navigate clinical uncertainty through experience and hierarchy.

The doctoral process required a different set of dispositions: tolerance of ambiguity, openness to multiple ways of knowing, and the capacity to sit with questions rather than reach immediately for answers. Learning to design qualitative studies, conduct and analyse focus groups, develop and validate survey instruments, and facilitate expert consensus through Delphi methodology represented a substantive expansion of my research capabilities, skills that are not part of standard surgical training and that required deliberate cultivation over the course of the programme.

Equally significant was the development of a dual professional identity. I am now both a surgical resident doctor and an educational researcher, two roles that carry different epistemological assumptions, different standards of evidence, and different communities of practice. Navigating between them has not always been straightforward. There were moments when the clinical instinct to solve problems quickly sat uncomfortably alongside the researcher's obligation to understand them deeply first. But this tension has ultimately been productive. It has equipped me to translate between the worlds of surgical practice and educational scholarship in ways that neither identity alone would permit, and it is this dual perspective that I believe gives this research its distinctive contribution, grounded in the realities of surgical training, yet rigorous in its scholarly approach.

In conclusion, this reflective process highlights that the research conducted for this thesis constituted both a scholarly endeavour and a form of professional development. Navigating multiple identities—clinician, trainee, educator, and researcher—required reconciling diverse

epistemological traditions and learning to situate educational inquiry within the cultural complexities of surgical practice. By making these reflections explicit, I seek to illuminate the contextual and positional factors shaping this thesis and to contribute to a wider discourse on professional reflexivity in medical education. Ultimately, the experience has reinforced my view that the advancement of EBM within surgical training demands not only pedagogical innovation but also an ongoing, collective transformation in the epistemic culture of the profession.

Chapter 6. Appendices

6.1 Appendix A – Scoping Review Database searches.

The White Rose Research Online search cannot be extracted as a table.

PubMed	Strategy and results
Search Query	((Evidence-Based Medicine[MeSH Major Topic]) AND ((Surgery OR Surgical Practice))) AND ((Teach* OR assess* OR train* OR curricul* OR perception OR attitudes OR perception OR awareness OR utility OR need*))
All results	2127
Duplicates	15
Articles for title screening	2112
Excluded	1910
Included for abstact screening	202
Excluded	35
Included for full text screening	167
Excluded	138
Included for analysis	29

Database	Strategy	Citations
MEDLINE		
1	evidence based surgery.mp.	177
2	(train* or teach* or perception or curricul* or assess* or awareness or attitude* or utility or need* or tool*).mp.	8139437
3	1 and 2	89
Comment 1	Included articles after manual deduplication	9

Database	Strategy	Citations
Embase		
1	evidence based surgery.mp.	209
2	(train* or teach* or perception or curricul* or assess* or awareness or attitude* or utility or need* or tool*).mp.	11693155
3	1 and 2	106

4	limit 3 to "remove medline records"	25
Comment 1	All articles excluded	

Database	Strategy	Citations
ERIC		
1	exp evidence based practice/	5358
2	exp surgery/	953
3	(train* or teach* or perception or curricul* or assess* or awareness or attitude* or utility or need* or tool*).mp. [mp=abstract, title, heading word, identifiers]	1365731
4	1 and 2 and 3	4
Comment 1	Search criteria modified from other Ovid databases due to "evidence based surgery.mp" producing no results on ERIC	
Comment 2	All articles excluded from title screening due to irrelevance	

6.2 Appendix B - Focus Group Discussion Supplementary Documents

6.2.1 Focus Group Discussion Participant Information Sheet

Participant Information Sheet

Investigating Perceptions and Requirements in a General Surgery higher surgical training programme

Invitation

You are being invited to take part in a research project. Before you decide to participate, it is essential for you to understand why this research is being undertaken. Please take time to read the following information carefully and discuss it with others if you wish. This project is part of a wider PhD to investigate teaching and training in evidence based surgical practice.

Aims and objectives

This research project aims to investigate knowledge and understanding of Evidence-Based Medicine (EBM), its importance in surgical training, and the needs for support and educational resources among higher surgical trainees in the UK. The project's objective is to better understand the experiences and perspectives of trainees in evidence-based surgical practice.

Why Have You Been Chosen?

You have been selected to participate in this research project as a higher surgical trainee in general surgery. We aim to recruit a group of trainees like yourself to gather diverse perspectives on evidence-based practice in postgraduate general surgical training.

Voluntary Participation

Your participation in this research project is entirely voluntary. You have the freedom to choose whether to participate, and there will be no negative consequences if you decide not to take part. You can also withdraw from the research project at any time without having to provide a reason. If you wish to withdraw, please contact the researcher directly.

What Will Happen During the Project

Your involvement in the research project will consist of participating in focus group discussions. The discussions will be semi-structured and will explore your understanding, perceptions, and needs related to evidence-based surgical practice. These discussions will be audio-recorded for analysis, but your identity will be kept confidential during the analysis and reporting of findings.

Disadvantages and Risks

There are no expected disadvantages or risks associated with participating in this research project. However, please note that any discomfort or concerns you experience during the discussions will be addressed promptly.

Benefits of Participation

Your insights will contribute to improving postgraduate training in evidence-based surgical practice, which can ultimately enhance the quality of patient care.

Confidentiality

All information collected during the research project will be kept strictly confidential and will only be accessible to members of the research team. Your identity will not be disclosed in any reports or publications without your explicit consent.

Data Protection

We will process your personal data in accordance with relevant data protection legislation. The legal basis for processing your data is that it is necessary for the performance of a task carried out in the public interest. For more information, refer to our Privacy Notice [1]

Use of Data and Results

The data collected and the research results will be used for analysis, presentation in academic contexts, and possible future research projects. Your data may be shared with other researchers only if you provide explicit consent.

Funding and Data Controller

This research project does not have external funding and the Data Controller for personal data collected is The University of Sheffield.

Ethical Review

This project has been ethically approved through the University of Sheffield's Ethics Review Procedure.

Complaints and Concerns

If you have any concerns or wish to make a complaint about the research project, please contact the researcher directly. You can also contact the Head of the Department of Medical Education, University of Sheffield Medical School, for assistance. If your concern relates to data protection, refer to our https://www.sheffield.ac.uk/govern/data-protection for further information.

Researcher's Contact

Evri Tokidis
etokidis1@sheffield.ac.uk

Thank you for considering participating in this research project. Your participation is valuable, and your insights will contribute to the advancement of evidence-based surgical practice. If you decide to participate, you will be provided with a copy of this information sheet and, if applicable, a consent form for you to keep.

6.2.2 Focus Group Discussions Consent Form

Focus Group Participant Consent Form

Developing evidence based surgical practice - Investigating Perceptions and Requirements to inform the development of Teaching and Assessment of EBM for trainees in General Surgery.

University Of Sheffield *Ethics*

Approval Number: TBC Study

Number: TBC

Name of Researcher: Evripidis Tokidis

Supervisors: SP Balasubramanian, PV Schmidt

* Indicates required question

1. Email *

_____

2. Name of Participant *

_____

3. I have read and understood the project information sheet dated DD/MM/YYYY *
(If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.)

Mark only one oval.

- ( ) Yes
- ( ) No

4. *

I understand and agree that taking part in the project will include participating in a focus group discussion with other surgical trainees

Mark only one oval.

- Yes
- No

5. I agree that whilst I am participating in this interview audio recordings will be made(if face to face interview) and video recordings(if virtual). *

Mark only one oval.

- Yes
- No

6. I understand that these recordings will be deleted once the interviews are transcribed. *

Mark only one oval.

- Yes
- No

7. The recordings will not be shared with anyone other than the research team. *

Mark only one oval.

- Yes
- No

8. I understand that by choosing to participate as a volunteer in this research, this does not create a legally binding agreement nor is it intended to create an employment relationship with the University of Sheffield. *

Mark only one oval.

- Yes
- No

9. I understand that my taking part is voluntary and that I can withdraw from the study at any time. I do not have to give any reasons for why I no longer want to take part and I understand that my current and future training will not be affected if I choose to withdraw *

Mark only one oval.

- Yes
- No

10. I understand my personal details such as name and email address will not be revealed to people outside the project. *

Mark only one oval.

- Yes
- No

11. I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be identified in these outputs unless I specifically request this. *

Mark only one oval.

- Yes
- No

12. I agree to take part in the project. *

Mark only one oval.

- Yes
- No

13. Insert date *

Example: 7 January 2019

This content is neither created nor endorsed by Google.

Google Forms

6.2.3 Focus Group Discussion Invitation Letter

Subject: Focus Group Discussion on Evidence Based Surgical Practice

Dear colleague,

I am writing to request your contribution in the following focus group discussion: **Developing evidence based surgical practice - Investigating Perceptions and Requirements to inform the development of Teaching and Assessment of EBM for trainees in General Surgery**

This is part of a Research Project to understand the perceptions and attitudes of Higher General Surgical Trainees towards Evidence Based Surgery. [Registration number/Ethics

approval]. This is a topic of essence for General Surgical Trainees given the recent changes in the General Surgical Curriculum and ISCP.

We aim for the discussion to last approximately 45-60 minutes. This is completely optional however, I would appreciate your collaboration. To incentivise participation, all participants will be offered free access to an all-day course on critical appraisal and methodology run by CRAMSURG in the two years following initial implementation of the survey. CRAMSURG is an educational charity aimed at improving understanding and application of critical appraisal and research methodology. The charity has previously run similar courses on critical appraisal and methodology in collaboration with the Association of Surgeons in Training (AsiT) in the UK.

Find the focused group link participation here: LINK/QR code

Yours sincerely,

Evri Tokidis (he/him)
General Surgery Registrar
Yorkshire and The Humber
@twitter
@instagram
@linktree
?picture

Data protection statement
University of Sheffield Logo
CRAMSURG Logo

6.3 Appendix C– COREQ Checklist

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	4-6
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	4-6
Occupation	3	What was their occupation at the time of the study?	4-6
Gender	4	Was the researcher male or female?	4-6
Experience and training	5	What experience or training did the researcher have?	4-6
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	4-6
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	4-6
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	4-6
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	6
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	4
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	4
Sample size	12	How many participants were in the study?	4
Non-participation	13	How many people refused to participate or dropped out? Reasons?	4
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	4-6
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	4-6
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	4 and 7
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	5 and 6
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	N/A
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	5
Field notes	20	Were field notes made during and/or after the inter view or focus group?	6
Duration	21	What was the duration of the inter views or focus group?	5
Data saturation	22	Was data saturation discussed?	11-12
Transcripts returned	23	Were transcripts returned to participants for comment and/or	Not reported

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	6
Description of the coding tree	25	Did authors provide a description of the coding tree?	6
Derivation of themes	26	Were themes identified in advance or derived from the data?	6, 8-11
Software	27	What software, if applicable, was used to manage the data?	6
Participant checking	28	Did participants provide feedback on the findings?	Not reported
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Appendix A
Data and findings consistent	30	Was there consistency between the data presented and the findings?	6-17
Clarity of major themes	31	Were major themes clearly presented in the findings?	Appendix A
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Appendix A

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

6.4 Appendix D - Delphistar Checklist

This checklist's pagination corresponds to the Delphi manuscript as it was submitted at the Journal of Surgical Education.

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
I Title and Abstract		1	Identification as a Delphi study in the title	Page 1	Integrating Evidence-based Medicine in the General Surgery curriculum: A modified Delphi study
		2	Identification as a Delphi study in the abstract	Page 1	A modified Delphi study was conducted…
		3	Structured abstract	Page 1	Abstract
II Context	**Formal**	4	Information about the sources of funding	Title page	Sources of funding heading
		5	Information about the team of authors and/or researchers (e.g., discipline, institution)	Title page	Authors and affiliations heading
		6	Information about method consulting	Page 19/20	This has been discussed at the PhD confirmation review and the method was considered appropriate – alternative method (nominal group) considered not feasible
		7	Information about the project background	Page 4/5	The Delphi study is the final piece of a medical education PhD about integrating EBM into General Surgical Postgraduate Education
		8	Information about the study protocol	Page 6	The study protocol was not registered online in an open access source, but the study has been registered with the University of Sheffield Ethics Committee
	Content	9	Justification of the chosen method (Delphi) to answer the research question	Page 3-4	Furthermore, General Surgery training in the UK lacks an EBM-specific training programme or curriculum. To establish the components of such a curriculum, consensus agreement among well-informed General Surgical educators is required.

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
		10	Aim of the Delphi study (e.g., consensus, forecasting)	Page 3-4	…aimed to derive a consensus for the EBM curriculum in General Surgery...
III Method	**Body & Integration of knowledge**	11	Identification and elucidation of relevant expertise, spheres of experience, and perspectives (e.g., theory, practice, affected groups, disciplines)	Page 5	Participants in this study were defined as well-informed persons rather than experts. Clinical and educational supervisors, Royal College tutors, members of General Surgery specialty committees and training programme directors were considered well-informed individuals for the purposes of this study.
		12	Handling of knowledge, expertise and perspectives which are missing or have been deliberately not integrated	Page 5	While expertise in Evidence-Based Medicine can be conceptualised in general terms, identifying individuals with recognised expertise in EBM within the specific context of General Surgery training is challenging and potentially exclusionary. Moreover, EBM teaching and supervision in surgical training are typically delivered by trainees' supervisory teams rather than by a small group of designated experts.
		13	Basic definition of expert[1]	Page 5	Participants in this study were defined as well-informed persons rather than experts.
	Delphi variant and modifications	14	Identification of the type of Delphi variant and potential modifications (e.g., classic Delphi, real-time Delphi, group Delphi)	Title	…modified Delphi study…
		15	Justification of the Delphi variant and modifications, including during the Delphi study, if applicable	Page 4	… Rather than adopting existing competencies verbatim or generating Delphi items de novo, we undertook an adaptation process to contextualise them for UK postgraduate General Surgical training…
	Sample of experts	16	Selection criteria for the experts (per round, per expert group if applicable)	Page 5-6	Round 1-well informed experts, Round 2-participants of Round 1 only
		17	Identification of the experts	Page 5	Training programme directors (via the chair of the General Surgery Specialty Advisory Committee), Royal College tutors (via publicly available contact details on the Royal College website), and General Surgery

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
					specialty committee members (via publicly available professional society email addresses).
		18	Information about recruiting and any subsequent recruiting of experts	Page 5	Invitations were distributed electronically via email to identified stakeholder groups, including training programme directors (via the chair of the General Surgery Specialty Advisory Committee), Royal College tutors (via publicly available contact details on the Royal College website), and General Surgery specialty committee members (via publicly available professional society email addresses). In addition, the study was promoted through professional social media platforms (LinkedIn) to reach other relevant stakeholders involved in surgical training. Participation was voluntary.
	Survey	19	Elucidation of the content development for the questionnaire[2]	Page 4 and Supplementary Material	Rather than adopting existing competencies[4] verbatim or generating Delphi items de novo, we undertook an adaptation process to contextualise them for UK postgraduate General Surgical training.
		20	Description of the questionnaire (content and structure)	Page 6 and Supplementary Material	The questionnaire is included in the supplementary material
	Delphi rounds	21	Number of Delphi rounds	Page 7 and 8	Two rounds were held
		22	Information about the aims of the individual Delphi rounds	Pages 7-12	Round 1 – aimed to gain consensus on all statements, Round 2 – aimed to gain consensus on remaining statements
		23	Disclosure and justification of the criterion for discontinuation	Page 12	Levels of agreement remained below the 75% threshold, with responses distributed across agreement, neutrality, and disagreement categories, and minimal change in median scores between rounds. This response stability indicated that further iteration was unlikely to alter the consensus position. Accordingly, in line with established Delphi

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
					methodology, the item was retained as a non-consensus outcome, and no additional Delphi rounds were undertaken.
	Feedback	24	Information about what data was reported back per round	Pages 6-7	Participants were instructed to rate statements independently in the first round without consultation with other respondents. The second round provided feedback from the first round results to the panellists who completed Round 1 as well as a summary of the round. Additionally, the statements that did not reach consensus in the first round were provided for rating similarly to Round 1…. After round 2, the participants were thanked and a summary of the results was provided to them via email.
		25	Information on how the results of the previous Delphi round were fed back to the experts surveyed (e.g., via frequencies, mean values, measures of dispersion, listing of comments)	Tables S1,S2,S3	• Frequency counts for each statement's Likert agreement scores (1-5) • Median agreement scores for each statement's Likert agreement scores (1-5) • Interquartile range (IQR) of each statement's Likert agreement scores (1-5) as an index of response dispersion
		26	Information on whether feedback was differentiated by specific groups (e.g., by field of expertise, institutional affiliation)	N/A	This was not done
		27	Information about how dissent and unclear results were handled	Page 12	Levels of agreement remained below the 75% threshold, with responses distributed across agreement, neutrality, and disagreement categories, and minimal change in median scores between rounds. This response stability indicated that further iteration was unlikely to alter the consensus position.

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
					Accordingly, in line with established Delphi methodology, the item was retained as a non-consensus outcome, and no additional Delphi rounds were undertaken.
	Data analysis	28	Disclosure of the quantitative and qualitative analytical strategy	Page 6	For each Delphi statement, the following metrics were calculated: • Frequency counts for each statement's Likert agreement scores (1-5) • Median agreement scores for each statement's Likert agreement scores (1-5) • Interquartile range (IQR) of each statement's Likert agreement scores (1-5) as an index of response dispersion Free-text responses were extracted and retained verbatim. Free-text responses were analysed descriptively and organised deductively using the Kirkpatrick Model to contextualise quantitative agreement patterns.
		29	Definition and measurement of consensus	Page 6	Pre-specified consensus criteria were set at ≥75% agreement, defined as the proportion selecting "somewhat agree" or "strongly agree".
		30	Information on group-specific analysis or weighting of experts (e.g., theory vs. practice, discipline-specific analysis)	N/A	No subgroup analysis was performed
IV Results	**Delphi process**	31	Illustration of the Delphi study (e.g., in a flow chart)	Figure 1, page 7	A summary of the Delphi study is illustrated in a flow chart (Figure 1).
		32	Information about special aspects during the Delphi study (e.g., deviations from the intended approach with justification)	Page 12	1 statement did not reach consensus after round 2 and was retained non-consensus; this was because of response stability suggested a 3rd round would unlikely alter the consensus position.

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
		33	Number of experts per round (both invited and participating)	Pages 7 and 12	Thirty-six participants completed Round 1 of the modified Delphi process. In Round 2…20/36 (55.5% retention rate) panellists (only the initial 36 were invited).
	Results	34	Presentation of the results for each Delphi round and the final results	Tables S1,S2,S3	Tables in manuscript
V Discussion	**Quality of findings**	35	Highlighting the findings from the Delphi study	Page 17	The findings demonstrate agreement across the panel on the centrality of EBM training in General Surgery and the importance of providing trainees with structured opportunities to formulate clinical questions, retrieve evidence, critically appraise research, and apply findings in clinical decision-making. These areas achieved consistently high levels of consensus and low response dispersion, indicating a shared professional understanding of the relevance and necessity of EBM within the surgical curriculum.
		36	Validity of the results (e.g., transferability of the findings)	Page 19	The validity of the results is supported by the inclusion of a diverse panel of well-informed surgical educators, pre-specified consensus criteria, transparent reporting of consensus and non-consensus outcomes, and demonstrated stability of responses across Delphi rounds.
		37	Reliability of the results (e.g., split half, inter-rater reliability)	N/A	The reliability of the results is supported by consistent response patterns across rounds, predefined analytic procedures, and minimal change in median scores and agreement levels between Delphi iterations, indicating response stability.
		38	Reflection on potential limitations (e.g., number of experts, response bias)	Page 20	Although participants represented multiple educational roles and subspecialties, recruitment was

Topic	Section	Item	Checklist Item	Location where item is reported	Exemplary wording
					voluntary and purposive, so selection bias and non-response bias remain possible. Different consensus methods such as the nominal group technique[180] were not deemed feasible given the time constraints of surgeons, whose demanding schedules preclude the synchronous participation required for structured group meetings. Attrition between rounds (36 to 20 panellists) may have affected Round 2 estimates of agreement, even though the second-round panel remained drawn from the same stakeholder groups. The study was undertaken within UK general surgery, and transferability to other surgical specialties cannot be assumed; however, given broadly comparable workplace constraints and curricular structures across surgical specialties, the agreed domains may be informative beyond general surgery and should be tested in other contexts. Finally, free-text comments were organised descriptively using the Kirkpatrick framework to support curriculum development rather than to generate an exhaustive qualitative account; this purposeful approach provides utility to surgical educators. However, the qualitative account was not explored for differences by role or subspecialty.

77

6.5Appendix E – Survey study supplementary documents

6.5.1 Survey Participant Information Sheet

Participant Information Sheet

Developing evidence based surgical practice - Investigating Perceptions and Requirements to inform the development of Teaching and Assessment of EBM for trainees in General Surgery

Invitation
You are being invited to take part in a research project. Before you decide to participate, it is essential for you to understand why this research is being undertaken. Please take time to read the following information carefully and discuss it with others if you wish. This project is part of a wider PhD to investigate teaching and training in evidence based surgical practice.

Aims and objectives
This research project aims to investigate knowledge and understanding of Evidence-Based Medicine (EBM), its importance in surgical training, and the needs for support and educational resources among general surgical higher surgical trainees in the UK. The project's objective is to better understand the experiences and perspectives of trainees in evidence-based surgical practice.

Why Have You Been Chosen?
You have been invited to participate in this research project as a higher surgical trainee in general surgery. We aim to recruit a cohort of trainees like yourself to gather diverse perspectives on evidence-based practice in postgraduate general surgical training.

Voluntary Participation
Your participation in this research project is entirely voluntary. You have the freedom to choose whether to participate, and your current and future training will not be affected if you decide not to take part. You can also withdraw from the research project at any time without having to provide a reason. If you wish to withdraw, please contact the researcher directly.

What Will Happen During the Project

Your involvement in the research project will consist of participating in an online survey. The questions will be exploring your understanding, perceptions, and needs related to evidence-based surgical practice. Your responses will be recorded for analysis, but your identity will be kept confidential during the analysis and reporting of findings. Your GMC number will be requested only to confirm genuine participation and avoid response duplication.

Disadvantages and Risks
There are no expected disadvantages or risks associated with participating in this research project. However, please note that any discomfort or concerns you experience during the discussions will be addressed promptly.

Benefits of Participation
Your insights will contribute to improving postgraduate training in evidence-based surgical practice, which can ultimately enhance the quality of patient care.

Confidentiality

All information collected during the research project will be kept strictly confidential and will only be accessible to members of the research team. Your identity will not be disclosed in any reports or publications without your explicit consent.

Data Protection

We will process your personal data in accordance with relevant data protection legislation. The legal basis for processing your data is that it is necessary for the performance of a task carried out in the public interest. For more information, refer to our Privacy Notice https://www.sheffield.ac.uk/govern/data-protection or email dataprotection@sheffield.ac.uk.

Use of Data and Results

Your GMC number will be deleted after the survey responses are collected on University of Sheffield Google Drive prior to data analysis. The rest of the survey responses will be used for analysis, presentation in academic contexts, and possible future research projects. The data will be anonymous and will be stored at the University of Sheffield Google Drive, will not be shared outside the research team. Anonymised data will be kept until the PhD is completed within 5 years.

Funding and Data Controller

This research project does not have external funding and the Data Controller for personal data collected is The University of Sheffield.

Ethical Review

This project has been ethically approved through the University of Sheffield's Ethics Review Procedure.

Complaints and Concerns

If you have any concerns or wish to make a complaint about the research project, please contact Pirashanthie Vivekananda-Schmidt, p.vivekananda-schmidt@sheffield.ac.uk in the first instance. You can also contact the School of Medicine and Population Health Head of Education Professor Michelle Marshall (m.marshall@sheffield.ac.uk), for assistance.

Researcher's Contact

Evri Tokidis
etokidis1@sheffield.ac.uk

Designated Safeguarding Contact

Pirashanthie Vivekananda-Schmidt
p.vivekananda-schmidt@sheffield.ac.uk

Thank you for considering participating in this research project. Your participation is valuable, and your insights will contribute to the advancement of evidence-based surgical practice. If you decide to participate, you will be provided with a copy of this information sheet and, if applicable, a consent form for you to keep.

6.5.1 Survey study consent form

Survey Participant Consent Form

Developing evidence based surgical practice - Investigating Perceptions and Requirements to inform the development of Teaching and Assessment of EBM for trainees in General Surgery.

University Of Sheffield *Ethics Approval Number: TBC Study Number: TBC*
Name of Researcher: Evripidis Tokidis

Supervisors: SP Balasubramanian, PV Schmidt
* Indicates required question

Please provide your GMC number. *
This is only to verify genuine participation and avoid duplicate responses. The GMC numbers will be removed on the data for analysis and not be stored

I have read and understood the survey information sheet dated DD/MM/YYYY (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.) *
Mark only one oval.

Yes No

I understand that by choosing to participate as a volunteer in this research, this does not create a legally binding agreement nor is it intended to create an employment relationship with the University of Sheffield. *
Mark only one oval.

Yes No

I understand that my taking part is voluntary and that I can withdraw from the *study at any time. I do not have to give any reasons for why I no longer want to take part and I understand that my current and future training will not be
affected if I choose to withdraw
Mark only one oval.

Yes No

I understand my personal details such as name and email address will not be *
revealed to people outside the project.
Mark only one oval.

Yes No

I understand and agree that my words may be quoted in publications, reports, *
web pages, and other research outputs. I understand that I will not be identified in these outputs unless I specifically request this.
Mark only one oval.

Yes No

I agree to take part in the project. *
Mark only one oval.

Yes No

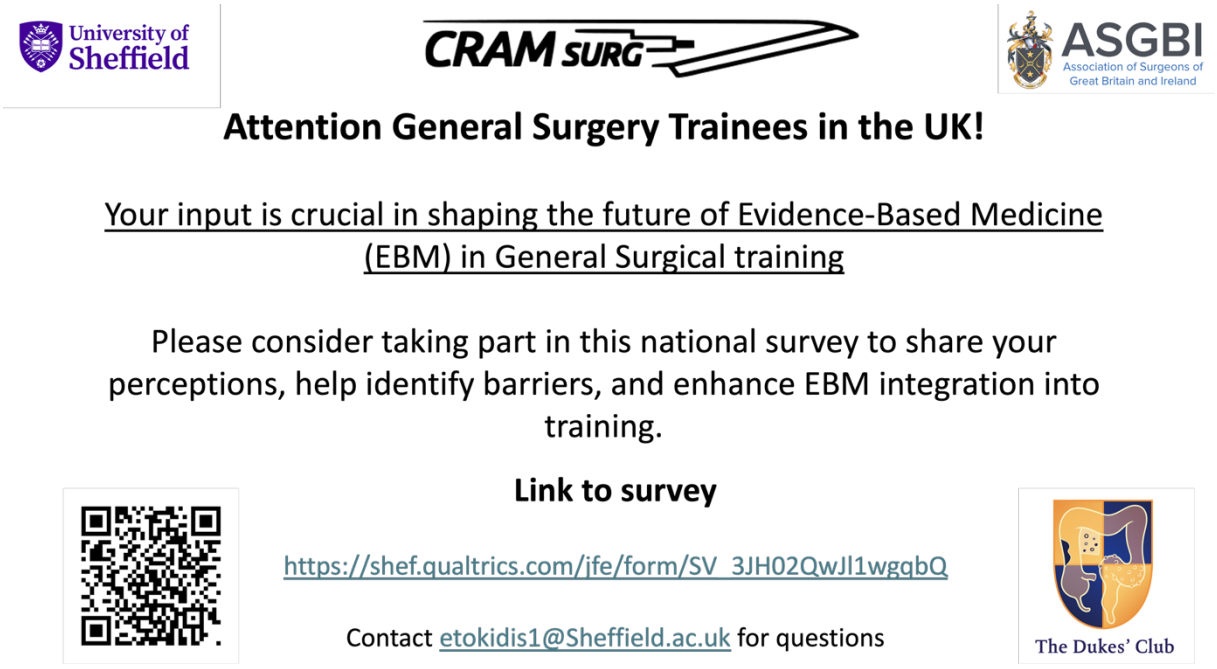
Date *

Example: 7 January 2019

This content is neither created nor endorsed by Google.

Google Forms

6.5.2 Survey invitation



6.5.4 Cherries checklist

This checklist corresponds to the pages of the original manuscript of the survey study as submitted to the Langenbeck's Archives Journal.

Checklist item	Description (this study)	Location in manuscript
Survey design	Cross-sectional survey conducted using the Qualtrics online platform.	Methods, p.2-3
Ethics approval	Approved by the University of Sheffield Research Ethics Committee.	Methods, p.2-3
Informed consent	Participants were provided with detailed study information and gave electronic consent before participation.	Methods, p.2-3
Development and testing	The questionnaire was internally piloted among surgical trainees and academic supervisors to ensure clarity and appropriate timing prior to dissemination.	Methods, p.2-3
Recruitment process	Dissemination was conducted via professional surgical societies, deanery mailing lists, and social media (Twitter). Reminder messages were issued to maximise participation.	Methods, p.2-3

Advertising of the survey	Survey invitations were distributed through national professional networks, including newsletters and online trainee forums.	Methods, p.2-3
Response rate	The estimated overall response rate was 4.8%. Of 101 invitees who accessed the survey, 53 provided complete responses (cooperation rate 52.4%).	Results, p.8
Preventing multiple entries	Qualtrics settings prevented duplicate responses by restricting entries via IP address and browser cookies.	Methods, p.2-3
Incentives	No financial or material incentives were offered to participants.	Methods, p.2-3
Data protection	All responses were anonymised. Data were stored securely on password-protected University of Sheffield servers accessible only to the research team.	Methods, p.2-3
Analysis	Descriptive and non-parametric (Kruskal–Wallis) analyses were performed using Jamovi statistical software.	Methods, p.2-3
Handling of incomplete questionnaires	Only fully completed questionnaires (n = 53) were included in the analysis; incomplete responses were excluded.	Methods, p.2-3
Open and closed questions	The survey included a combination of Likert-scale (closed) and free-text (open) questions to capture quantitative and qualitative insights.	Methods, p.2-3
Statistical correction	No weighting, imputation, or statistical correction was applied owing to the exploratory nature and sample size of the survey. Analyses were performed on complete cases only.	Methods, p.2-3

6.5.5 Survey Tool

EBM survey

Start of Block: Consent block

Evidence-based Medicine competency is considered essential for shared decision making in General Surgery; this is governed by the current training curriculum and is a certification criterion for surgeons who are training to specialise in General Surgery. In the UK, at present, there is no formal EBM educational programme for General Surgical trainees. This survey aims to: 1. To gain an understanding of perceptions and attitudes in relation to EBM amongst General Surgical trainees in the United Kingdom 2. To develop an insight into perceived barriers to achieving EBM competency and practice and potential solutions to address EBM training and integration into surgical training and practice.

Q1.1 Do you currently hold a national training number in the United Kingdom?

- ○ Yes
- ○ No



Q1.2 This is a survey for General Surgery registrars currently working within a training programme; if you wish to provide feedback regarding your experience of EBM training in the UK please do so in the box below or by contacting the researcher on etokidis1@sheffield.ac.uk

_____

Page Break

Q1.3 Please read the participant information sheet

Q1.4

By clicking the button below, you acknowledge the information on the participant information sheet and you agree to proceed with the survey.

- ○ I consent, begin the study
- ○ I do not consent, I do not wish to participate

Page Break

Q1.5 Please enter your GMC number-we will not use this data as a personal identifier. This is only to avoid duplicate responses and responses from non-UK medically registered professionals. These will be destroyed at completion of survey data collection.

_____

End of Block: Consent block

Start of Block: Demographics



Q2.1 My age is...

_____

Page Break

Q2.2 I describe my gender as...

- ○ Female
- ○ Male
- ○ Non-Binary
- ○ Genderfluid
- ○ Intersex
- ○ Prefer to describe
- ○ Prefer not to say

Page Break

Q2.3 My training level is...

- ○ ST3
- ○ ST4
- ○ ST5
- ○ ST6
- ○ ST7
- ○ ST8
- ○ Out of Programme-please specify if OOPT/OOPE/OOPC/OOPR/OOPP
  _____
- ○ Prefer not to say

Page Break

Q2.4 My training region is... (If you are currently Out of Programme, please choose the Deanery you hold a National Training Number in)

- East Midlands
- East of England
- KSS
- London
- Merseyside
- Northern
- Northern Ireland
- North Western
- Oxford
- Severn
- Scotland East
- Scotland North
- Scotland South East
- Scotland West
- South West and Peninsula
- Yorkshire and the Humber
- Wales
- Wessex
- West Midlands
- Prefer not to say

Page Break

*

Q2.5 Have you done (or are you currently undertaking) a postgraduate qualification?

- [ ] MD
- [ ] PhD
- [ ] Other-please specify _____
- [ ] I do not hold any postgraduate qualification

Page Break

Q2.6 I currently work at...

- ○ a District General Hospital
- ○ a Tertiary Centre
- ○ a Quaternary centre
- ○ Prefer to specify _____
- ○ Prefer not to say

End of Block: Demographics

Start of Block: Attitudes to Evidence Based Medicine

Q3.1 Do you welcome EBM practice in your surgical training and place of work?

- ○ Extremely unwelcoming
- ○ Somewhat unwelcoming
- ○ Neutral
- ○ Somewhat welcoming
- ○ Extremely welcoming

Page Break

Q3.2 How do you perceive your fellow trainees' attitude towards EBM?

- ○ Extremely unwelcoming
- ○ Somewhat unwelcoming
- ○ Neutral
- ○ Somewhat welcoming
- ○ Extremely welcoming

Page Break

Q3.3 How do you perceive your consultant colleagues' attitude towards EBM?

- ○ Extremely unwelcoming
- ○ Somewhat unwelcoming
- ○ Neutral
- ○ Somewhat welcoming
- ○ Extremely welcoming

Page Break

Q3.4 Do you agree that practice in EBM improves patient care?

- ○ Completely disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

Page Break

Q3.5 Do you feel EBM is useful in day to day management of general surgical patients?

- ○ Totally useless
- ○ Somewhat useless
- ○ Neutral
- ○ Somewhat useful
- ○ Extremely useful

Page Break

*

Q3.6 Please provide an estimated (0-100) percentage (%) of your current practice that is evidence based

_____

Page Break

Q3.7 Please describe your understanding of the following EBM terms

	It would not be helpful for me to understand	Don't understand but would like to	Some understanding	Understand and could explain to others
Relative risk	○	○	○	○
Absolute Risk	○	○	○	○
Systematic review	○	○	○	○
Odds ratio	○	○	○	○
Meta-analysis	○	○	○	○
Clinical effectiveness	○	○	○	○
Number needed to treat	○	○	○	○
Confidence interval	○	○	○	○
Heterogeneity	○	○	○	○
Publication bias	○	○	○	○

Page Break

Q3.8 Which of the following methods of moving towards Evidence Based Medicine **are you currently using?** (please select all that apply)

- [ ] Learning the skills of evidence based medicine i.e. identify and appraise literature or systematic reviews oneself
- [ ] Seeking and applying evidence based summaries which give the clinical 'bottom line'
- [ ] Using evidence based practice guidelines or protocols developed by colleagues for use by others

Page Break

Q3.9 Which of the following methods of moving towards Evidence Based Medicine **will you be using in the future?** (please select all that apply)

- [ ] Learning the skills of evidence based medicine i.e. identify and appraise literature or systematic reviews oneself
- [ ] Seeking and applying evidence based summaries which give the clinical 'bottom line'
- [ ] Using evidence based practice guidelines or protocols developed by colleagues for use by others

Page Break

Q3.10 Which of the following methods of moving towards Evidence Based Medicine **do you consider most appropriate in General Surgery?** (choose only one answer)

- ○ Learning the skills of evidence based medicine i.e. identify and appraise literature or systematic reviews oneself
- ○ Seeking and applying evidence based summaries which give the clinical 'bottom line'
- ○ Using evidence based practice guidelines or protocols developed by colleagues for use by others

Page Break

Q3.11 Awareness of relevant EBM sources in General Surgery in the United Kingdom

	Unaware	Aware but not used/read	Use and/or read	Used to help in clinical decision making
PubMed or other medical database	○	○	○	○
Cochrane Database of Systematic Reviews	○	○	○	○
High Impact surgery journals	○	○	○	○
Specialty or society guidance	○	○	○	○
Recent editions of surgical textbooks	○	○	○	○

Q3.12 Any other EBM resources you are aware or using?

_____

End of Block: Attitudes to Evidence Based Medicine

Start of Block: Barriers to EBM implementation

Q4.1 To what extent do you perceive the following items as barriers to EBM practice

	No barrier	Minor	Moderate	Major
Lack of time	○	○	○	○
Complex Statistics	○	○	○	○
Lack of critical appraisal skills	○	○	○	○
Lack of good quality evidence	○	○	○	○
Access to EBM resources	○	○	○	○
Lack of investment by health authorities in EBM	○	○	○	○
No financial gain in using evidence based medicine	○	○	○	○
Surgical Dogma	○	○	○	○
Evidence not related to context of clinical practice	○	○	○	○
Too much evidence	○	○	○	○
Availability and access to EBM resources	○	○	○	○
Patients' expectations	○	○	○	○
Patients demanding ineffective treatment	○	○	○	○
The need for lengthy discussions with patients	○	○	○	○

Attitudes of colleagues towards EBM	○	○	○	○

Page Break

Q4.2 Any other barriers you prefer to describe?

_____

End of Block: Barriers to EBM implementation

Start of Block: Current EBM training in General Surgery in the United Kingdom

Q5.1 To what extent do you agree with the following statement?

	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
I have had formal EBM training PRIOR to becoming a registrar on how to interpret evidence for my own practice	○	○	○	○	○

Q5.2 To what extent do you agree with the following statement?

	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
I have had formal EBM training AFTER becoming a registrar on how to interpret evidence for my own practice	○	○	○	○	○

Q5.3 Do you get any ***ongoing teaching or training*** in EBM in your current training programme?

- ○ Yes
- ○ No
- ○ Unsure

Page Break

*

Q5.4 If this is the case, how is EBM currently taught in your training programme?

- [ ] Embedded into regional teaching
- [ ] Deanery Workshops and/or courses
- [ ] Journal Clubs
- [ ] Ad-hoc lectures
- [ ] Prefer to describe _____
- [ ] None of the above

Page Break



Q5.5 Any suggestions of how training in EBM can be facilitated in current general surgical training?

_____

Page Break

Q5.6 Were you aware of the need to be assessed in your competence in EBM in order to complete your training?

- ○ Yes
- ○ No
- ○ Unsure

Page Break

Q5.7 What do you feel is the most appropriate way of assessing EBM? (can select more than one option)

- [ ] Annual Review of Competence Progression (ARCP)
- [ ] Fellowship of the Royal College of Surgeons (FRCS) exam
- [ ] Higher degree completion
- [ ] Publication in peer-reviewed journal
- [ ] ISCP portfolio assessment
- [ ] Audit
- [ ] Informal assessment
- [ ] Prefer not to say

Page Break

Q5.8 Any suggestions of the assessment of EBM competence in current general surgical training?

_____

End of Block: Current EBM training in General Surgery in the United Kingdom

6.7 Approvals for PhD studies

6.7.1 Ethics approvals



Downloaded: 23/03/2026
Approved: 20/11/2023

Evripidis Tokidis
Registration number: 230149526
Medical School [Archived]
Programme: Medical Education

Dear Evripidis

PROJECT TITLE: Developing evidence based surgical practice - Investigating Perceptions and Requirements to inform the development of Teaching and Assessment of EBM for trainees in General Surgery
APPLICATION: Reference Number 056808

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 20/11/2023 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 056808 (form submission date: 15/11/2023); (expected project end date: 10/10/2024).
- Participant information sheet 1127927 version 8 (13/11/2023).
- Participant information sheet 1128243 version 5 (07/11/2023).
- Participant information sheet 1129512 version 3 (15/11/2023).
- Participant information sheet 1129513 version 3 (15/11/2023).
- Participant information sheet 1129514 version 3 (15/11/2023).
- Participant consent form 1128241 version 4 (13/11/2023).
- Participant consent form 1128760 version 4 (13/11/2023).
- Participant consent form 1129515 version 2 (13/11/2023).

The following amendments to this application have been approved:

- Amendment approved: 06/06/2024
  - Survey_PIS_minor_changes.docx

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Your responsibilities in delivering this research project are set out at the end of this letter.

Yours sincerely

Cecilia Biolchini
Ethics Admin
Medical School [Archived]

Please note the following responsibilities of the researcher in delivering the research project:

- The project must abide by the University's Research Ethics Policy: https://www.sheffield.ac.uk/research-services/ethics-integrity/policy
- The project must abide by the University's Good Research & Innovation Practices Policy: https://www.sheffield.ac.uk/polopoly_fs/1.671066!/file/GRIPPolicy.pdf
- The researcher must inform their supervisor (in the case of a student) or Ethics Admin (in the case of a member of staff) of any significant changes to the project or the approved documentation.
- The researcher must comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data.
- The researcher is responsible for effectively managing the data collected both during and after the end of the project in line with best practice, and any relevant legislative, regulatory or contractual requirements.

The University Of Sheffield.

Downloaded: 23/03/2026
Approved: 28/01/2025

Evripidis Tokidis
Registration number: 230149526
School of Medicine and Population Health
Programme: Medical Education

Dear Evripidis

PROJECT TITLE: Integrating Evidence-based Medicine in the General Surgery curriculum; A modified Delphi study
APPLICATION: Reference Number 065891

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 28/01/2025 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 065891 (form submission date: 13/01/2025); (expected project end date: 01/09/2025).
- Participant information sheet 1147838 version 2 (06/01/2025).
- Participant consent form 1147839 version 1 (17/12/2024).

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Your responsibilities in delivering this research project are set out at the end of this letter.

Yours sincerely

Sarah Jackson
Ethics Admin
School of Medicine and Population Health

Please note the following responsibilities of the researcher in delivering the research project:

- The project must abide by the University's Research Ethics Policy: https://www.sheffield.ac.uk/research-services/ethics-integrity/policy
- The project must abide by the University's Good Research & Innovation Practices Policy: https://www.sheffield.ac.uk/polopoly_fs/1.671066!/file/GRIPPolicy.pdf
- The researcher must inform their supervisor (in the case of a student) or Ethics Admin (in the case of a member of staff) of any significant changes to the project or the approved documentation.
- The researcher must comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data.
- The researcher is responsible for effectively managing the data collected both during and after the end of the project in line with best practice, and any relevant legislative, regulatory or contractual requirements.

6.7.2 Co-author approvals

Permission to use all co authored manuscripts for your doctoral thesis



Pirashanthie Vivekananda-Schmidt <p.viv... Tuesday, 17 March 2026 at 14:18

To: Evripidis Tokidis; **Cc:** Sabapathy Balasubramanian

Dear Evri,

I provide permission to use the manuscripts I have co-authored with you for your thesis titled " Evidence-based Medicine in General Surgical Postgraduate Training".

With best wishes Pirashanthie (She/Her)
****
Pirashanthie Vivekananda-Schmidt
Professor of Medical Education
MBChB Professionalism & Patient Safety Theme Lead
Deputy Head of Section (Medical Education)
A World Top 100 University
Independent Thinking. Shared Ambition; Sheffield Research Roundup

permission

GP

Giordano Perin <giordanoperin87@gmail.... Saturday, 21 March 2026 at 10:03

To: Evripidis Tokidis

00001665-2025030... 170.8 KB | 1-s2.0-S193172042... 363 KB | +4 more

Download All • Preview All

Dear Evri,

I provide permission to use the scoping review manuscript I have co-authored with you for your thesis titled " Evidence-based Medicine in General Surgical Postgraduate Training".

Furthermore please find attached the papers I retrieved from the list you sent me.

Kind regards,
--
Giordano Perin
giordanoperin87@gmail.com

Re: Permissions to include publications in the thesis

BS

BALASUBRAMANIAN, Sabapathy (SHEFFI... Tuesday, 17 March 2026 at 14:12

To: Evripidis Tokidis; Pirashanthie Vivekananda-Schmidt

Fine no problem

Best wishes
Saba P Balasubramanian
Endocrine Surgeon and Clinical Director, Directorate of General Surgery
Honorary Professor, University of Sheffield

From: Evripidis Tokidis <etokidis1@sheffield.ac.uk>
Sent: Tuesday, March 17, 2026 2:07 PM
To: BALASUBRAMANIAN, Sabapathy (SHEFFIELD TEACHING HOSPITALS NHS FOUNDATION TRUST) <sabapathy.balasubramanian@nhs.net>; Pirashanthie Vivekananda-Schmidt <p.vivekananda-schmidt@sheffield.ac.uk>
Subject: Permissions to include publications in the thesis

This message originated from outside of NHS.net Connect. Please do not click links or open attachments unless you recognise the sender and know the content is safe.

Dear Saba and Pirashanthie,

can I have a written line from both of you saying:

Dear Evri, I provide permission to use the manuscripts I have co-authored with you for your thesis titled " Evidence-based Medicine in General Surgical Postgraduate Training".

This is for the appendices of the thesis; looks like other people have done it and were asked for corrections because they hadn't done it.

I have got all the licence documents from the journals to add on as well.

Kind regards,

6.7.3 CC-BY-Licenses

Scoping review



World Journal of Surgery

SCIENTIFIC REVIEW | Open Access

Evidence-Based Medicine Within Surgical Practice and Training: A Scoping Review

E. Tokidis, G. Perin, P. Vivekananda-Schmidt, S. P. Balasubramanian

First published: 04 February 2025 | https://doi-org.sheffield.idm.oclc.org/10.1002/wjs.12479 |

VIEW METRICS

Funding: We declare that we received no sources of funding for this work. The lead author is currently a Clinical Research Fellow, self-funding his PhD.

SECTIONS PDF CITE TOOLS SHARE

ABSTRACT

Background

Evidence-based medicine (EBM) is a fundamental element of modern surgical practice. However, its integration into surgical training remains challenging. Through a scoping review, this study mapped existing evidence on the practice of EBM in surgery, focusing on knowledge, attitudes, barriers, and curricula.

Methods

The literature was systematically searched through 3 databases and 2 registers. Fifty articles published over a 22-year period (2001–2023) were identified based on predefined eligibility criteria. These were reviewed using Arksey and O'Malley's methodological

Volume 49, Issue 4
April 2025
Pages 916-929

Figures References Related Information

Details

© 2025 The Author(s). *World Journal of Surgery* published by John Wiley & Sons Ltd on behalf of International Society of Surgery/Société Internationale de Chirurgie (ISS/SIC).

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

Keywords

evidence-based medicine
post-graduate education
resident education
surgery
surgical education

Publication History

Focus Group Discussions Study



CCC RightsLink

A Focus Group Discussion Study Exploring General Surgery Trainees' Views on Evidence-Based Medicine Within Their Training Program in the United Kingdom

Author: Evripidis Tokidis,Pirashanthie Vivekananda-Schmidt,Saba P. Balasubramanian
Publication: Journal of Surgical Education
Publisher: Elsevier
Date: January 2025

© 2024 The Author(s). Published by Elsevier Inc. on behalf of Association of Program Directors in Surgery.

Creative Commons

This is an open access article distributed under the terms of the Creative Commons CC-BY license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

You are not required to obtain permission to reuse this article.

© 2026 Copyright - All Rights Reserved | Copyright Clearance Center, Inc. | Privacy statement | Data Security and Privacy | For California Residents | Terms and Conditions
Comments? We would like to hear from you. E-mail us at customercare@copyright.com

Survey Study

Licence to Publish - Open Access

SPRINGER NATURE

Licensee:	Springer-Verlag GmbH, DE	(the 'Licensee')
Journal Name:	Langenbeck's Archives of Surgery	(the 'Journal')
Manuscript Number:	cdac9a22-b1ef-4c09-8a25-ba7833ab3cd4	
Proposed Title of Article:	Evidence-based medicine training in general surgery in the United Kingdom: an exploratory snapshot survey study	(the 'Article')
Author(s) [Please list all named Authors]:	Evripidis Tokidis, Saba P. Balasubramanian, Pirashanthie Vivekananda-Schmidt	(the 'Author')
Corresponding Author Name:	Evripidis Tokidis	

Licence Applicable to the Article:

Creative Commons licence CC BY: This licence permits use, duplication, adaptation, distribution and reproduction in any medium or format, as long as appropriate credit is given to the original author(s) and the source, a link is provided to the Creative Commons licence, and any changes made are indicated. Please read the full licence for further details at - http://creativecommons.org/licenses/by/4.0/

Subject to editorial acceptance of the Article, it will be published under the Creative Commons licence shown above.

Grant of Rights

a) For good and valuable consideration, the Author hereby grants to the Licensee the perpetual, non-exclusive, irrevocable, world-wide, assignable, sublicensable and unlimited right to: publish, reproduce, copy, distribute, communicate, display publicly, sell, rent and/ or otherwise make available the article identified above, including any supplementary information and graphic elements therein (e.g. illustrations, charts, moving images) (the "Article") in any language, in any versions or editions in any and all forms and/or media of expression (including without limitation in connection with any and all end-user devices), whether now known or developed in the future. Without limitation, the above grant includes: (i) the right to edit, alter, adapt, adjust and prepare derivative works; (ii) all commercial use, advertising, and marketing rights, including without limitation graphic elements on the cover of the journal and in relation to social media; (iii) rights for any training, educational and/or instructional purposes; (iv) the right to add and/or remove links or combinations with other media/works; and (v) the right to create, use and/or license and/or sublicense content data or metadata of any kind in relation to the Article (including abstracts and summaries) without restriction. The above rights are granted in relation to the Article as a whole or any part and with or in relation to any other works.

b) Without limiting the rights granted above, Licensee is granted the rights to use the Article for the purposes of analysis, testing, and development of publishing- and research-related workflows, systems, products, projects, and services; to confidentially share the Article with select third parties to do the same; and to retain and store the Article and any associated correspondence/files/forms to maintain the historical record, and to facilitate research integrity investigations. The grant of rights set forth in this clause (b) is irrevocable.

c) The Licensee will have the right, but not the obligation, to exercise any or all of the rights granted herein. If the Licensee elects not to publish the Article for any reason, all publishing rights under this Agreement as set forth in clause 1.a) above will revert to the Author.

Copyright

Ownership of copyright in the Article will be vested in the name of the Author. When reproducing the Article or extracts from it, the Author will acknowledge and reference first publication in the Journal.

Use of Article Versions

d) For purposes of this Agreement: (i) references to the "Article" include all versions of the Article; (ii) "Submitted Manuscript" means the version of the Article as first submitted by the Author; (iii) "Accepted Manuscript" means the version of the Article accepted for publication, but prior to copy-editing and typesetting; and (iv) "Version of Record" means the version of the Article published by the Licensee, after copy-editing and typesetting. Rights to all versions of the Manuscript are granted on a non-exclusive basis.

e) The Author may make the Submitted Manuscript available at any time and under any terms (including, but not limited to, under a CC BY licence), at the Author's discretion. Once the Article has been published, the Author will include an acknowledgement and provide a link to the Version of Record on the publisher's website: "This preprint has not undergone peer review (when applicable) or any post-submission improvements or corrections. The Version of Record of this article is published in [insert journal title], and is available online at https://doi.org/[insert DOI]".

f) Immediately after acceptance the Author may deposit the Accepted Manuscript to any location, and under any terms (including, but not limited to, under a CC BY licence), provided it is not made publicly available until after publication. The Author will include an acknowledgement in the Accepted Manuscript, together with a link to the Version of Record on the publisher's website: "This version of the article has been accepted for publication, after peer review (when applicable) but is not the Version of Record and does not reflect post-acceptance improvements, or any corrections. The Version of Record is available online at: http://dx.doi.org/[insert DOI]".

2. **Warranties & Representations** Author

warrants and represents that: a)

i. the Author is the sole copyright owner or has been authorised by any additional copyright owner(s) to grant the rights defined in clause 1,

ii. the Article does not infringe any intellectual property rights (including without limitation copyright, database rights or trade mark rights) or other third party rights and no licence from or payments to a third party are required to publish the Article,

iii. the Article has not been previously published, nor has the Author committed to licensing any version of the Article under a licence inconsistent with the terms of this Agreement,

iv. if the Article contains materials from other sources (e.g. illustrations, tables, text quotations), Author has obtained written permissions to the extent necessary from the copyright holder(s), to license to the Licensee the same rights as set out in clause 1 and has cited any such materials correctly;

b) all of the facts contained in the Article are according to the current body of research true and accurate;

c) nothing in the Article is obscene, defamatory, violates any right of privacy or publicity, infringes any other human, personal or other rights of any person or entity or is otherwise unlawful and that informed consent to publish has been obtained for any research participants;

d) nothing in the Article infringes any duty of confidentiality owed to any third party or violates any contract, express or implied, of the Author;

e) all institutional, governmental, and/or other approvals which may be required in connection with the research reflected in the Article have been obtained and continue in effect;

f) all statements and declarations made by the Author in connection with the Article are true and correct; and

g) the signatory who has signed this agreement has full right, power and authority to enter into this agreement on behalf of all of the Authors.

Cooperation

a) The Author will cooperate fully with the Licensee in relation to any legal action that might arise from the publication of the Article, and the Author will give the Licensee access at reasonable times to any relevant accounts, documents and records within the power or control of the Author. The Author agrees that any Licensee affiliate through which the Licensee exercises any rights or performs any obligations under this Agreement is intended to have the benefit of and will have the right to enforce the terms of this Agreement.

b) Author authorises the Licensee to take such steps as it considers necessary at its own expense in the Author's name(s) and on their behalf if the Licensee believes that a third party is infringing or is likely to infringe copyright in the Article including but not limited to initiating legal proceedings.

Author List

Changes of authorship, including, but not limited to, changes in the corresponding author or the sequence of authors, are not permitted after acceptance of a manuscript.

Post Publication Actions

The Author agrees that the Licensee may remove or retract the Article or publish a correction or other notice in relation to the Article if the Licensee determines that such actions are appropriate from an editorial, research integrity, or legal perspective.

Controlling Terms

The terms of this Agreement will supersede any other inconsistent terms that the Author or any third party may assert apply to any version of the Article.

This Agreement will be governed by, and construed in accordance with, the laws of the Federal Republic of Germany. The courts of Berlin, Germany will have exclusive jurisdiction.

Signed for and on behalf of the Author(s)
Corresponding Author: Evripidis Tokidis Email:
etokidis1@sheffield.ac.uk
IP Address: 82.36.58.193

Time Stamp: 2025-12-12 10:28:43

Springer-Verlag GmbH, DE, Heidelberger Platz 3, 14197 Berlin, Germany
v.4.2.2 - (10_2025)-SVGmbH DE

References

1. Sackett DL; R William; Gray, Jam; Haynes, Richard; Richardson, WS. Evidence based medicine: what it is and what it isn't. BMJ. 1996;312(7023):71–2. doi:10.1136/bmj.312.7023.71

2. Dawes MS William Less; Glasziou, Paul; Cartabellotta, Antonino; Martin, Janet; Hopayian, Kevork; Porzsolt, Franz; Burls, Amanda; Osborne, James. Sicily statement on evidence-based practice. BMC Med Educ. 2005;5(1):1–7. doi:10.1186/1472-6920-5-1

3. Haynes RBD Philip J; Guyatt, Gordon H. Clinical expertise in the era of evidence-based medicine and patient choice. ACP J Club. 2002;136(2):36–8.

4. Albarqouni LH Tammy; Straus, Sharon E; Olsen, Nina Rydland; Young, Taryn; Ilic, Dragan; Shaneyfelt, Terrence M; Haynes, R Brian; Guyatt, Gordon H; Glasziou, Paul. Core Competencies in Evidence-Based Practice for Health Professionals: Consensus Statement Based on a Systematic Review and Delphi Survey. JAMA Netw Open. 2018;1(2):e180281-NA. doi:10.1001/jamanetworkopen.2018.0281

5. Good medical practice [Internet]. [cited 2026 Mar 24]. Available from: https://www.gmc-uk.org/professional-standards/the-professional-standards/good-medical-practice

6. Nass SJ, Levit LA, Gostin LO, Institute of Medicine (U.S.), editors. Beyond the HIPAA privacy rule: enhancing privacy, improving health through research. Washington, D.C: National Academies Press; 2009. 320 p.

7. Cruz Rivera S, Kyte DG, Aiyegbusi OL, Keeley TJ, Calvert MJ. Assessing the impact of healthcare research: A systematic review of methodological frameworks. PLoS Med. 2017 Aug;14(8):e1002370. doi:10.1371/journal.pmed.1002370 PubMed PMID: 28792957; PubMed Central PMCID: PMC5549933.

8. Penfield T, Baker MJ, Scoble R, Wykes MC. Assessment, evaluations, and definitions of research impact: A review. Res Eval. 2014 Jan 1;23(1):21–32. doi:10.1093/reseval/rvt021

9. Meshikhes AWN. Evidence-based surgery: The obstacles and solutions. Int J Surg Lond Engl. 2015;18:159–62. doi:10.1016/j.ijsu.2015.04.071

10. Den Dulk M, Poston GJ, Van De Velde CJH. Challenges and opportunities for surgical trials, the role of quality assurance. Eur J Cancer. 2013 Sep;2):S18. Located at: Embase; 71216873. doi:10.1016/S0959-8049%2813%2970059-5

11. Gutierrez-Castrellon P. Current challenges on the generation and dissemination of scientific evidence in health and how to translate it to health decision making. Los Retos Actuales En Generacion Difusion Evid Cient En Salud Su Impacto Efic

En Toma Decis Hacia Poblacion. 2020;88(3):247–8. Located at: Ovid MEDLINE(R) <2020>. doi:10.24875/CIRU.M20000064

12. Vaos G, Dimopoulou A, Zavras N. A Review of History and Challenges of Evidence-Based Pediatric Surgery. J Investig Surg Off J Acad Surg Res. 2022;35(4):821–32. Located at: Ovid MEDLINE(R) <2022>. doi:10.1080/08941939.2021.1950875

13. Farrokhyar FK Paul J; Thoma, Achilleas; Simunovic, Marko; Bhandari, Mohit; Devereaux, Philip J; Anvari, Mehran; Adili, Anthony; Guyatt, Gordon H. Randomized Controlled Trials of Surgical Interventions. Ann Surg. 2010;251(3):409–16. doi:10.1097/sla.0b013e3181cf863d

14. Slim K. Limits of Evidence-based Surgery. World J Surg. 2005;29(5):606–9. doi:10.1007/s00268-005-7922-x

15. Solomon MJ; M Robin S. Clinical studies in surgical journals—have we improved? Dis Colon Rectum. 1993;36(1):43–8. doi:10.1007/bf02050300

16. Wente MN; S Christoph M; Uhl, Waldemar; Büchler, Markus W. Perspectives of Evidence-Based Surgery. Dig Surg. 2003;20(4):263–9. doi:10.1159/000071183

17. The Evolving Relationship between Surgery and Medicine. AMA J Ethics. 2010 Feb 1;12(2):119–23. doi:10.1001/virtualmentor.2010.12.2.mhst1-1002

18. Slim KP Yves; Chipponi, Jacques. Half of the current practice of gastrointestinal surgery is against the evidence: a survey of the French society of digestive surgery. J Gastrointest Surg Off J Soc Surg Aliment Tract. 2004;8(8):1079–82. doi:10.1016/j.gassur.2004.02.013

19. Ward JG Melina; Solomon, Michael J. Management of Patients With Colorectal Cancer: Do Australian Surgeons Know the Scientific Evidence? Arch Surg Chic Ill 1960. 2002;137(12):1389–94. doi:10.1001/archsurg.137.12.1389

20. Halalau A, Holmes B, Rogers-Snyr A, Donisan T, Nielsen E, Cerqueira TL, et al. Evidence-based medicine curricula and barriers for physicians in training: a scoping review. Int J Med Educ. 2021 May 28;12:101–24. doi:10.5116/ijme.6097.ccc0

21. Husnoo N, Johnston J, Harikrishnan A. Incorporation of Evidence-Based Surgery into the Curriculum. Indian J Surg. 2022 Apr;84(S1):31–4. doi:10.1007/s12262-021-03038-z

22. Maggio LA. Educating physicians in evidence based medicine: current practices and curricular strategies. Perspect Med Educ. 2016 Oct 25;5(6):358–61. doi:10.1007/S40037-016-0301-5

23. Catto JWF, Blazeby JM, Holmberg L, Hamdy FC, Brown J. In Defense of Randomized Clinical Trials in Surgery: Let Us Not Forget Archie Cochrane's

Legacy. Eur Urol. 2017;Comment on: Eur Urol. 2017 May;71(5):811-819 PMID: 27914898 [https://www.ncbi.nlm.nih.gov/pubmed/27914898]71(5):820–1. Located at: Ovid MEDLINE(R) <2017>. doi:10.1016/j.eururo.2016.12.029

24. Elisa Knebel, Ann C. Greine. Health Professions Education: A Bridge to Quality (Quality chasm series). National Academies Press; 2003.

25. Generic-professional-capabilities-framework--2109_pdf-70417127.pdf.

26. Ramos KDS Sean; Tracz, Susan M. Validation of the Fresno test of competence in evidence based medicine. BMJ. 2003;326(7384):319–21. doi:10.1136/bmj.326.7384.319

27. Fritsche LG Trisha; Falck Ytter, Yngve; Hh, Neumayer; Kunz, Regina. Do short courses in evidence based medicine improve knowledge and skills? Validation of Berlin questionnaire and before and after study of courses in evidence based medicine. BMJ. 2002;325(7376):1338–41. doi:10.1136/bmj.325.7376.1338

28. MacRae HR Glenn; Brenneman, Fred; McKenzie, Marg; McLeod, Robin S. Assessment of critical appraisal skills. Am J Surg. 2004;187(1):120–3. doi:10.1016/j.amjsurg.2002.12.006

29. Ilic DBN Rusli; Glasziou, Paul; Tilson, Julie K; Villanueva, Elmer Virgil. Development and validation of the ACE tool: assessing medical trainees' competency in evidence based medicine. BMC Med Educ. 2014;14(1):114–114. doi:10.1186/1472-6920-14-114

30. Taylor RSR Barnaby C; Mears, Rebecca; Keast, John; Binns, Sarah; Ewings, Paul; Khan, Khalid S. Development and validation of a questionnaire to evaluate the effectiveness of evidence-based practice teaching. Med Educ. 2001;35(6):544–7. doi:10.1046/j.1365-2923.2001.00916.x

31. Kumaravel BH Jasmine Heath; Jahangiri, Leila; Pollard, Rachel; Stocker, Claire J; Nunan, David. A systematic review and taxonomy of tools for evaluating evidence-based medicine teaching in medical education. Syst Rev. 2020;9(1):91–91. doi:10.1186/s13643-020-01311-y

32. Larsen CM, Terkelsen AS, Carlsen AMF, Kristensen HK. Methods for teaching evidence-based practice: a scoping review. BMC Med Educ. 2019 Dec;19(1):259. doi:10.1186/s12909-019-1681-0

33. Kortekaas MF, Bartelink MLEL, de Groot E, Korving H, de Wit NJ, Grobbee DE, et al. The Utrecht questionnaire (U-CEP) measuring knowledge on clinical epidemiology proved to be valid. J Clin Epidemiol. 2017 Feb;82:119–27. doi:10.1016/j.jclinepi.2016.08.009

34. MacRae HM, Regehr G, Brenneman F, McKenzie M, McLeod RS. Assessment of critical appraisal skills. Am J Surg. 2004 Jan;187(1):120–3. doi:10.1016/j.amjsurg.2002.12.006

35. Tilson JK; K Sandra L; Harris, Janet; Hutchinson, Andy; Ilic, Dragan; Niederman, Richard; Potomková, Jarmila; Zwolsman, Sandra E. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med Educ. 2011;11(1):78–78. doi:10.1186/1472-6920-11-78

36. Lund J. The new General Surgical Curriculum and ISCP. Surg Oxf. 2020 Oct;38(10):601–6. doi:10.1016/j.mpsur.2020.07.005

37. Meats EH Carl; Crilly, Michael A; Glasziou, Paul. Evidence-based medicine teaching in UK medical schools. Med Teach. 2009;31(4):332–7. doi:10.1080/01421590802572791

38. Ilic DM Stephen. Methods of teaching medical trainees evidence-based medicine: a systematic review. Med Educ. 2014;48(2):124–35. doi:10.1111/medu.12288

39. General Medical Council. Good Medical Practice. General Medical Council.

40. Coomarasamy AK Khalid S. What is the evidence that postgraduate teaching in evidence based medicine changes anything? A systematic review. BMJ. 2004;329(7473):1017–1017. doi:10.1136/bmj.329.7473.1017

41. Ilic D. Assessing competency in Evidence Based Practice: strengths and limitations of current tools in practice. BMC Med Educ. 2009;9(1):53–53. doi:10.1186/1472-6920-9-53

42. Guyatt GH; R Drummond; Meade, Maureen O; Cook, Deborah J. Users' guides to the medical literature : a manual for evidence-based clinical practice. NA. 2002. NA.

43. Antonoff MB; S Jennifer A; Green, Courtney A; Mann, Barry D; Maddaus, Michael A; D'Cunha, Jonathan. The significant impact of a competency-based preparatory course for senior medical students entering surgical residency. Acad Med J Assoc Am Med Coll. 2012;87(3):308–19. doi:10.1097/acm.0b013e318244bc71

44. Zhang QZ Tie ying; Chen, Ying; Li, Xiaopan. Assisting undergraduate nursing students to learn evidence-based practice through self-directed learning and workshop strategies during clinical practicum. Nurse Educ Today. 2011;32(5):570–5. doi:10.1016/j.nedt.2011.05.018

45. Ahmadi NM Margaret E; MacLean, Anthony; Brown, Carl J; Mastracci, Tara M; McLeod, Robin S. Teaching evidence based medicine to surgery residents-is journal club the best format? A systematic review of the literature. J Surg Educ. 2011;69(1):91–100. doi:10.1016/j.jsurg.2011.07.004

46. Young TR Anke; Volmink, Jimmy; Clarke, Mike. What Are the Effects of Teaching Evidence-Based Health Care (EBHC)? Overview of Systematic Reviews. PloS One. 2014;9(1):e86706-NA. doi:10.1371/journal.pone.0086706

47. Maggio LA; C Olle ten; Chen, H Carrie; Irby, David M; O'Brien, Bridget C. Challenges to Learning Evidence-Based Medicine and Educational Approaches to Meet These Challenges: A Qualitative Study of Selected EBM Curricula in U.S. and Canadian Medical Schools. Acad Med J Assoc Am Med Coll. 2016;91(1):101–6. doi:10.1097/acm.0000000000000814

48. Bhandari M, Montori V, Devereaux PJ, Dosanjh S, Sprague S, Guyatt GH. Challenges to the Practice of Evidence-Based Medicine during Residents' Surgical Training: A Qualitative Study Using Grounded Theory: Acad Med. 2003 Nov;78(11):1183–90. doi:10.1097/00001888-200311000-00022

49. Trickey AW; C Moira E; Singh, Monika; Dort, Jonathan. An Evidence-Based Medicine Curriculum Improves General Surgery Residents' Standardized Test Scores in Research and Statistics. J Grad Med Educ. 2014;6(4):664–8. doi:10.4300/jgme-d-14-00117

50. Luton O, James OP, Mellor K, Powell A, Hopkins L, Robinson DBT, et al. Surgical curriculum concordance: requiem for the educational dream. Postgrad Med J. 2022 Jun 1;98(1160):411–4. doi:10.1136/postgradmedj-2020-139385

51. Farrell I, Duff S. Research requirements for CCT across the surgical specialties: why the difference? Bull R Coll Surg Engl. 2020 Sep;102(S1):39–42. doi:10.1308/rcsbull.TB2020.11

52. Intercollegiate Surgical Curriculum Programme. ISCP [Internet]. United Kingdom. Available from: https://www.iscp.ac.uk

53. Post Graduate Medical Education, UK. The Gold Guide 9th Edition [Internet]. Available from: https://pgme.info/wp-content/uploads/2022/08/Gold-Guide-9th-Edition-August-2022.pdf

54. MacRae HM, Regehr G, McKenzie M, Henteleff H, Taylor M, Barkun J, et al. Teaching practicing surgeons critical appraisal skills with an Internet-based journal club: a randomized, controlled trial. Surgery. 2004 Sep;136(3):641–6. doi:10.1016/j.surg.2004.02.003

55. Perin G, Tokidis E, Digby M, O'Connor-Manson M, Balasubramanian S. CRAMsurg: Teaching Evidence Based Practice Through a VCoP Model. Clin Teach. 2026;23(2):e70391. doi:10.1111/tct.70391

56. NELA Project Team [Internet]. Available from: https://www.nela.org.uk

57. National Bowel Cancer Audit [Internet]. Available from: https://www.nboca.org.uk

58. Ali T, Al Shakarchi J, Dewan V, Hussain K. The importance of evidence-based surgery, surgical protocols and research methodologies. J Surg Protoc Res Methodol. 2021 Sep 1;2021(1):snab003. doi:10.1093/jsprm/snab003

59. Gollins SM Brendan; Adams, Richard; Cunningham, Christopher M; Bach, Simon P; Myint, Arthur Sun; Renehan, Andrew G; Karandikar, Sharad; Goh, Vicky; Prezzi, Davide; Langman, Gerald; Ahmedzai, Sam H; Geh, Ian. Association of Coloproctology of Great Britain & Ireland (ACPGBI): Guidelines for the Management of Cancer of the Colon, Rectum and Anus (2017) - Multidisciplinary Management. Colorectal Dis Off J Assoc Coloproctology G B Irel. 2017;19(1):18–36. doi:10.1111/codi.13704

60. Tokidis E, Perin G, Vivekananda-Schmidt P, Balasubramanian SP. Evidence-Based Medicine Within Surgical Practice and Training: A Scoping Review. World J Surg. 2025 Feb 4;wjs.12479. doi:10.1002/wjs.12479

61. Constructivism - an overview | ScienceDirect Topics [Internet]. [cited 2025 Feb 21]. Available from: https://www-sciencedirect-com.sheffield.idm.oclc.org/topics/social-sciences/constructivism

62. Vygotsky LS. Mind in Society: Development of Higher Psychological Processes [Internet]. Harvard University Press; 1978 [cited 2026 Mar 31]. Available from: https://www.jstor.org/stable/j.ctvjf9vz4 doi:10.2307/j.ctvjf9vz4

63. Creswell JW, Plano Clark VL. Designing and conducting mixed methods research. Third edition, international student edition. Los Angeles London New Delhi Singapore Washington DC Melbourne: Sage; 2018. 492 p.

64. Foster C. Methodological pragmatism in educational research: from qualitative-quantitative to exploratory-confirmatory distinctions. Int J Res Method Educ. 2024 Jan 1;47(1):4–19. doi:10.1080/1743727X.2023.2210063

65. Park YS, Konge L, Artino ARJ. The Positivism Paradigm of Research. Acad Med. 2020 May;95(5):690. doi:10.1097/ACM.0000000000003093

66. Ryan G. Introduction to positivism, interpretivism and critical theory. Nurse Res. 2018 Mar 16;25(4):14–20. doi:10.7748/nr.2018.e1466 PubMed PMID: 29546962.

67. Bleakley A, Bligh J, Browne J. Medical Education for the Future: Identity, Power and Location [Internet]. Vol. 1. Dordrecht: Springer Netherlands; 2011 [cited 2026 Mar 31]. (Advances in Medical Education). Available from: https://link.springer.com/10.1007/978-90-481-9692-0 doi:10.1007/978-90-481-9692-0

68. Arksey HO Lisa. Scoping studies: towards a methodological framework. Int J Soc Res Methodol. 2005;8(1):19–32. doi:10.1080/1364557032000119616

69. Munn ZP Micah D J; Stern, Cindy; Tufanaru, Catalin; McArthur, Alexa; Aromataris, Edoardo. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Med Res Methodol. 2018;18(1):1–7. doi:10.1186/s12874-018-0611-x

70. Ogden K, Kilpatrick S, Elmer S. Examining the nexus between medical education and complexity: a systematic review to inform practice and research. BMC Med Educ. 2023 Dec;23(1):1. doi:10.1186/s12909-023-04471-2

71. Goodman MS, Sanders Thompson VL. The science of stakeholder engagement in research: classification, implementation, and evaluation. Transl Behav Med. 2017 Sep;7(3):486–91. doi:10.1007/s13142-017-0495-z PubMed PMID: 28397159; PubMed Central PMCID: PMC5645283.

72. O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. BMJ. 2010 Sep 17;341:c4587. doi:10.1136/bmj.c4587 PubMed PMID: 20851841.

73. Cornish F, Breton N, Moreno-Tabarez U, Delgado J, Rua M, de-Graft Aikins A, et al. Participatory action research. Nat Rev Methods Primer. 2023 Apr 27;3(1):34. doi:10.1038/s43586-023-00214-1

74. Stalmeijer RE, McNaughton N, Van Mook WNKA. Using focus groups in medical education research: AMEE Guide No. 91. Med Teach. 2014 Nov;36(11):923–39. doi:10.3109/0142159X.2014.917165

75. Jamshed S. Qualitative research method-interviewing and observation. J Basic Clin Pharm. 2014 Sep;5(4):87–8. doi:10.4103/0976-0105.141942 PubMed PMID: 25316987; PubMed Central PMCID: PMC4194943.

76. Chenail R. Ten Steps for Conceptualizing and Conducting Qualitative Research Studies in a Pragmatically Curious Manner. Qual Rep. 2014 Dec 8. doi:10.46743/2160-3715/2011.1324

77. Braun V, Clarke V. What can "thematic analysis" offer health and wellbeing researchers? Int J Qual Stud Health Well-Being. 2014 Jan;9(1):26152. doi:10.3402/qhw.v9.26152

78. Ponto J. Understanding and Evaluating Survey Research. J Adv Pract Oncol. 2015;6(2):168–71. PubMed PMID: 26649250; PubMed Central PMCID: PMC4601897.

79. Dalkey N. An experimental study of group opinion: The Delphi method. Futures. 1969 Sep 1;1(5):408–26. doi:10.1016/S0016-3287(69)80025-X

80. Diamond IG Robert C; Feldman, Brian M; Pencharz, Paul B; Ling, Simon C; Moore, Aideen M; Wales, Paul W. Defining consensus: A systematic review recommends methodologic criteria for reporting of Delphi studies. J Clin Epidemiol. 2014;67(4):401–9. doi:10.1016/j.jclinepi.2013.12.002

81. Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: How to decide its appropriateness. World J Methodol. 2021 Jul 20;11(4):116–29. doi:10.5662/wjm.v11.i4.116 PubMed PMID: 34322364; PubMed Central PMCID: PMC8299905.

82. Niederberger M, Spranger J. Delphi Technique in Health Sciences: A Map. Front Public Health. 2020 Sep 22;8. doi:10.3389/fpubh.2020.00457

83. Niederberger M. Delphi studies in social and health sciences – recommendations for a standardized reporting (DELPHISTAR)) [Internet]. OSF Registries; 2022 [cited 2026 Jan 5]. Available from: https://osf.io/gc4jk/ doi:10.17605/OSF.IO/GC4JK

84. Green B, Jones M, Hughes D, Williams A. Applying the Delphi technique in a study of GPs' information requirements. Health Soc Care Community. 1999 May;7(3):198–205. doi:10.1046/j.1365-2524.1999.00176.x PubMed PMID: 11560634.

85. Dusin J, Melanson A, Mische-Lawson L. Evidence-based practice models and frameworks in the healthcare setting: a scoping review. BMJ Open. 2023 May;13(5):e071188. doi:10.1136/bmjopen-2022-071188

86. Thoma A, Sprague S, Voineskos SH, Goldsmith CH, editors. Evidence-Based Surgery: A Guide to Understanding and Interpreting the Surgical Literature [Internet]. Cham: Springer International Publishing; 2019 [cited 2024 Mar 28]. Available from: https://link.springer.com/10.1007/978-3-030-05120-4 doi:10.1007/978-3-030-05120-4

87. Ashrafian H, Sevdalis N, Athanasiou T. Evidence-Based Surgery. In: Athanasiou T, Debas H, Darzi A, editors. Key Topics in Surgical Research and Methodology [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2010 [cited 2024 Jan 8]. p. 9–26. Available from: http://link.springer.com/10.1007/978-3-540-71915-1_2 doi:10.1007/978-3-540-71915-1_2

88. Corrigan N, Brown JM, Emsley R, Jayne DG, Walwyn REA. Surgical trial design for incorporating the effects of learning: what is the current methodological guidance, and is it sufficient? Trials. 2023 Apr 25;24:294. doi:10.1186/s13063-023-07265-5 PubMed PMID: 37095568; PubMed Central PMCID: PMC10127059.

89. Reid AM, Brown JM, Smith JM, Cope AC, Jamieson S. Ethical dilemmas and reflexivity in qualitative research. Perspect Med Educ. 2018 Apr;7(2):69–75. doi:10.1007/s40037-018-0412-2 PubMed PMID: 29536374; PubMed Central PMCID: PMC5889383.

90. Hong J, Chen J. Clinical Physicians' Attitudes towards Evidence-Based Medicine (EBM) and Their Evidence-Based Practice (EBP) in Wuhan, China. Int J Environ Res Public Health. 2019 Oct 7;16(19):3758. doi:10.3390/ijerph16193758

91. Hajebrahimi S, Sadeghi-Ghyassi F, Olfati N, Dastgiri S, Maghbouli L. Evidence Based Practice: Perspectives of Iranian Urologists. Urol J. 2013 FAL;10(4):1099–105. Located at: WOS:000329142800016

92. Lugano G, Gianola S, Castellini G, Banfi G, Seil R, Denti M, et al. Evidence-Based Medicine (EBM) is properly perceived but its application is still limited in the orthopedic clinical practice: an online survey among the European Society of

Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA) members. Knee Surg Sports Traumatol Arthrosc Off J ESSKA. 2020 May;28(5):1665–72. doi:10.1007/s00167-019-05670-5 PubMed PMID: 31435706.

93. Poolman RW; S Inger N; Farrokhyar, Forough; Mazel, J Adriaan; Blankevoort, Leendert; Bhandari, Mohit. Perceptions and competence in evidence-based medicine: Are surgeons getting better? A questionnaire survey of members of the Dutch Orthopaedic Association. J Bone Joint Surg Am. 2007;89(1):206–15. doi:10.2106/jbjs.f.00633

94. Amin M, Saunders JA, Fenton JE. Pilot study of the knowledge and attitude towards evidence based medicine of otolaryngology higher surgical trainees. Clin Otolaryngol Off J ENT-UK Off J Neth Soc Oto-Rhino-Laryngol Cervico-Facial Surg. 2007;32(2):133–5. Located at: Ovid MEDLINE(R) <2005 to 2007>

95. Roth K, Siemens DR. The status of evidence-based medicine education in urology residency. Can Urol Assoc J. 2013 Apr 16;4(2):114. doi:10.5489/cuaj.807

96. Knops AM, Vermeulen H, Legemate DA, Ubbink DT. Attitudes, awareness, and barriers regarding evidence-based surgery among surgeons and surgical nurses. World J Surg. 2009;33(7):1348–55. Located at: Ovid MEDLINE(R) <2008 to 2009>. doi:10.1007/s00268-009-0020-8

97. Sur RL, Scales CD, Preminger GM, Dahm P. Evidence-based medicine: a survey of American Urological Association members. J Urol. 2006 Sep;176(3):1127–34. doi:10.1016/j.juro.2006.04.043 PubMed PMID: 16890708.

98. Kitto S, Petrovic A, Gruen RL, Smith JA. Evidence-based medicine training and implementation in surgery: the role of surgical cultures. J Eval Clin Pract. 2011;17(4):819–26. Located at: Ovid MEDLINE(R) <2010 to 2011>. doi:10.1111/j.1365-2753.2010.01526.x

99. Johnson TV AA Schoenberg ED, Kellum R, Speake LD, Spiker C, Foust A, Kreps A, Ritenour CW, Brawley OW, Master VA. Numeracy among trainees: are we preparing physicians for evidence-based medicine? Located at: rayyan-592376123. doi:10.1016/j.jsurg.2013.07.013

100. Woloshin S, Schwartz LM, Moncur M, Gabriel S, Tosteson ANA. Assessing Values for Health: Numeracy Matters. Med Decis Making. 2001 Oct;21(5):382–90. doi:10.1177/0272989X0102100505

101. Kumar M, Gopalakrishna C, Swaminath PV, Mysore SS. Evidence-based surgery--evidence from survey and citation analysis in orthopaedic surgery. Ann R Coll Surg Engl. 2011;93(2):133–8. Located at: Ovid MEDLINE(R) <2010 to 2011>. doi:10.1308/003588411X12851639107872

102. Mildon D CP Rollins D, Blicker J, Law F. Knowledge, attitudes and practices regarding evidence-based medicine and outcome assessment: a survey of British

Columbia cataract surgeons. Located at: rayyan-592377326. doi:10.1016/s0008-4182(01)80119-8

103. Weller FS HJ Repping S, van Bodegom Vos L. What information sources do Dutch medical specialists use in medical decision-making: a qualitative interview study. Located at: rayyan-592375341. doi:10.1136/bmjopen-2023-073905

104. Mittal R, Perakath B. Evidence-Based Surgery: Knowledge, Attitudes, and Perceived Barriers among Surgical Trainees. J Surg Educ. 2010 Sep;67(5):278–82. Located at: WOS:000284243200002. doi:10.1016/j.jsurg.2010.06.012

105. Rademaker MM, Smit AL, Kortekaas MF, Benthem PPG van, Stegeman I. Attitude and behaviour of Dutch Otorhinolaryngologists to Evidence Based Medicine. PLOS ONE. 2019 Dec 30;14(12):e0226743. doi:10.1371/journal.pone.0226743

106. McColl A, Smith H, White P, Field J. General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. BMJ. 1998 Jan 31;316(7128):361–5. doi:10.1136/bmj.316.7128.361

107. Kitto SC, Peller JC, Villanueva EV, Gruen RL, Smith JA. Rural surgeons' attitudes towards and usage of evidence-based medicine in rural surgical practice. J Eval Clin Pract. 2011;17(4):678–83. Located at: Ovid MEDLINE(R) <2010 to 2011>. doi:10.1111/j.1365-2753.2011.01695.x

108. Dawes M, Sampson U. Knowledge management in clinical practice: a systematic review of information seeking behavior in physicians. Int J Med Inf. 2003 Aug 1;71(1):9–15. doi:10.1016/S1386-5056(03)00023-6

109. Teunis T, Janssen S, Guitton TG, Ring D, Parisien R. Do Orthopaedic Surgeons Acknowledge Uncertainty? Clin Orthop. 2016 Jun;474(6):1360–9. doi:10.1007/s11999-015-4623-0

110. Funk SG, Champagne MT, Wiese RA, Tornquist EM. Barriers: The barriers to research utilization scale. Appl Nurs Res. 1991 Feb;4(1):39–45. doi:10.1016/S0897-1897(05)80052-7

111. Scales C, Int Evidence-Based Urology Working. Education and training in evidence-based urology. WORLD J Urol. 2011 Jun;29(3):325–9. Located at: WOS:000290806800011. doi:10.1007/s00345-011-0651-x

112. Schnitzbauer AA, Proneth A, Pengel L, Ansorg J, Anthuber M, Bechstein WO, et al. Evidence-based medicine in daily surgical decision making: a survey-based comparison between the UK and Germany. Eur Surg Res Eur Chir Forsch Rech Chir Eur. 2015;54(1–2):14–23. Located at: Ovid MEDLINE(R) <2015>. doi:10.1159/000367940

113. Herur A, Kolagi S, Ramadurg U, Hiremath C, Hadimani C, Goudar S. Refining the journal club presentations of postgraduate students in seven clinical

departments for better evidence-based practice. Ann Med Health Sci Res. 2016;6(3):185. doi:10.4103/2141-9248.183939

114. Sprague S, Pozdniakova P, Kaempffer E, Saccone M, Schemitsch E, Bhandari M. Principles and Practice of Clinical Research course for surgeons: an evaluation of knowledge transfer and perceptions. Can J Surg. 2012 Feb 1;55(1):46–52. doi:10.1503/cjs.018610

115. Ubbink DT, Legemate DA, Koelemay MJ. The Merits of a Two-Day Evidence-Based Medicine Course for Surgical Residents. World J Surg. 2016;40(8):1809–14. Located at: Ovid MEDLINE(R) <2016>. doi:10.1007/s00268-016-3495-0

116. Fischer L, Bruckner T, Diener MK, Kadmon M, Wente MN, Sauerland S, et al. Four years of teaching principles in clinical trials--a continuous evaluation of the postgraduate workshop for surgical investigators at the study center of the German Surgical Society. J Surg Educ. 2009;66(1):15–9. Located at: Ovid MEDLINE(R) <2008 to 2009>. doi:10.1016/j.jsurg.2008.08.003

117. Santori G RA Lasagna F, Casaccia M, Fontana I, Valente U. Italian continuing medical education program: an evidence-based course for surgeons and health personnel of a regional transplantation center. Located at: rayyan-592376478. doi:10.1016/j.transproceed.2011.01.135

118. Wolf JM AG Hoang BH, Mehta S, Williams AE, Owens BD. Knowledge of levels of evidence criteria in orthopedic residents. Located at: rayyan-592376727. doi:10.3928/01477447-20090527-10

119. Komenaka IK, Heberer MA, O'Neill PJ, Hsu CH, Nesset EM, Goldberg RF, et al. The effect of an evidence-based medicine curriculum on breast cancer knowledge and satisfaction of surgical residents. J Surg Educ. 2015;72(4):717–25. Located at: Ovid MEDLINE(R) <2015>. doi:10.1016/j.jsurg.2014.12.017

120. Jones AT, Biester TW, Buyske J, Lewis FR, Malangoni MA. Using the American Board of Surgery In-Training Examination to Predict Board Certification: A Cautionary Study. J Surg Educ. 2014 Nov;71(6):e144–8. doi:10.1016/j.jsurg.2014.04.004

121. Haines SJ NJS. Teaching evidence-based medicine to surgical subspecialty residents. Located at: rayyan-592377211. doi:10.1016/S1072-7515(03)00114-5

122. Temple C, Ross D. Acquisition of Evidence-Based Surgery Skills in Plastic Surgery Residency Training. J Surg Educ. 2011 May;68(3):167–71. Located at: WOS:000289877700003. doi:10.1016/j.jsurg.2010.12.004

123. Luc JGY, Nguyen TC, Fowler CS, Eisenberg SB, Wolf RK, Estrera AL, et al. Novel Debate-Style Cardiothoracic Surgery Journal Club: Results of a Pilot Curriculum. Ann Thorac Surg. 2017 Oct;104(4):1410–6. doi:10.1016/j.athoracsur.2017.05.072

124. Luc JGY, Fowler CS, Eisenberg SB, Estrera AL, Wolf RK, Choi CW, et al. Multiinstitutional Evaluation of a Debate-Style Journal Club for Cardiothoracic Surgery Trainees. Ann Thorac Surg. 2022 Jul;114(1):327–33. doi:10.1016/j.athoracsur.2021.07.104

125. Lao WS, Puligandla P, Baird R. A pilot investigation of a pediatric surgery journal club. J Pediatr Surg. 2014 May;49(5):811–4. doi:10.1016/j.jpedsurg.2014.02.068

126. Duong MN, Strumpf A, Daniero JJ, Jameson MJ, Mattos JL. Redesigning Journal Club to Improve Participant Satisfaction and Education. J Surg Educ. 2022 Jul;79(4):964–73. doi:10.1016/j.jsurg.2022.01.011

127. Siegrist M GM. A Swiss survey on teaching evidence-based medicine. Located at: rayyan-592376972. doi:10.4414/smw.2006.11473

128. Ahmadi SFB Hamid Reza; Ahmadi, Emad. Effectiveness of teaching evidence-based medicine to undergraduate medical students: a BEME systematic review. Med Teach. 2014;37(1):21–30. doi:10.3109/0142159x.2014.971724

129. Williams AD, Mann BD, Lipman J. Understanding the Modern Surgical Journal Club. J Surg Educ. 2019 May;76(3):637–43. doi:10.1016/j.jsurg.2018.09.012

130. Mullen SJ, Sabri K. Role of journal club in Canadian ophthalmology residency training: a national survey of program directors. Can J Ophthalmol. 2016 Jun;51(3):226–31. doi:10.1016/j.jcjo.2016.04.003

131. Ibrahim A, Mshelbwala P, Mai A, Asuku M, Mbibu H. Perceived role of the journal clubs in teaching critical appraisal skills: A survey of surgical trainees in Nigeria. Niger J Surg. 2014;20(2):64. doi:10.4103/1117-6806.137292

132. Junckerstorff R, Brady S, Aung AK, editors. Beyond Evidence-Based Medicine: Clinical Pearls from Experienced Physicians [Internet]. Singapore: Springer Nature Singapore; 2023 [cited 2024 Apr 7]. Available from: https://link.springer.com/10.1007/978-981-99-4440-8 doi:10.1007/978-981-99-4440-8

133. Khanna P, Roberts C, Lane AS. Designing health professional education curricula using systems thinking perspectives. BMC Med Educ. 2021 Dec;21(1):20. doi:10.1186/s12909-020-02442-5

134. Miller GE. The Assessment of Clinical skills/competence/performance. Acad Med J Assoc Am Med Coll. 1990;65(9):S63-7. doi:10.1097/00001888-199009000-00045

135. Tokidis E, Balasubramanian S, 0000-0003-1629-6574, Perin G. Evidence Based Surgery Scoping Review [Internet]. 2024 Mar 26. doi:10.17605/OSF.IO/6VZM3

136. Albarqouni LH Tammy; Glasziou, Paul. Evidence-based practice educational intervention studies: a systematic review of what is taught and how it is measured. BMC Med Educ. 2018;18(1):177–177. doi:10.1186/s12909-018-1284-1

137. CRAMSURG [Internet]. Available from: https://www.cramsurg.org

138. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007 Dec 1;19(6):349–57. doi:10.1093/intqhc/mzm042

139. Coates WC, Jordan J, Clarke SO. A practical guide for conducting qualitative research in medical education: Part 2—Coding and thematic analysis. AEM Educ Train. 2021 Oct;5(4):e10645. doi:10.1002/aet2.10645

140. Nowell LS, Norris JM, White DE, Moules NJ. Thematic Analysis: Striving to Meet the Trustworthiness Criteria. Int J Qual Methods. 2017 Dec 1;16(1):1609406917733847. doi:10.1177/1609406917733847

141. Jackson K. Qualitative data analysis with NVivo. 3rd edition. Thousand Oaks, CA: SAGE Publications; 2019.

142. Sutton J, Austin Z. Qualitative Research: Data Collection, Analysis, and Management. Can J Hosp Pharm. 2015;68(3):226–31. PubMed PMID: 26157184; PubMed Central PMCID: PMC4485510.

143. Hennink MM, Kaiser BN, Weber MB. What Influences Saturation? Estimating Sample Sizes in Focus Group Research. Qual Health Res. 2019 Aug;29(10):1483–96. doi:10.1177/1049732318821692 PubMed PMID: 30628545; PubMed Central PMCID: PMC6635912.

144. Chong EJX, Wang MJ, Lim JY, Shen GS, Chow MJY, Koh KK, et al. Surgical portfolios: A systematic scoping review. Surg Pract Sci. 2022 Sep 1;10:100107. doi:10.1016/j.sipas.2022.100107

145. Johnson M, Majewska D. Formal, non-formal, and informal learning: What are they, and how can we research them?

146. James O, Smith L, Locker D, Hopkins L, Robinson D, Abdelrahman T, et al. Half-life of surgical truth in general surgery. Bull R Coll Surg Engl. 2021 Jul;103(5):254–7. doi:10.1308/rcsbull.2021.94

147. Chalmers IO Andrew D; Austvoll Dahlgren, Astrid; Ryan Vig, Selena; Pannell, Sarah; Sewankambo, Nelson K; Semakula, Daniel; Nsangi, Allen; Albarqouni, Loai; Glasziou, Paul; Mahtani, Kamal R; Nunan, David; Heneghan, Carl; Badenoch, Douglas. Key Concepts for Informed Health Choices: a framework for helping people learn how to assess treatment claims and make informed choices. BMJ Evid-Based Med. 2018;23(1):29–33. doi:10.1136/ebmed-2017-110829

148. Jenkins TR. It's time to challenge surgical dogma with evidence-based data. Located at: rayyan-592377201. doi:10.1067/s0002-9378(03)00587-8

149. Wilke LG, Dickson-Witmer D, Boughey JC. Dissemination and implementation: Translating cancer guidelines and clinical trial outcomes into everyday practice. Bull Am Coll Surg. 2016;101(2):33–4. Located at: Ovid MEDLINE(R) <2016>

150. Morton D, Bicknell CD. Should surgical training include involvement in a clinical trial? BMJ. 2015 Apr 22;350:h2045. doi:10.1136/bmj.h2045 PubMed PMID: 25904564.

151. Gökalp E, Gülpınar N, Doan XV. Dynamic surgery management under uncertainty. Eur J Oper Res. 2023 Sep 1;309(2):832–44. doi:10.1016/j.ejor.2022.12.006

152. Huo M, Zhao B, Li Y, Li J. Evidence-based practice dynamic capabilities: a concept derivation and analysis. Ann Transl Med. 2022 Jan;10(1):22. doi:10.21037/atm-21-6506 PubMed PMID: 35242867; PubMed Central PMCID: PMC8825542.

153. McLeod RS. Instilling a Culture of Evidence-Based Surgery in Canada. World J Surg. 2007;31(8):1212. doi:10.1007/s00268-007-9133-0

154. Raymond L, Weldon SL, Kelly D, Arriaga XB, Clark AM. Making Change: Norm-Based Strategies for Institutional Change to Address Intractable Problems. Polit Res Q [Internet]. 2014 [cited 2024 Apr 17];67(1):197–211. Available from: https://www.jstor.org/stable/23612046

155. Brenna CTA, Das S. Divides of identity in medicine and surgery: A review of duty-hour policy preference. Ann Med Surg. 2020 Jul 10;57:1–4. doi:10.1016/j.amsu.2020.07.006 PubMed PMID: 32685142; PubMed Central PMCID: PMC7358620.

156. Fritz T, Stachel N, Braun BJ. Evidence in surgical training – a review. Innov Surg Sci. 2019 Apr 22;4(1):7–13. doi:10.1515/iss-2018-0026 PubMed PMID: 31579796; PubMed Central PMCID: PMC6754061.

157. Donald N, Lindsay T. Surgical trainee experiences from 2013 to 2023 within the United Kingdom as reported by the General Medical Council National Training Survey. Surg J R Coll Surg Edinb Irel. 2024 Apr;22(2):74–9. doi:10.1016/j.surge.2023.11.005 PubMed PMID: 38081759.

158. Tokidis E, Vivekananda-Schmidt P, Balasubramanian SP. A Focus Group Discussion Study Exploring General Surgery Trainees' Views on Evidence-Based Medicine Within Their Training Program in the United Kingdom. J Surg Educ. 2024 Nov 23;82(1):103348. doi:10.1016/j.jsurg.2024.103348 PubMed PMID: 39581163.

159. Shorten A, Smith J. Mixed methods research: expanding the evidence base. Evid Based Nurs. 2017 Jul 1;20(3):74–5. doi:10.1136/eb-2017-102699 PubMed PMID: 28615184.

160. Sharieff I. SAS and locally employed doctors are also disenfranchised. BMJ. 2023 Mar 7;380:p508. doi:10.1136/bmj.p508 PubMed PMID: 36882192.

161. jamovi - open statistical software for the desktop and cloud [Internet]. [cited 2024 Dec 30]. Available from: https://www.jamovi.org/

162. Eysenbach G. Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res. 2004;6(3):e34-NA. doi:10.2196/jmir.6.3.e34

163. Pitt SC, Schwartz TA, Chu D. AAPOR Reporting Guidelines for Survey Studies. JAMA Surg. 2021 Aug 1;156(8):785. doi:10.1001/jamasurg.2021.0543

164. Home - AAPOR [Internet]. 2022 Oct 14 [cited 2024 Dec 30]. Available from: https://aapor.org/

165. Kirkpatrick DL. The Four Levels of Evaluation. In: Brown SM, Seidner CJ, editors. Evaluating Corporate Training: Models and Issues [Internet]. Dordrecht: Springer Netherlands; 1998 [cited 2025 Oct 7]. p. 95–112. Available from: https://doi.org/10.1007/978-94-011-4850-4_5 doi:10.1007/978-94-011-4850-4_5

166. Ahmadi NM Margaret E; MacLean, Anthony; Brown, Carl J; Mastracci, Tara M; McLeod, Robin S. Teaching evidence based medicine to surgery residents-is journal club the best format? A systematic review of the literature. J Surg Educ. 2011;69(1):91–100. doi:10.1016/j.jsurg.2011.07.004

167. Ahmadi N, Dubois L, McKenzie M, Brown CJ, MacLean AR, McLeod RS. Role of Evidence-Based Reviews in Surgery in teaching critical appraisal skills and in journal clubs. Can J Surg J Can Chir. 2013;56(4):E98-102. Located at: Ovid MEDLINE(R) <2013>

168. Swanwick T. Understanding Medical Education. In: Understanding Medical Education [Internet]. John Wiley & Sons, Ltd; 2018 [cited 2025 Jan 2]. p. 1–6. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119373780.ch1 doi:10.1002/9781119373780.ch1

169. Brown RF, St John A, Hu Y, Sandhu G. Differential Electronic Survey Response: Does Survey Fatigue Affect Everyone Equally? J Surg Res. 2024 Feb;294:191–7. doi:10.1016/j.jss.2023.09.072 PubMed PMID: 37913726.

170. CASP - Critical Appraisal Skills Programme [Internet]. [cited 2025 Jan 2]. Different Types of Bias in Research - CASP. Available from: https://casp-uk.net/news/different-types-of-research-bias/

171. Tokidis E, Balasubramanian SP, Vivekananda-Schmidt P. Evidence-based medicine training in general surgery in the United Kingdom: an exploratory snapshot survey study. Langenbecks Arch Surg. 2025 Dec 18. doi:10.1007/s00423-025-03955-7

172. Stahel PF, Cobianchi L, Dal Mas F, Paterson-Brown S, Sakakushev BE, Nguyen C, et al. The role of teamwork and non-technical skills for improving emergency surgical outcomes: an international perspective. Patient Saf Surg. 2022 Feb 8;16:8. doi:10.1186/s13037-022-00317-w PubMed PMID: 35135584; PubMed Central PMCID: PMC8822725.

173. Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: How to decide its appropriateness. World J Methodol. 2021 Jul 20;11(4):116–29. doi:10.5662/wjm.v11.i4.116 PubMed PMID: 34322364; PubMed Central PMCID: PMC8299905.

174. Hasson F, Keeney S, McKenna H. Revisiting the Delphi technique - Research thinking and practice: A discussion paper. Int J Nurs Stud. 2025 Aug 1;168:105119. doi:10.1016/j.ijnurstu.2025.105119

175. Greenhalgh T, Howick J, Maskrey N. Evidence based medicine: a movement in crisis? The BMJ. 2014 Jun 13;348:g3725. doi:10.1136/bmj.g3725 PubMed PMID: 24927763; PubMed Central PMCID: PMC4056639.

176. Shang Z. Use of Delphi in health sciences research: A narrative review. Medicine (Baltimore). 2023 Feb 17;102(7):e32829. doi:10.1097/MD.0000000000032829 PubMed PMID: 36800594; PubMed Central PMCID: PMC9936053.

177. Jünger S, Payne SA, Brine J, Radbruch L, Brearley SG. Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. Palliat Med. 2017 Sep 1;31(8):684–706. doi:10.1177/0269216317690685

178. Beamish AJ, Johnston MJ, Harries RL, Mohan HM, Fitzgerald JEF, Humm G, et al. Real-world use of workplace based assessments in surgical training: A UK nationwide cross-sectional exploration of trainee perspectives and consensus recommendations from the Association of Surgeons in Training. Int J Surg. 2020 Dec 1;84:212–8. doi:10.1016/j.ijsu.2020.07.068

179. Gaunt A, Patel A, Royle J, Fallis S, Almond M, Mylvaganam S, et al. What do surgeons and trainees think of WBAs and how do they use them? Bull R Coll Surg Engl. 2016 Oct;98(9):408–14. doi:10.1308/rcsbull.2016.408

180. Jones J, Hunter D. Qualitative Research: Consensus methods for medical and health services research. BMJ. 1995 Aug 5;311(7001):376–80. doi:10.1136/bmj.311.7001.376 PubMed PMID: 7640549.

181. Ruiz-Gutiérrez FK, Galván-Barrios J, Montoya Quintero KF, Narvaez-Rojas AR. Teaching surgeons to question the evidence: should surgical meta-research be embedded early in undergraduate and residency training? Ann Med Surg. 2025 Nov;87(11):7768–70. doi:10.1097/MS9.0000000000003979

182. Galbraith K, Ward A, Heneghan C. A real-world approach to Evidence-Based Medicine in general practice: a competency framework derived from a systematic

614 review and Delphi process. BMC Med Educ. 2017 May 3;17:78.
615 doi:10.1186/s12909-017-0916-1 PubMed PMID: 28468646; PubMed Central
616 PMCID: PMC5415750.

617 183. O'Cathain A, Croot L, Duncan E, Rousseau N, Sworn K, Turner KM, et al.
618 Guidance on how to develop complex interventions to improve health and
619 healthcare. BMJ Open. 2019 Aug 15;9(8):e029954. doi:10.1136/bmjopen-2019-
620 029954 PubMed PMID: 31420394; PubMed Central PMCID: PMC6701588.

621 184. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, et al. A new
622 framework for developing and evaluating complex interventions: update of
623 Medical Research Council guidance. BMJ. 2021 Sep 30;374:n2061.
624 doi:10.1136/bmj.n2061 PubMed PMID: 34593508.

625 185. Tricco AC; L Erin; Zarin, Wasifa; O'Brien, Kelly K; Colquhoun, Heather; Levac,
626 Danielle; Moher, David; Peters, Micah D J; Horsley, Tanya; Weeks, Laura;
627 Hempel, Susanne; Akl, Elie A; Chang, Christine; McGowan, Jessie; Stewart,
628 Lesley A; Hartling, Lisa; Aldcroft, Adrian; Wilson, Michael G; Garritty, Chantelle;
629 Lewin, Simon; Godfrey, Christina; Macdonald, Marilyn; Langlois, Etienne V;
630 Soares Weiser, Karla; Moriarty, Jo; Clifford, Tammy; Tunçalp, Özge; Straus,
631 Sharon E. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and
632 Explanation. Ann Intern Med. 2018;169(7):467–73. doi:10.7326/m18-0850

633 186. Greene JC, Caracelli VJ, Graham WF. Toward a Conceptual Framework for Mixed-
634 Method Evaluation Designs. Educ Eval Policy Anal. 1989 Sep;11(3):255–74.
635 doi:10.3102/01623737011003255

636 187. Bleakley A. Broadening conceptions of learning in medical education: the
637 message from teamworking. Med Educ. 2006 Feb;40(2):150–7.
638 doi:10.1111/j.1365-2929.2005.02371.x PubMed PMID: 16451243.

639 188. Ambrosetti É, Gaudin C, Flandin S, Poizat G. Students as co-designers in health
640 professional education: a scoping review. BMC Med Educ. 2025 May 3;25:645.
641 doi:10.1186/s12909-025-07110-0 PubMed PMID: 40319259; PubMed Central
642 PMCID: PMC12049780.

643 189. Vargas C, Whelan J, Brimblecombe J, Allender S. Co-creation, co-design, co-
644 production for public health – a perspective on definitions and distinctions.
645 Public Health Res Pract. 2022 Jun 15;32(2):e3222211. doi:10.17061/phrp3222211

646 190. Bleakley A. Social comparison, peer learning and democracy in medical
647 education. Med Teach. 2010;32(11):878–9. doi:10.3109/0142159X.2010.519071
648 PubMed PMID: 21039095.

649 191. Schönrock-Adema J, Bouwkamp-Timmer T, van Hell EA, Cohen-Schotanus J. Key
650 elements in assessing the educational environment: where is the theory? Adv
651 Health Sci Educ Theory Pract. 2012 Dec;17(5):727–42. doi:10.1007/s10459-011-
652 9346-8 PubMed PMID: 22307806; PubMed Central PMCID: PMC3490064.

192. Wenger E. Communities of practice: Learning, meaning, and identity. New York, NY, US: Cambridge University Press; 1998. xv, 318 p. (Communities of practice: Learning, meaning, and identity). doi:10.1017/CBO9780511803932

193. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. The Lancet. 2010 Dec 4;376(9756):1923–58. doi:10.1016/S0140-6736(10)61854-5

194. Seifman MA, Woodward-Kron R, Kagan RY, Dalrymple K, Gardner AK, Incoll I, et al. The Anatomy of Change: A Scoping Review of Surgical Curriculum Renewal Processes. Perspect Med Educ. 14(1):956–73. doi:10.5334/pme.2010 PubMed PMID: 41356410; PubMed Central PMCID: PMC12679985.

195. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Health. 2011 Mar;38(2):65–76. doi:10.1007/s10488-010-0319-7 PubMed PMID: 20957426; PubMed Central PMCID: PMC3068522.

196. ISCP [Internet]. [cited 2023 Sep 21]. Available from: https://www.iscp.ac.uk/

197. Edmondson A. Psychological Safety and Learning Behavior in Work Teams. Adm Sci Q. 1999 Jun;44(2):350–83. doi:10.2307/2666999

198. England NHS. NHS England » The NHS Patient Safety Strategy [Internet]. [cited 2026 Mar 30]. Available from: https://www.england.nhs.uk/patient-safety/the-nhs-patient-safety-strategy/

199. Getting It Right First Time - GIRFT [Internet]. [cited 2026 Mar 30]. Getting It Right First Time - GIRFT. Available from: https://gettingitrightfirsttime.co.uk/

200. Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA. A scoping review of scoping reviews: advancing the approach and enhancing the consistency. Res Synth Methods. 2014 Dec;5(4):371–85. doi:10.1002/jrsm.1123 PubMed PMID: 26052958; PubMed Central PMCID: PMC4491356.

201. Birt L, Scott S, Cavers D, Campbell C, Walter F. Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation? Qual Health Res. 2016 Nov;26(13):1802–11. doi:10.1177/1049732316654870 PubMed PMID: 27340178.

202. Healy P, Galvin S, Williamson PR, Treweek S, Whiting C, Maeso B, et al. Identifying trial recruitment uncertainties using a James Lind Alliance Priority Setting Partnership – the PRioRiTy (Prioritising Recruitment in Randomised Trials) study. Trials. 2018 Mar 1;19:147. doi:10.1186/s13063-018-2544-4 PubMed PMID: 29490702; PubMed Central PMCID: PMC5831203.

203. Wheeler JR, Tikkinen KAO, Guyatt G, Malde S. How Can We Understand Patients' Values, Preferences, and Expectations in Urology? Eur Urol Focus. 2023 Sep 1;9(5):719–22. doi:10.1016/j.euf.2023.10.002

204. Thomas PA; K David E; Hughes, Mark T; Chen, Belinda Y. Curriculum Development for Medical Education: A Six-Step Approach. NA. 1998. NA.

205. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ. 2008 Sep 29;337:a1655. doi:10.1136/bmj.a1655 PubMed PMID: 18824488.

206. Domecq JP, Prutsky G, Elraiyah T, Wang Z, Nabhan M, Shippee N, et al. Patient engagement in research: a systematic review. BMC Health Serv Res. 2014 Feb 26;14:89. doi:10.1186/1472-6963-14-89 PubMed PMID: 24568690; PubMed Central PMCID: PMC3938901.

207. Ilic D, Tepper K, Misso M. Teaching evidence-based medicine literature searching skills to medical students during the clinical years: a randomized controlled trial. J Med Libr Assoc JMLA. 2012 Jul;100(3):190–6. doi:10.3163/1536-5050.100.3.009 PubMed PMID: 22879808; PubMed Central PMCID: PMC3411272.

208. Shah AP, Walker KA, Walker KG, Cleland J. Context matters in curriculum reform: An analysis of change in surgical training. Med Educ. 2023 Aug;57(8):741–52. doi:10.1111/medu.15071 PubMed PMID: 36869257.

209. Brett J, Staniszewska S, Mockford C, Herron-Marx S, Hughes J, Tysall C, et al. Mapping the impact of patient and public involvement on health and social care research: a systematic review. Health Expect Int J Public Particip Health Care Health Policy. 2014 Oct;17(5):637–50. doi:10.1111/j.1369-7625.2012.00795.x PubMed PMID: 22809132; PubMed Central PMCID: PMC5060910.

210. Cook DA, Beckman TJ. Current concepts in validity and reliability for psychometric instruments: theory and application. Am J Med. 2006 Feb;119(2):166.e7-16. doi:10.1016/j.amjmed.2005.10.036 PubMed PMID: 16443422.

211. Duvivier RJ, van Dalen J, Muijtjens AM, Moulaert VRMP, van der Vleuten CPM, Scherpbier AJJA. The role of deliberate practice in the acquisition of clinical skills. BMC Med Educ. 2011 Dec 6;11:101. doi:10.1186/1472-6920-11-101 PubMed PMID: 22141427; PubMed Central PMCID: PMC3293754.

212. Steinert Y, Mann K, Anderson B, Barnett BM, Centeno A, Naismith L, et al. A systematic review of faculty development initiatives designed to enhance teaching effectiveness: A 10-year update: BEME Guide No. 40. Med Teach. 2016 Aug;38(8):769–86. doi:10.1080/0142159X.2016.1181851 PubMed PMID: 27420193.

213. Marinopoulos SS, Dorman T, Ratanawongsa N, Wilson LM, Ashar BH, Magaziner JL, et al. Effectiveness of continuing medical education. Evid ReportTechnology

Assess. 2007 Jan;(149):1–69. PubMed PMID: 17764217; PubMed Central PMCID: PMC4781050.

214. Wennberg JE. Unwarranted variations in healthcare delivery: implications for academic medical centres. BMJ. 2002 Oct 26;325(7370):961–4. doi:10.1136/bmj.325.7370.961 PubMed PMID: 12399352; PubMed Central PMCID: PMC1124450.