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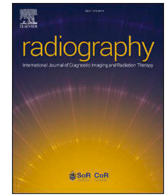

Evaluation of the British Medical Ultrasound Society (BMUS) Preceptorship and Capability Development Framework for Sonographers: A realist approach

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A B S T R A C T

Introduction: In 2022, the British Medical Ultrasound Society (BMUS) launched their Preceptorship and Capability Development Framework, the first document of its kind for sonographers and an important professional milestone. Since the framework's publication, its functionality in practice has not been evaluated. To address this gap, a preliminary realist evaluation was conducted. Its aim was to advance our understanding of why the framework 'works' (or not), how, for whom, in what context, and to what extent.
Methods: As a preliminary realist enquiry, the central objective was to elicit initial programme theories (IPTs) about how the framework effects change (intended or otherwise) in different contexts. The IPTs were generated 'retroductively'. First, the incarnate theories embedded within the framework were inductively surfaced. Then, these were deductively tested in two semi-structured focus groups, comprising eight participants. Themes were surfaced using thematic analysis, from which IPTs emerged as 'context-mechanism-outcome' configurations (CMOCs).
Results: The analysis surfaced three core themes: *structured, systems thinking approach*; *human factors*; and *boundary-spanning benefits*. From these, thirty-five IPTs emerged in the form of CMOCs, capturing the causal pathways between contexts, mechanisms, and outcomes.
Conclusion: Preceptorship should be a priority for the ultrasound workforce: it helps to future-proof the profession, solidify sonographer identity, elevate the professional profile, and demonstrate self-regulation. This study advances the preceptorship agenda by evaluating the framework and offering valuable insights into its 'real world' functionality.
Implications for practice: The surfacing of IPTs as functional units (CMOCs) narrows the knowledge-to-practice gap; because stakeholders can discern which outcomes are triggered in which circumstances, they can target their efforts accordingly. As such, the study has important implications for practice, as its design and outputs facilitate the development of holistic implementation strategies.
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Introduction

Background

The concept of preceptorship is long established[1] and widely endorsed.[2–5] Indeed, in their Allied Health Professions' (AHP) Preceptorship Standards and Framework, NHS (National Health Service) England espouses the benefits of a tailored programme of transition support[6]:

> *'Delivered well, [preceptorship] can give AHPs … the confidence to act as an autonomous practitioner … Preceptorship does this by providing a personalised programme of uni-professional and multi-professional development opportunities with support from an experienced professional … This tailored approach should build on their personal journey into their profession, reference their experience, and consider their personal career development.'* (p.4)

Despite this, preceptorship programmes are not, at present, well-embedded in the ultrasound workforce. Until recently, there has been a dearth of profession-specific guidance. However, in 2022, the British Medical Ultrasound Society (BMUS) launched their Preceptorship and Capability Development Framework for

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Sonographers (henceforth referred to as the BMUS Framework). The first of its kind for the sonographic workforce, its aim was to facilitate the integration of newly qualified sonographers (NQS) into their clinical teams, offering preceptorship guidance, standards, and standardisation where previously there had been little.[7]

The context into which the BMUS Framework landed was (and remains) one of great turbulence: in the 2019 Ultrasound Workforce UK Census, sonographer vacancy rates were estimated at 13%; meanwhile, the period between 2012 and 2020 saw a 24% increase in the number of diagnostic ultrasound examinations performed.[7–9] Furthermore, the lingering psychological impact of the COVID-19 pandemic has contributed significantly to occupational burnout amongst sonographers.[10,11] These themes are borne out in the wider literature, which capture the growing pressures felt by sonographers as a consequence of staff shortages, increasing workload, and workplace anxiety.[12,13]

On balance, there scarcely has been a more challenging time to enter the sonographic workforce.[12] The stress and 'culture shock' experienced by newly qualified practitioners is well-documented; for newly qualified sonographers, their experience is exacerbated by the current context of ultrasound practice and its challenges.[7,14,15] Preceptorship, which intervenes to mitigate these stressors, is therefore essential to support transition and reduce attrition.

Rationale

Numerous studies have explored the impacts of preceptorship.[14–21] Many authors have described the benefits of a structured approach, as provided by a framework, model, or policy. For example, in their mixed-methods evaluation, Taylor et al.[14] reported a positive relationship between strategic vision (as provided by Trust policy) and preceptorship delivery. This theme was mirrored elsewhere in the literature,[15,19–21] including several systematic reviews.[15,19,21] Evidently, the literature endorses the adoption of a framework (or equivalent) when implementing preceptorship.

However, there remain some notable gaps in the evidence base. Crucially, much of the literature is based in the nursing profession. While overlap exists between healthcare professions, sonography is relatively unique: for example, training is predominantly delivered at postgraduate level, and trainees may originate from diverse professional backgrounds (such as diagnostic radiography or midwifery) with varying levels of healthcare experience.[8,12] As such, given its unique characteristics and concerns, the sonographic profession warrants unique consideration. Furthermore, in searching the literature via the MEDLINE and CINAHL (Cumulative Index to Nursing and Allied Health Literature) databases, no evaluative studies of a sonography-specific preceptorship framework were returned. It is on these grounds, therefore, that an evaluation of the BMUS Framework is merited.

Methods

In response, a preliminary realist evaluation was designed and deployed: its purpose was to appraise how the BMUS Framework functions in practice, and to ascertain how it generates different outcomes (intended or otherwise) in different circumstances.

Research methodology

As a research methodology, realist evaluation assumes the same intervention may not work everywhere and for everyone.[22] It therefore seeks to answer the following: does a complex intervention 'work' (or not), why, how, for whom, in what context, and to what extent[23]? This approach contrasts with traditional evaluation methods, which measure and report results without considering the causal dynamics connecting the intervention to the outcome. This has been described as a 'black box' style of evaluation, because the inner workings are concealed from view. Meanwhile, realist evaluation is known as a 'clear box' approach because the explanatory pathways are reported transparently alongside the outcomes.[24–26] Because realist evaluation aims to improve programme implementation by distinguishing between situations with effective and ineffective outcomes,[27] it represents an ideal fit for the evaluation of a preceptorship framework, which, by definition, demands a tailored approach.[6]

Central to realist evaluation is programme theory and the development, testing, and refining thereof (Fig. 1). Programme theories explain how generative causal processes interact to produce outcomes. They are expressed as 'context-mechanism-outcome' configurations (CMOCs). CMOCs, as the core analytical units of realist evaluation, recognise that *outcomes* are the result of *mechanisms* triggered in specific *contexts*.[24–26,28–30] Conceptually, the settings into which programmes are deposited do not, in isolation, constitute *contexts*. Rather, *contexts* are often people; specifically, the psychological, organisational, technical, and economic forces that interact with (and influence) people.[30] *Mechanisms*, as a concept, are a combination of *resources* and *reasoning*.[23,29] When intervention *resources* (e.g. the BMUS Framework) are introduced in a *context*, it enhances a change in *reasoning*. This alters the behaviour of stakeholders, which leads to *outcomes*. The disaggregated configuration is illustrated in Fig. 2.[29]

Study design

As a preliminary realist enquiry, the aim was to elicit initial programme theories (IPTs); that is, tentative theories about how

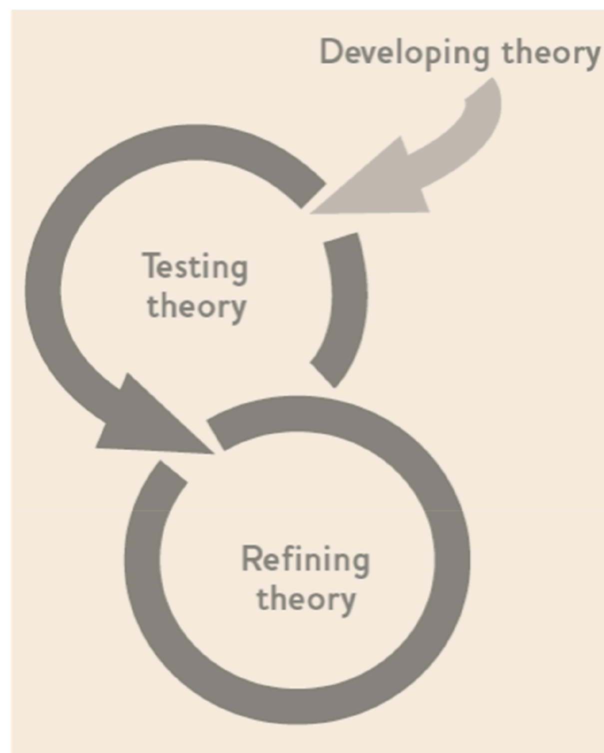

Figure 1. Iterative stages of realist evaluation.[24]

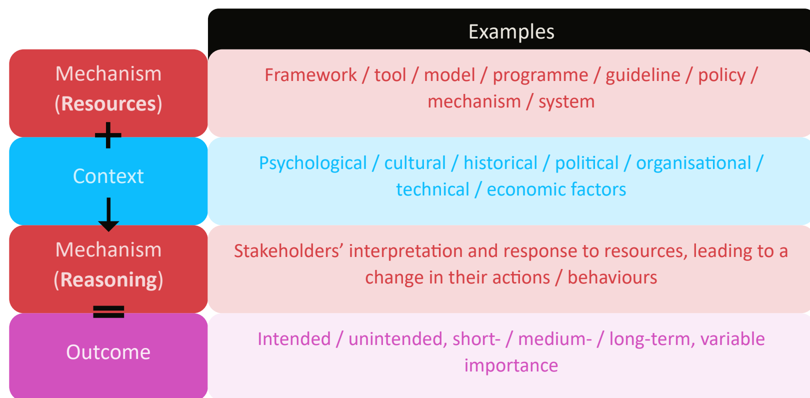

Figure 2. Disaggregated CMO configuration.[29]

the BMUS Framework 'works' to be tested and refined in subsequent research efforts.[25,28,31–33] The IPTs were generated *retroductively*, using *inductive* followed by *deductive* logic (Fig. 3).[34] The first step was to *inductively* surface the incarnate theories contained within the BMUS Framework. According to realist evaluation principles, programmes (such as the BMUS Framework) are 'theories incarnate'; that is, every programme has a theoretical underpinning, whether it is explicitly stated or not.[25,32,34–36]

By reviewing the programme documentation with a realist lens, emerging theories were drawn from the BMUS Framework (see Supplementary Materials – Incarnate Theories).[25,32,34–36] These incarnate theories were of a high level of abstraction, too far removed from real-world contexts and mechanisms to be meaningful. As such, the next step was to *deductively* test the incarnate theories.[25,35] To achieve this, a qualitative realism approach was selected, as qualitative data is needed to uncover causal pathways. Although qualitative realism is insufficient to formally chart outcomes, it allows hypotheses to be drawn as to the outcomes that may flow from mechanisms, which can be corroborated empirically in future research endeavours.[27]

Data collection

Realist evaluation requires its sampling and data collection methods to align with realist principles. The researcher must, therefore, consider the following: who do they need to interview to test their theories, and what are the best methods and tools for accomplishing this? For IPT generation, it is recommended that participants include those whose responsibility it is to administer and monitor the programme.[24,37,38] For this study, it was determined that ultrasound department leads, practice educators, and 'senior' (advanced or consultant practice) sonographers best matched this description. To facilitate the purposive sampling and recruitment of participants, a brief online questionnaire was developed. The questionnaire was administered via Qualtrics across the South East and South West regions of England; thirty-four completed responses were returned.

In total, eight participants were recruited through the questionnaire, distributed across two online, semi-structured ninety-minute focus groups. In realist evaluation, the purpose of focus groups is to test theories, so topic guides must be prepared with

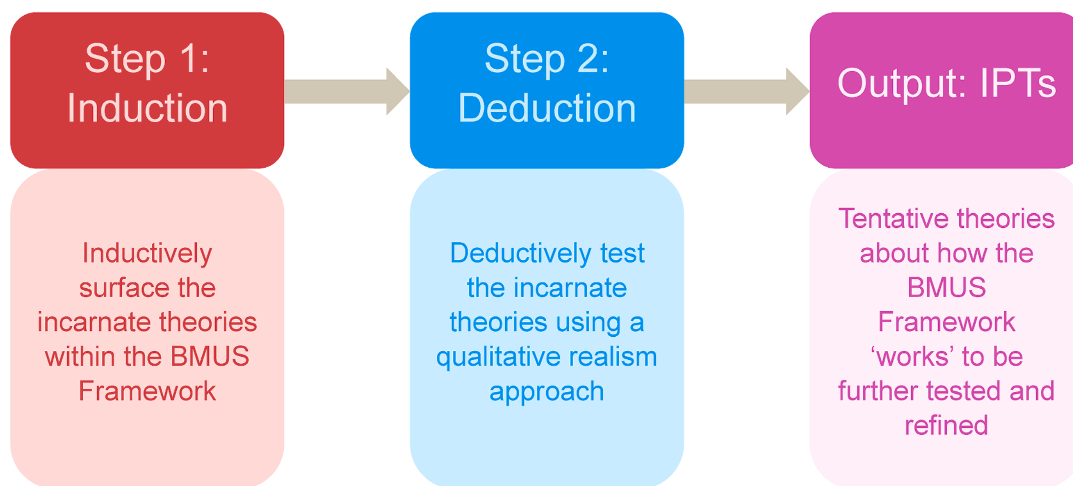

Figure 3. Retroductive generation of IPTs.[34]

the pursuit of specific knowledge embedded into the questions.[37–40] To fulfil this requirement, the topic guide was adapted from The RAMESES II Project 'Starter Set' of Questions, factoring in the incarnate BMUS Framework theories (see Supplementary Materials – Incarnate Theories and Supplementary Materials – Example Topic Guide).[40] For the second focus group, the questions were iteratively amended based on the responses from the first group.[37]

Data collection took place in September 2023. Prior to collecting data, the study was granted approval as a 'low risk' research project, as per the University of the West of England (UWE) Bristol Research Ethics Committee policy. Concerning the data collection, storage, interpretation, and disposal, ethical principles were adhered to in accordance with the British Educational Research Association (BERA) Ethical Guidelines for Educational Research.[41]

Data analysis

As with the data collection, data analysis strategies should be cognisant of realist principles. Despite the increasing number of published realist evaluations, there remains little guidance on the optimum analysis approach.[25,42] As previously mentioned, the core analytical units of realist evaluation are CMOCs; however, the technique for identifying and incorporating CMOCs into theory refinement is not clearly defined in the extant literature. Several authors have championed the virtues of thematic analysis, but their recommendation comes with qualifiers.[25,28,31,42]

In addition to identifying the separate CMOC elements (the contexts, mechanisms, and outcomes), the analysis must capture the relationship between them (i.e. the entire causal pathway). This presents a challenge: typically, thematic analysis concentrates on *similarity* coding, which generates categories of data that are alike (similar concepts, views, or experiences), but fragments associations, processes, and causal connections in the original structure of the data. Realist evaluation requires *contiguity* coding, which preserves these connections.[31,43,44] For this study, the six-phase process of thematic analysis (as described by Braun and Clarke) was expanded, combining categorising and connecting strategies,[45,46] thus ensuring the relational patterns were not disaggregated when grouping similar codes.[31,43,44]

Results

Thematic analysis of the focus group data surfaced numerous themes and sub-themes (see Supplementary Materials – Thematic Maps). These were further reduced and amalgamated into three core themes: *structured*, *systems thinking approach*; *human factors*; and *boundary-spanning benefits* (Fig. 4). From these themes, thirty-five CMOCs emerged. These are presented in tables to preserve the causal pathways,[31,43,44] organised according to their originating theme and subtheme (see Supplementary Materials – CMOC Tables). While the comprehensive results can be found in the CMOC Tables, a narrative overview of several key findings is provided below.

Structured, systems thinking approach

Participants talked favourably about the structure afforded to preceptorship by the BMUS Framework. It was felt that a standardised approach ensured parity, through which preceptees could be reassured of fair treatment, while preceptors and employers could be shielded from vexatious accusations. Central to this was transparency, facilitated by clear documentation; the mechanisms suggested in the BMUS Framework,[7] including the written agreement and regular review meetings, were positively received.

> *'What I like about the [BMUS Framework] is the suggestion that we need to have measurable outcomes and, you know, clear documentation– a more structured approach to preceptorship.'* (2UPE1)

Interestingly, the duration of the preceptorship period was consistently likened to a careful balancing act. If too short or too long, it could have a detrimental effect on the preceptee's progress. If the former, the proverbial 'flaky bridge' (the transition period between

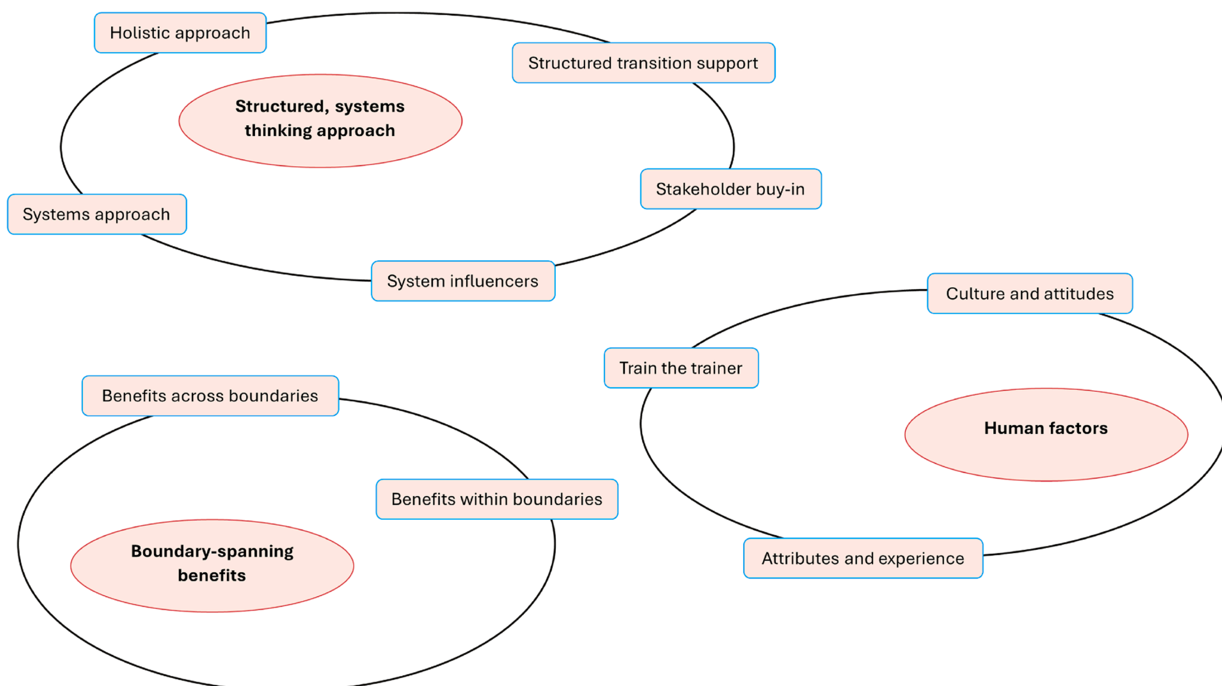

Figure 4. Aggregated thematic map (focus groups 1 & 2).

student and qualified practitioner)[47] crumbles before the preceptee can attain their goals. If the latter, the preceptee becomes over-reliant on support measures, and fails to thrive as an autonomous practitioner. Positive outcomes were attributed to getting the right balance, which was deemed to be individual to the preceptee.

> *'You need this process and period where you've got a bit of a buffer. It allows you to find your feet. And it allows you to gain those confidences that will take you forward through your career.'* (1SS1)

> *' … [NQS get too] used to having more time for their scans, having more support … I think protracting the preceptorship [period] to a year doesn't help in the long run.'* (1APS)

Participants also discussed the need for a whole team approach to preceptorship, one which encompasses the ultrasound department and beyond.

> *'We need to expose everyone to preceptorship … if we leave people out, it won't do anything for them … if people are engaged, we can work collaboratively and support each other.'* (2SS1)

Within the team, participants identified key influential agents: preceptors, practice educators, and managers were perceived as having exceptional influence over the success of preceptorship. The preceptor role will be discussed in the *human factors* theme. Meanwhile, practice educators are uniquely positioned to take ownership of preceptorship, to coordinate efforts, and to disseminate guidance and training to preceptors. Where practice educators are embedded into organisations, the participants described their positive impact on preceptorship implementation.

> *'We're lucky to have an excellent education lead sonographer … without someone to take ownership of [preceptorship], we would struggle to implement it effectively.'* (1SS2)

Managers, at a departmental level and beyond, are key decision-makers; as such, preceptorship cannot be implemented without their buy-in.

> *'There was minimal resistance, [preceptorship] was supported by management because they could see the benefit … it ticks a lot of boxes from a quality and governance point of view, from a managerial point of view, and also a clinical point of view.'* (1APS)

The importance of a holistic approach to preceptorship was a consistent theme. The programme must suit the needs of the service, not just in terms of outputs, but also in its capacity to flex around service pressures.

> *'One size doesn't fit all … [the BMUS Framework] is a great document, but [preceptorship] is an evolving thing for your department, depending on what works best for your needs and resources.'* (1SS1)

Furthermore, according to the participants, the preceptee must be viewed as an individual with individual needs (see the *human factors* theme), and this ought to be reflected in the programme.

> *'Your basic [preceptorship] expectations and outcomes should be the same for everyone … and that's to produce a safe, capable reporting sonographer … that's your bottom line … but there'll be adaptations you need to make to achieve that.'* (1SS1)

Human factors

The participants ascribed great significance to the attributes and experiences of both the preceptee and preceptor. For the preceptee, their skills coming into the preceptorship, their training experience, the unit of study, their confidence, their personality type and learning style; these were viewed as influential factors which could shape the course of preceptorship.

> *'Having the confidence to work independently, I think, is very individual … it comes down to personality as much as clinical skill.'* (1APS)

As for the preceptor, the participants described a range of desirable attributes, spanning the personal, professional, and clinical domains. Indeed, the participants agreed with the BMUS Framework in its assessment of desirable preceptor attributes.[7] Interestingly, there was considerable discussion about the optimum experience level for the preceptor. It was suggested that two/three years' post-qualification experience may be best; enough to be confident and credible in the role, but not so much as to be intimidating to the preceptee.

> *'Having a preceptor who's more junior, you'll find the preceptee can better relate to them … also, having someone who's been qualified two or three years, it then cements their own practice.'* (1SS1)

> *'If you've got [a preceptor] who's thirty years' qualified and knows everything, it can be very intimidating.'* (1APS)

In any case, there was universal agreement that a keen interest in the role was an absolute prerequisite. However, in isolation, a keen interest is not enough to support best practice; we must also equip our preceptors with the necessary tools. Indeed, participants described the responsibility to ensure preceptor preparedness as a joint one between organisations and their higher education provider.

> *'For preceptors to have some formalised training … it would be valuable … '* (1APS)

> *'When they're students, a lot is done by the university. But when it comes to preceptorship, it all falls to me as the practice educator.'* (2UPE2)

Additionally, the participants felt that preceptorship success was influenced by the workplace culture. As discussed in the previous theme, preceptorship benefits from a whole team approach. It is therefore important to cultivate a culture in which preceptorship is accepted and supported. This may require the adoption of change management strategies to overcome historical practices and attitudes.

> *'Especially when it comes to education … some of them are so set in their ways, they don't want anything to change.'* (2UPE2)

Boundary-spanning benefits

Within the boundaries of the ultrasound department, the participants described numerous potential benefits. Preceptorship sets newly qualified sonographers on the path to becoming confident, competent, and capable practitioners. This inevitably leads to a confident, competent, and capable team. Also, participants were of the view that preceptorship was beneficial to recruitment and retention. Preceptees with a good preceptorship experience are far more likely to remain in post.

'It was highlighted by certain staff members who left several years ago that they didn't feel like they had the required support when they'd first qualified … so implementing preceptorship was sort of a reaction to that– a way to try and bridge that gap to hopefully retain staff a bit more effectively.' (1SS2)

Meanwhile, a department can advertise on the strength of a preceptorship programme, which speaks volumes to prospective candidates about the standards and culture of the workplace.

'I think if your Trust has a solid preceptorship programme, as [1SS2] says, it's got a good reputation, it attracts people … I think it helps with recruitment, and in the competitive market that we're in– to try and attract people– every little helps.' (1APS)

Furthermore, participants saw preceptorship as a valuable development opportunity for preceptors (building on the leadership and education pillars), as well as an excellent opportunity for talent spotting.

'It also allows us to identify, at an earlier point, people who may want to go down a more management oriented, or education oriented, route.' (1SS2)

Across boundaries, the participants described the potential gains to departmental and organisational reputation. As previously mentioned, a robust preceptorship programme transmits a positive message about the department's priorities. Also, a competent, capable team is bound to be a high-performing team. Over time, the ultrasound department garners a good reputation with referrers, the multidisciplinary team, and senior management. Furthermore, preceptorship success may inspire other teams (within and across organisations) to adopt similar practices. According to the participants, this provides an opportunity to share learning and resources, enhancing the reputation of the department and organisation, and, ultimately, improving the functionality of the wider system. Most importantly, by imposing standards and standardisation, preceptorship potentially confers benefits to patient care and safety.

'[Preceptorship] helps us– to kind of prove to other teams in the hospital, prove to our radiologists, and prove to senior management, you know, that we are working at a high level, and we are effective as a team, and we are effective in terms of our imaging for [positive] patient outcomes.' (1SS2)

Discussion

This study contributes to our understanding of the BMUS Framework and how it effects change (intended or otherwise) in different contexts. Its purpose, design, and findings are novel for several reasons. First, while the benefits of structured preceptorship have been widely reported,[14,15,19–21] until now, the causal pathways between inputs (preceptorship framework) and outputs (preceptorship outcomes) have not been explored in-depth. Uncovering the causal connections was made possible by a realist methodology. A recent literature search returned no realist evaluations of preceptorship frameworks, rendering the study unique in its design. Furthermore, the study's focus was sonographers and their profession-specific framework, a previously uncharted topic.

The results capture the interactions between contexts, mechanisms, and outcomes as CMOCs (see Supplementary Materials – CMOC Tables). As the core units of realist evaluation, these represent IPTs about how the BMUS Framework functions in practice. While many of the hypothesised outcomes were desirable, as the results demonstrate, not all were. In one interesting example, the preceptorship period was described as a crucial determinant in both positive and negative outcomes. Notably, there was little discussion of the preceptorship period (specifically, its duration) in the reviewed literature. Instead, greater attention was directed at the preceptee/preceptor relationship, the number/frequency of review meetings, and competency assessment tools.

For example, in their mixed-methods evaluation of preceptorship practices for newly qualified radiographers in Northern Ireland, Morris et al.[17] reported significant variation in preceptorship duration, ranging from zero to almost one year. While the authors highlighted the need for greater consistency, their study did not venture an optimum timeframe. Meanwhile, Walker et al.,[20] in their literature review and narrative synthesis, concluded a preceptorship period of four months (or more) was optimal, but did not delve into the reasons behind this. As such, this represents a novel and significant finding, one which warrants further exploration to verify the impact of preceptorship timeframes on individuals.

During the study, abundant hypotheses were generated about the boundary-spanning benefits that may arise from the correct configuration of contexts and mechanisms. While many of these benefits have been previously reported,[14,15,19–21] the link between preceptorship and patient safety has yet to be definitively demonstrated. This study depicts the potential relationship, which has frequently been inferred elsewhere in the literature. Several authors describe the association between preceptorship and preceptee confidence in patient communication and management. However, with sparse quantitative (and only some qualitative) evidence of improved patient outcomes, further investigation is required to cement the link.[15,18,20] Furthermore, there is little mention of the reputational benefits, or talent spotting opportunities, in the reviewed literature. One may therefore assume these represent original findings of interesting significance.

Altogether, one could argue the BMUS Framework functions as a boundary object: it bridges the gap between intersecting practices and people, conferring cross-boundary benefits. The framework brings different corners of the profession (alongside wider stakeholders) together and synergises their efforts to embed preceptorship, serving the ultimate function of future-proofing the ultrasound workforce.[48–50] Through these efforts, the profile of the sonography profession is elevated, as the workforce demonstrates self-regulation and solidifies its professional identity.[7] For the foreseeable future, the sonography profession is unlikely to receive statutory regulation.[51] Therefore, acts of self-regulation (such as preceptorship) are essential for maintaining professional credibility. Encouragingly, further evidence of self-regulation has been demonstrated in this field already: in 2023, BMUS launched their Preceptorship Endorsement Scheme, which recognises departments that offer a supportive environment for ultrasound practitioners of all grades and experience.[52]

Evidently, preceptorship implementation is a priority for any profession. This study advances the sonography preceptorship agenda by evaluating the BMUS Framework. In surfacing the IPTs as functional units, the findings are more translatable to practice. Stakeholders can readily discern which outcomes are triggered in which circumstances, so their efforts can be targeted accordingly. This unique advantage of realist evaluation is reinforced in the literature: exposing the generative processes is known to enhance the scalability, translatability, and longer-term sustainability of interventions. Furthermore, the theoretical understanding conferred by realist evaluation is invaluable for honing local implementation strategies.[24–26,31] Crucially, the IPTs target

different levels (from NQS to senior decision-maker) and domains (clinical/educational/leadership) within the system. In so doing, the IPTs take advantage of a systems-thinking approach. This approach asserts that, when change is introduced at strategic points, the whole system can be moved towards a desired goal.[53–55] As such, stakeholders can proceed with greater confidence, knowing their efforts have been carefully calibrated.

Conclusion

Limitations

Naturally, the study has not been without its limitations. In qualitative realism, there is a tendency to produce 'good news' stories. It is therefore important to stress that, in the absence of quantitative data to measure outcomes, participants' positive accounts are not enough to confirm the BMUS Framework 'works'. Rather, the IPTs capture the contexts and mechanisms in which the framework *may* 'work'.[27] Furthermore, the study was limited by its small sample size and restricted geographical coverage. As the study's intention was to further test and refine the IPTs in future research endeavours, the IPTs were never intended to be generalisable at this preliminary stage. Therefore, caution must be exercised when interpreting the results, as further research is required to substantiate the findings and explore their impact.

Recommendations

This preliminary realist evaluation has produced numerous IPTs about the BMUS Framework. To the study's credit, many of these traverse novel and potentially significant ground. Next, the IPTs must undergo further testing and refinement. This study, therefore, lays a solid foundation from which a complete mixed-methods realist evaluation can be launched.[27,32] Ultimately, the aim of realist evaluation is to generate middle-range programme theories; these are specific enough to provide a clear explanation, but general enough to apply across cases of the same type.[25,26,31] The RAMESES II Project offers guidance on the design and reporting of quality realist evaluations and, as such, offers a convenient roadmap for next steps.[56]

Going forward, it may be prudent to prioritise IPTs for further testing and, therefore, thought should be given as to which are the most pressing. As it currently remains ambiguous in the extant literature and is likely to be of greatest interest to stakeholders, the causal relationship between preceptorship and patient experience warrants prioritisation. This could, potentially, be achieved by conducting patient surveys pre- and post-preceptorship implementation, engaging in complaints and compliments analysis, examining waiting times and patient flow, and appraising staff confidence. Irrespective of the focus and methods, follow-on research should consider the impact of the BMUS Preceptorship Endorsement Scheme.[52]

In the meantime, the IPTs uncovered in this study offer valuable causal insights, likely to be of 'real world' interest to stakeholders. Though the findings are most relevant to the ultrasound workforce, transferability to other postgraduate preceptees (such as reporting radiographers) is possible. The authors hope this study will encourage the adoption of high-quality preceptorship for sonographers and the continuation of high-quality research in this subject area.

Ethics approval and consent to participate

This study was granted approval as a 'low risk' research project, as per the University of the West of England (UWE) Bristol Research Ethics Committee policy. Written informed consent was obtained from participants prior to the data collection.

Availability of data

Data required for this study may be made available by the author(s) upon reasonable request.

Author contributions

HS: Conceptualisation, Methodology, Formal Analysis, Investigation, Resources, Writing - Original Draft, Writing - Review & Editing, Visualisation, Project Administration.

RP: Conceptualisation, Methodology, Validation, Investigation, Resources, Writing - Review & Editing, Supervision.

Declaration of generative AI and AI-assisted technologies in the writing process

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Conflict of interest statement

RP was involved in the preparation of the BMUS Preceptorship and Capability Development Framework for Sonographers, the document on which this preliminary realist evaluation is centred.

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Appendix A. Supplementary materials

Materials supplementary to this article can be found online at https://doi.org/10.1016/j.radi.2026.103347.

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