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Elements of clinical examination preparation courses that increase trainee preparedness for clinical examination: narrative review of 63 studies

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## **Elements of clinical examination preparation courses that increase trainee preparedness for clinical examination: narrative review of 63 studies**

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## Abstract

*Introduction:* High-stakes clinical examinations are key in trainee progression to specialisation. Courses may support trainees in examination preparation.

*Objective:* To describe how preparation courses support and prepare trainees for clinical examinations, and to identify which elements of preparation courses are key.

*Methods:* EMBASE (Ovid), PubMed, and Cochrane Central Register of Controlled Trials databases were searched for studies published between 2004 and 2024. Search terms included Medical/paediatr\* AND educat\*/undergraduate/trainee/training AND clinical exam\*/exam\*/certification exam AND residen\* AND/OR prepar\*. We additionally searched for four specific examinations. We followed PRISMA guidelines and conducted a thematic analysis of the included studies.

*Results:* Sixty-three studies were included for review. Four key themes emerged from the literature: 1) Effective pedagogy - including cognitive and social supports and technological aids; 2) Curriculum alignment; 3) Accounting for personal factors and experiences of clinical examination candidates, including clinical expertise, language factors, and mentorship; and 4) Demystifying clinical examinations through supervision factors and familiarising trainees with examination conditions through mock examinations (discussed by 54% of included studies).

*Conclusion:* Diverse approaches to clinical examination preparation courses exist. Studies suggest that preparation courses may positively impact trainee confidence. Further research is needed to understand the effect of preparation courses on examination outcomes.

## I INTRODUCTION

Specialist clinicians dedicate years of study to their profession, with the pinnacle of their training arguably being the final clinical examination required for entry into a specialist program. Clinical examinations for specialist entry are high-stakes and high-stress, and the outcome of the clinical examination plays a major role in shaping the clinician's future. Depending on the medical speciality, clinical examinations may include written, oral and practical assessments of a candidate's clinical knowledge and skills. Yet, clinical assessment, physical examination, and communication skills are declining among medical trainees worldwide (Ramani, 2008; Ramani et al. 2010; Vukanovic-Criley et al., 2006), a trend compounded by the COVID-19 pandemic (Chahar, 2021; Fu, 2023). The need for support to prepare clinicians for success in specialist-entry clinical examinations has never been greater.

The United States Medical Licensing Examination (USMLE) Step 2 Clinical Skills, a high-stakes clinical assessment required for medical students' licensure, was cancelled during the COVID-19 pandemic (Yudkowsky & Szauter, 2021), while low pass rates continue to pose challenges in certification examinations across various disciplines (The Royal Australasian College of Physicians, 2023). Speculatively, reasons for low exam pass rates include trainee readiness and experience (Gao et al., 2023; McManus et al., 2006), examination quality (McManus et al., 2006; Staudenmann et al., 2023), and examiner stringency or bias (Chong et al., 2017; McManus et al., 2006; Yeates et al., 2013).

Extracurricular courses are available to prepare trainees for written and certification examinations, aiming to improve pass rates (Aeder et al., 2010; Grant et al., 2008) and increase trainee confidence (Shin et al., 2023). Commercial test preparation courses, such as for the USMLE Step 1, are associated with high costs and increased student anxiety and have been criticised for not demonstrating improved examination scores or long-term knowledge retention (Tompkins, 2011). Physical and oral clinical examinations test trainees on practical skills and synthesis and application of knowledge and so require a different approach to teaching than written examinations. Paediatric clinical and oral examinations pose special challenges for educators and trainees due to the extra considerations needed to protect younger patients (Klaber & Pollock, 2009; Tsai, 2004).

We conducted a narrative literature review concerning available research on approaches to extracurricular clinical examination preparation. This review aimed to describe how preparation courses support and prepare trainees for clinical examinations, and to identify key elements of clinical examination preparation courses.

## II METHODS

### A Search strategy

We searched EMBASE (Ovid), PubMed, and Cochrane Central Register of Controlled Trials databases for studies published between 2004 and 2024. The search was completed in April 2024. We followed the PICO formula to develop search terms (Table 1).

**Table 1.****PICO**

| QUESTION COMPONENTS                                      | YOUR QUESTION                                                                                                                                                                                                                         |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>P – Patient or Population</i>                         | Studies concerned with clinical trainees or teachers involved in clinical examination preparation courses                                                                                                                             |
| <i>I – Intervention;<br/>Prognostic Factor; Exposure</i> | Studies reporting clinical examination preparation course/s                                                                                                                                                                           |
| <i>C – Comparison</i>                                    | Observation studies<br>Comparison studies<br>Longitudinal studies<br>Self-reported user experience studies (e.g. survey, interview, focus group)                                                                                      |
| <i>O – Outcome(s)</i>                                    | Studies concerned with preparing trainees for clinical examination. Outcomes include course elements, course strategies, trainee success, trainee engagement, trainee learning, preparedness, trainee support, or trainee confidence. |

**B Inclusion and exclusion criteria**

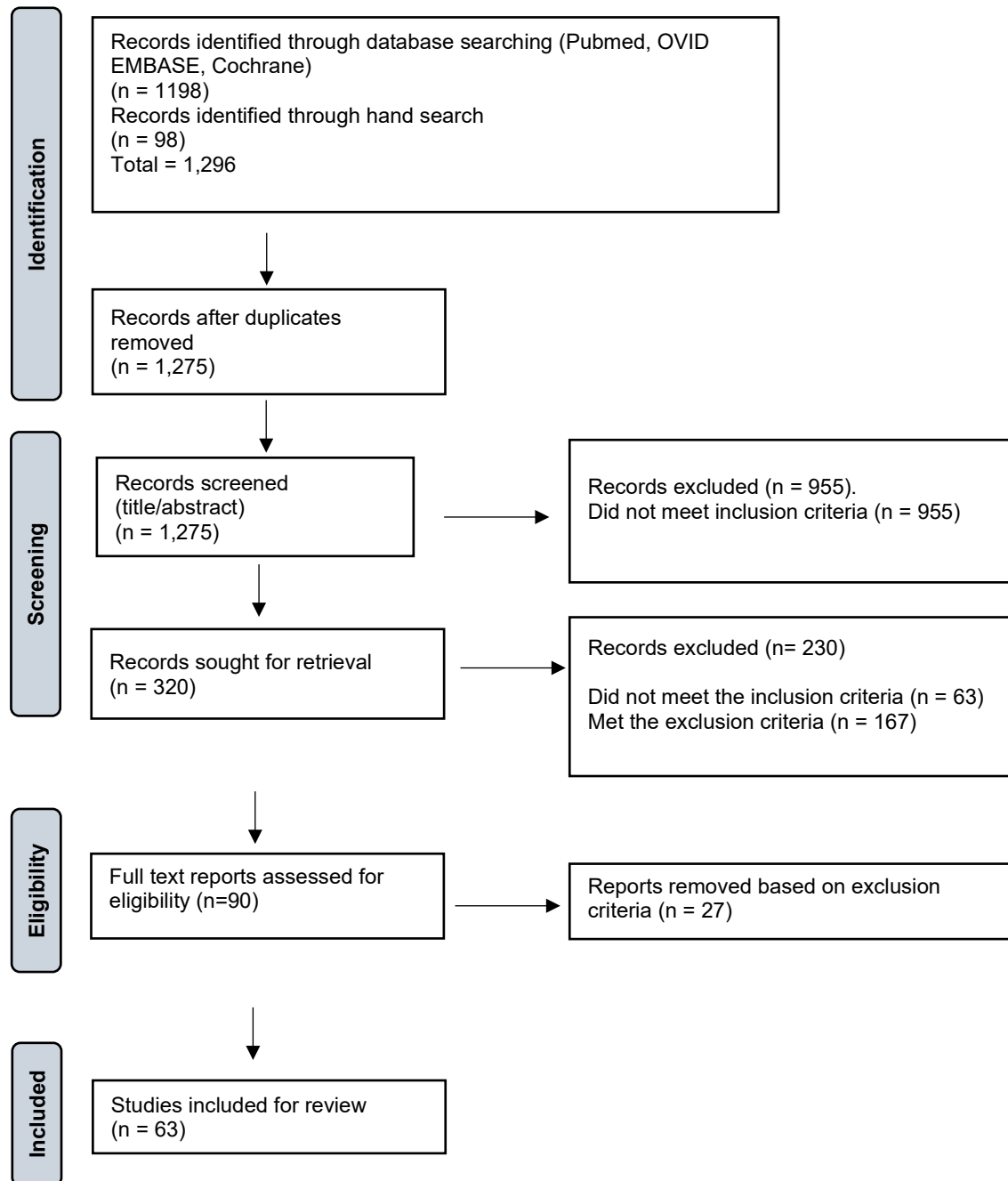
Included studies were full-text, peer-reviewed articles written in English, reporting primary studies concerned with preparation courses for clinical examinations for clinical undergraduate students or postgraduate trainees. Studies were excluded if they were related to preparation for written examinations, preclinical undergraduate students, veterinary medicine, or the teaching of surgical or practical skills. Conference reports, case reports, and commentaries and literature reviews were excluded.

**C Search terms**

Specific search terms and derivatives were used: Medical/paediatr\* AND educat\*/undergraduate/trainee/training AND clinical exam\*/exam\*/certification exam AND residen\* AND/OR prepar\*. Four specific vocational examinations were also used in the exam part of the string: Membership of the Royal College of Paediatrics and Child Health (MRCPCH), The Royal Australasian College of Physicians: Paediatrics and Child Health, United States Medical Licensing Examination (USMLE) and The Royal Australasian College of Physicians (RACP).

**Figure 1.**

**PRISMA Article selection**



Two authors (EG, PCI) independently screened titles and abstracts, followed by eligibility screening (full text). Article selection was independently reviewed (GD). Where there was uncertainty about article inclusion, articles were discussed by the authors EG, GD, and PCI, with reference to inclusion and exclusion criteria until a consensus was reached. We extracted the following information: author (s), year of publication, country of study origin, level of training,

type/name of the clinical examination of interest, study design, study aims, population sample, and key reported findings. We did not undertake quality appraisal or risk of bias assessments.

We did, however, go beyond the requirements of narrative reviews by undertaking a thematic analysis (Jowsey, 2016) led by the first and last authors (EG, PCI). This involved a close reading of full texts, highlighting subheadings and key results that related to our research question. We grouped data into categories (codes) and grouped these into themes (Appendix 1). We met as a group to discuss identified themes as well as how our positionalities shaped our various lenses on what we deemed important. Each team member is experienced in clinical teaching, clinical examinations, and clinical research. Our team included two paediatricians (EG, CG) and three social scientists (PCI, GD, TJ). We all live in affluent multicultural cities. We are all mindful of social justice matters such as equitable care, integrity, and equitable student opportunity. Our positionalities informed how we interpreted the reviewed literature.

### **III RESULTS**

The 63 studies were from the USA (n=25), UK (n=18), Europe (n=7), Canada (n=5), Australia or New Zealand (n=4), and one each from Pakistan, Korea, China, and Israel. Forty-eight studies focused on registrars or residents, fourteen on clinical medical students, and one on international medical graduates. A range of medical disciplines were represented, including paediatric medicine (n=12), surgery (n=17), internal medicine (n=6), emergency medicine (n=3), family medicine (n=2), psychiatry (n=2), radiation oncology (n=2), and multiple topics (n=15). Other subspecialties (intensive care, ophthalmology, anaesthesiology, neurology) were covered by only one paper each. Eight studies were published before 2010, and 20 studies from 2020 to 2024. Details of included studies are summarised in Appendix 2.

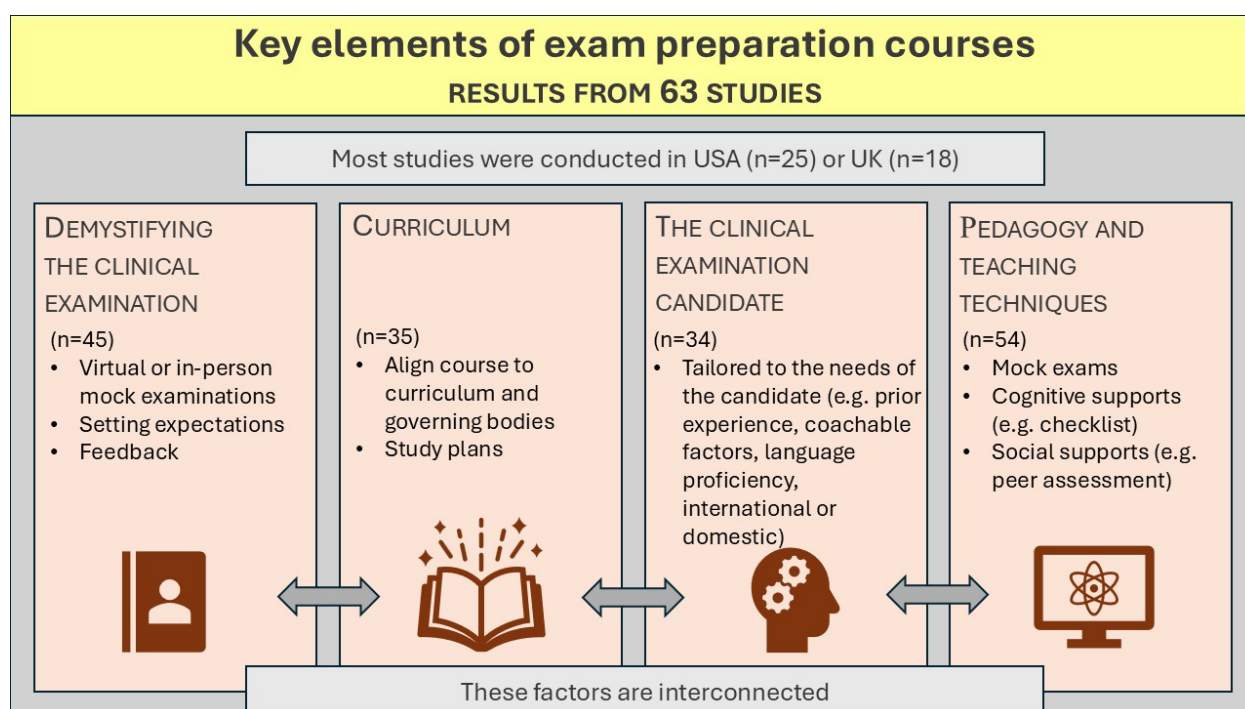
Research methodologies included qualitative studies (n=33), ten of which utilised semi-structured interviews or focus groups; quantitative studies (n=10); mixed methodology studies (n=18); and descriptive studies (n=2). Twenty-one studies reported on final examination results.

#### **A Themes across included studies**

Four key themes concerning how preparation courses prepare trainees for clinical examinations emerged from the literature: 1) Effective pedagogy - including cognitive and social supports and technological aids ; 2) Curriculum alignment ; 3) Accounting for personal factors and experiences of clinical examination candidates including clinical expertise, language factors, and mentorship; and 4) Demystifying clinical examinations through identifying evolving formats and supervision factors, and familiarising trainees with examination conditions or components via mock examinations. These themes are summarised in Figure 2. In Appendix 1, we provide details of themes and codes, and the literature included in each theme is provided in Appendix 3.

**Figure 2.**

**Summary of thematic findings**



**B Theme 1. Pedagogy and teaching techniques**

This theme examines how extracurricular courses utilise different teaching supports and strategies, underpinned by specific teaching theories, to enhance trainee learning. Table 2 lists the different pedagogies described by studies that considered theory-informed practice.

**Table 2. Pedagogy underpinning the reviewed literature**

| Pedagogy described by studies utilising theory-informed practice.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Bloom's Taxonomy (Lenz et al., 2018)</li> <li>Constructive alignment (Chon et al., 2018; Garofalo et al., 2023; Harendza et al., 2023; Harry et al., 2017; Lu et al., 2020; Shebrain et al., 2021; Young et al., 2014)</li> <li>Deliberate practice (Park et al., 2018; Saeed et al., 2023; Siddharthan et al., 2017; Wiggins et al., 2008)</li> <li>Experiential learning (Levine et al., 2017)</li> <li>Kolb's reflective model (Malhotra et al., 2008; Ryan et al., 2019)</li> </ul> |

Teaching supports focussed on addressing cognitive load included clinical examination checklists (Benjamin et al., 2019; Martinez et al., 2015; Park et al., 2018; Saeed et al., 2023), marking rubrics (Lu et al., 2020; Noel et al., 2016; Park et al., 2018), and specialty-specific resources (Brescia et al., 2022; Caretta-Weyer, 2018; Cooper et al., 2013; Fischer et al., 2016; Kleiven et al., 2016; Smith et al., 2013). Several studies highlighted the importance of teaching scaffolded by social support techniques via various approaches including trainees taught by peers (Bevan et al., 2019; Grover et al., 2022; Martinez et al., 2015; Siddiqui et al., 2018; Young et al., 2014) or near-peers

(Mediratta et al., 2022; Rashid et al., 2011; Stone et al., 2021; Young et al., 2014), trainees teaching medical students or peers (Kleiven et al., 2016; Martinez et al., 2015; Siddiqui et al., 2018), group practice (Rudland et al., 2008), team-based learning (Caretta-Weyer, 2018), practising with peers (Brescia et al., 2022; Harendza et al., 2023; Kleiven et al., 2016), observing and assessing peers (Abouljian et al., 2010; Bevan et al., 2019; Caretta-Weyer, 2018; London et al., 2014; McKenna, 2018b), patient feedback (Harendza et al., 2023), a buddy system (Jerrom et al., 2017; Lenz et al., 2018), and peer feedback following mock examinations (Abouljian et al., 2010; Fischer et al., 2016; Harendza et al., 2023; Karthaus & Schmidt, 2016; London et al., 2014; McKenna, 2018).

Teaching supports provided can be grouped into two main categories: strategies aimed at reducing cognitive load and those designed to enhance social learning in clinical education. Table 3 outlines the support mechanisms within each category.

**Table 3. Teaching Support Categories**

| Teaching Support Category                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cognitive Load Supports                                                                                                                                                                                                                                                                                                                                                                                                                                   | Social Support Techniques                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>• Clinical examination checklists (Benjamin et al., 2019; Martinez et al., 2015; Park et al., 2018; Saeed et al., 2023)</li> <li>• Marking rubrics (Lu et al., 2020; Noel et al., 2016; Park et al., 2018; Saeed et al., 2023)</li> <li>• Specialty-specific resources (Brescia et al., 2022; Caretta-Weyer, 2018; Cooper et al., 2013; Fischer et al., 2016; Kleiven et al., 2016; Smith et al., 2013)</li> </ul> | <ul style="list-style-type: none"> <li>• Peers (Bevan et al., 2019; Grover et al., 2022; Martinez et al., 2015; Siddiqui et al., 2018; Young et al., 2014)</li> <li>• near-peers (Mediratta et al., 2022; Rashid et al., 2011; Stone et al., 2021; Young et al., 2014)</li> <li>• trainees teaching medical students or peers (Kleiven et al., 2016; Martinez et al., 2015; Siddiqui et al., 2018)</li> <li>• Group practice (Rudland et al., 2008)</li> <li>• Team-based learning (Caretta-Weyer, 2018),</li> <li>• Practising with peers (Brescia et al., 2022; Harendza et al., 2023; Kleiven et al., 2016)</li> <li>• Observing and assessing peers (Abouljian et al., 2010; Bevan et al., 2019; Caretta-Weyer, 2018; London et al., 2014; McKenna, 2018)</li> <li>• Patient feedback (Harendza et al., 2023)</li> <li>• A buddy system (Jerrom et al., 2017; Lenz et al., 2018),</li> <li>• Peer feedback following mock examinations (Abouljian et al., 2010; Fischer et al., 2016; Harendza et al., 2023; Karthaus &amp; Schmidt, 2016; London et al., 2014; McKenna, 2018)</li> </ul> |

Differing approaches to utilising teacher supports included senior consultant-led teaching (Ferguson et al., 2014; Grech & Buttigieg, 2012; Harry et al., 2017; Jerrom et al., 2017; Low et al., 2013; Martinez et al., 2015), utilising teachers with recent formal examiner experience (Cooper et al., 2013; Crockford et al., 2004; Harry et al., 2017; Peters et al., 2020), facilitation by clinical education specialists (Ferguson et al., 2014) and peer teachers (Bevan et al., 2019; Harendza et al., 2023; Karthaus & Schmidt, 2016; Young et al., 2014). One study specified that formal examiners should not be used (Fiedler et al., 2020). Teachers also played roles in clinical supervision (Kleiven et al., 2016; Low et al., 2013; MacDonald & Ellis, 2011; Subhas et al., 2009; Tang et al., 2021), mentorship (Mahajan & Stark, 2007), and debriefing (Fischer et al., 2016; Harendza et al., 2023; Subhas et al., 2009). Formal systematic programmes of consultant-led bedside teaching were associated with higher pass rates compared to ad-hoc opportunistic bedside teaching (Ferguson et al., 2014; Harry et al., 2017; Jerrom et al., 2017). Teaching and mock assessments from examiners not known to trainees improved feedback objectivity (Fiedler et al., 2020; Garofalo et al., 2023; Goodman et al., 2021; Subhas et al., 2009). Formal teaching on giving feedback to clinical examination teachers was beneficial and likely to improve the quality of feedback (Bevan et al., 2019; Low et al., 2013; Rochlen et al., 2021; Young et al., 2014).

Technology-enhanced teaching approaches included WhatsApp groups (Jerrom et al., 2017), video-based learning (Saeed et al., 2023), online tutorials or virtual mock examinations (Chhabra et al., 2020; Fiedler et al., 2020; Garofalo et al., 2023; Goodman et al., 2021; Lu et al., 2020;

Stone et al., 2021; Waldau et al., 2017), recording sessions to aid self-assessment (Guzman et al., 2008; Levine et al., 2017; Subhas et al., 2009), and learning supported by artificial intelligence (Chon et al., 2018). A flipped classroom approach, combined with blended learning, supported medical students (Saeed et al., 2023) and residents (Benjamin et al., 2019) in balancing their studies with busy workloads.

Several studies showed online learning could effectively teach clinical reasoning and communication techniques (Grover et al., 2022; Harendza et al., 2023; Ryan & Edwards., 2022). Technological challenges identified include connectivity (Chhabra et al., 2020; Garofalo et al., 2023; Grover et al., 2022), timing issues (Garofalo et al., 2023), and limitations to practising clinical skills (Grover et al., 2022).

Several studies incorporated longitudinal teaching into their pedagogical approach, using techniques such as experiential learning (Levine et al., 2017; Malhotra et al., 2008), repeated practice over time (Abouljian et al., 2010; Crockford et al., 2004; Fischer et al., 2016; Kleiven et al., 2016; McKenna, 2018; Wiggins et al., 2008), repeated feedback (verbal and group debriefing) (Fischer et al., 2016), effective clinical supervision (Tang et al., 2021), and mini-CEX assessments (Malhotra et al., 2008).

Commercial examination courses report limited information about pedagogical approaches (Gondhalekar et al., 2021; Jones et al., 2015).

## **C Theme 2. Curriculum alignment**

This theme examines important considerations for curriculum development in extracurricular courses to optimise clinical examination success, including curriculum alignment and focus, teacher focus and interpretation, and the use of outcome monitoring for curriculum development. Studies suggested that preparation courses best prepare trainees for passing clinical examinations by aligning course content with curriculum learning aims (Garofalo et al., 2023; Harendza et al., 2023; Harry et al., 2017; Lu et al., 2020; Mediratta et al., 2022; Saeed et al., 2023; Shebrain et al., 2021; Stone et al., 2021; Tang et al., 2021; Young et al., 2014). A preparation course focused on tricky examination topics was associated with improved student confidence (Rashid et al., 2011). Several studies highlighted the benefits of including topics that trainees found more difficult or struggled to gain clinical exposure in (Benjamin et al., 2019; Martinez et al., 2015; Smith et al., 2013). In a cross-sectional study of paediatric residents, fellows, paediatricians, and subspecialists, respondents were asked to identify cardiology-specific curriculum objectives from the American Board of Paediatrics that were most important to their learning. Paediatricians rated objectives recognising the clinical features of cardiac disease higher than residents, while fellows rated initial management higher than paediatricians. Patient-centred communication and longitudinal concerns were among the lowest-rated objectives, despite featuring heavily in the work of General Paediatricians (Neal et al., 2017). Conversely, patient-centred communication and clinical reasoning are often highlighted as key focuses for examination preparation courses (Crockford et al., 2004; Grover et al., 2022; Harendza et al., 2023; Harry et al., 2017; Jerrom et al., 2017; Levine et al., 2017; Low et al., 2013; Lu et al., 2020).

A small study of medical registrars showed minor improvements in trainee ability to identify a normal jugular venous pressure (JVP) following clinical examination preparation. The authors suggest that training was sufficiently aligned with the curriculum to support the increased skills needed to act as a senior physician (Sibbin et al., 2016).

The different priorities of teaching, focused on passing the examination (Jerrom et al., 2017; Levine et al., 2017; MacDonald & Ellis, 2011; Rudland et al., 2008), versus teaching that emphasises real-world skills with less relevance to the examination (Malhotra et al., 2008), may conflict with clinical examination preparation. Several studies highlighted the importance of a structured programme across the whole training period rather than immediately before the oral examination (Crockford et al., 2004; Fischer et al., 2016; London et al., 2014; Tang et al., 2021). One study highlighted the importance of developing a systematic curriculum and study plan to ensure trainees learn what is needed to be safe clinicians, with training curriculum success

measured by final clinical exam results (Tang et al., 2021). Final examination pass rates are frequently used as a marker of training programme quality (Aboulian et al., 2010; Fischer et al., 2016; Guzman et al., 2008; Higgins et al., 2016; Kimbrough et al., 2018; London et al., 2014). Several studies described how monitoring final examination outcomes (Jerrom et al., 2017; Ryan et al., 2019; Tang et al., 2021) or trainee satisfaction (Benjamin et al., 2019; Bevan et al., 2019; Karthaus & Schmidt, 2016; Sloan, 2023; Stone et al., 2021) may be useful for quality improvement. Mock clinical examinations can identify gaps in a programme curriculum (Subhas et al., 2009).

### **D Theme 3. The clinical examination candidate**

This theme explores how personal factors, candidate experiences, and professional support related to examination success influence the success of clinical examination preparation courses. Age (Waldauf et al., 2017), baseline clinical knowledge (Jones et al., 2024), previous academic outcomes (Waldauf et al., 2017), motivation and organisational skills (Stanley et al., 2006), and clinical experience - years and caseload exposure (Fischer et al., 2016; Lu et al., 2020) were identified as important factors informing course design and engagement. Coachable factors - including confidence, clothing choices, communication skills, and style - were perceived to be associated with examination success (Mahajan & Stark, 2007), for which specific teaching may be beneficial (Karthaus & Schmidt, 2016; Lenz et al., 2018; London et al., 2014; Rochlen et al., 2021). Language factors played a role, with English as a first language associated with higher scores (Low et al., 2013; Waldauf et al., 2017) and greater examination success in two studies (Low et al., 2013; Waldauf et al., 2017).

International medical graduates (IMGs) were at risk of lower clinical examination scores (Low et al., 2013), facing language barriers, cultural assumptions, social isolation, discrimination, and inadequate professional support (Lenz et al., 2018; Levine et al., 2017; Low et al., 2013; Mahajan & Stark, 2007). IMGs reported benefits from specific clinical examination teaching, with a focus on communication skills (Lenz et al., 2018; Levine et al., 2017), as well as reduced social isolation through a buddy system (Lenz et al., 2018). However, courses targeting IMGs for examination preparation may incur high costs with limited evidence of effectiveness (Gondhalekar et al., 2021).

Studies described residents' challenges in balancing long hours, heavy clinical loads, and managing examination preparation stress (Aboulian et al., 2010; Garofalo et al., 2023; Harry et al., 2017; McKenna, 2018; Peters et al., 2020; Ryan & Edwards, 2022; Tang et al., 2021), emphasising the need for time-efficient examination preparation (Aboulian et al., 2010).

Assessment-related stress, anxiety, and negative mental health impacts were common themes (Crockford et al., 2004; Goodman et al., 2021; Kleiven et al., 2016; London et al., 2014; Malhotra et al., 2008; Onlock et al., 2023; Wiggins et al., 2008). Candidates attempted to strike a balance between the demands of examination preparation and the benefits of career progression (Ferguson et al., 2014; Onlock et al., 2023). Examination failure was associated with stress, financial burden, and delays in career progression while also affecting local workforce planning (Ferguson et al., 2014), highlighting the strong incentives for both trainees and training centres to optimise exam preparation support. Candidates cited specific teaching on anxiety management as beneficial (Crockford et al., 2004; London et al., 2014).

Candidate engagement in clinical examination practice was influenced by concern about the impact on patients (Rudland et al., 2008). Saeed et al. (2023) increased simulation-based teaching to address this concern, while Grech & Buttigieg (2012) aimed to include enough children to minimise patient fatigue.

Access to preparation resources varied among candidates, influenced by geographical distance or institutional barriers (Cooper et al., 2013; Goodman et al., 2021; Grech & Buttigieg, 2012; Harry et al., 2017; Stone et al., 2021). Isolation was identified as negatively impacting examination preparation (Lenz et al., 2018; Mahajan & Stark, 2007), while personal and professional support benefited residents (Onlock et al., 2023). Connecting trainees with

mentors may support examination preparation (Harry et al., 2017; Lenz et al., 2018; Mahajan & Stark, 2007). Mock clinical examinations were used to identify at-risk candidates for targeted additional support (Fingeret et al., 2016; Subhas et al., 2009).

#### **E Theme 4. Demystifying the clinical examination**

This theme explores how extracurricular examination courses can help trainees familiarise themselves with exam formats and expectations and build confidence in the examination setting.

Clinical examination formats have evolved following the COVID-19 pandemic (Jones et al., 2024; Ryan & Edwards., 2022; Ryan et al., 2019; Sloan, 2023; Stone et al., 2021). Trainees may have a limited understanding of the latest examination formats (Stone, 2021), and those who sat previous iterations may struggle with newer formats (Cooper et al., 2013). Virtual or in-person mock examinations are commonly used to acclimate trainees to unfamiliar formats (Chhabra et al., 2020; Fiedler et al., 2020; Garofalo et al., 2023; Grech & Buttigieg, 2012; Mediratta et al., 2022; Rudland et al., 2008; Sloan, 2023; Subhas et al., 2009).

Mock examinations - discussed in 34 studies - serve multiple purposes, including developing situational awareness and fostering comfort in the examination setting (n=7) (Caretta-Weyer, 2018; Higgins et al., 2016; London et al., 2014; McKenna, 2018; Siddiqui et al., 2018; Subhas et al., 2009). Some studies discuss safe learning environments to support trainees in learning from mistakes (Bevan et al., 2019; Harendza et al., 2023; Karthaus & Schmidt, 2016; Martinez et al., 2015; Rudland et al., 2008; Saeed et al., 2023), while other studies emphasise the benefits of managing stress through exposure to examination-related anxiety (Aboulian et al., 2010; Grech & Buttigieg, 2012; Kleiven et al., 2016; London et al., 2014; Peters et al., 2020; Wiggins et al., 2008). Feedback from mock examinations boosts trainee confidence (Bevan et al., 2019; Cooper et al., 2013; Grover et al., 2022; Mediratta et al., 2022; Peters et al., 2020; Sloan, 2023; Young et al., 2014) and highlights learning gaps to guide future study (Bevan et al., 2019; Lu et al., 2020; McKenna, 2018; Siddiqui et al., 2018). Progressive exposure to mock oral examinations correlates with increased comfort and reduced anxiety (Kleiven et al., 2016; London et al., 2014; McKenna, 2018; Noel et al., 2016; Wiggins et al., 2008). Mock examinations were associated with an increase in the first pass rate in surgical oral examinations (Fingeret et al., 2016; Fischer et al., 2016; London et al., 2014) and the USMLE Step 2 Clinical Examination (Ryan et al., 2019). Studies emphasise the benefits of setting expectations and offering feedback concerning cultural considerations for professionalism, performance, and communication skills in examinations (Guzman et al., 2008; London et al., 2014; Lu et al., 2020; MacDonald & Ellis, 2011; Mahajan & Stark, 2007; McKenna, 2018; Ryan & Edwards, 2022; Subhas et al., 2009). Feedback approaches include emphasising feedback based on attributes or behaviours rather than focusing on knowledge (Higgins et al., 2016; Rochlen et al., 2021). Immediate delivery of verbal or written feedback is emphasised for maximising learning opportunities (Fingeret et al., 2016; Garofalo et al., 2023; Grech & Buttigieg, 2012; Harendza et al., 2023; Higgins et al., 2016; Lu et al., 2020; Noel et al., 2016; Ryan et al., 2019; Shebrain et al., 2021). Assuring consistency in mock examiners' feedback is crucial, requiring specific training for mock examiners, monitoring inter-rater reliability, and ensuring alignment of grading to the real examination format (Goodman et al., 2021; Higgins et al., 2016; Low et al., 2013; Lu et al., 2020; McKenna, 2018; Rochlen et al., 2021). Supervisors play a pivotal role in demystifying examiners' expectations. However, they may perpetuate a hidden curriculum that focuses on examination-related skills not used in everyday practice (MacDonald & Ellis, 2011).

Mock examinations may involve real patients (Grech & Buttigieg, 2012), standardised patients (Harendza et al., 2023; Levine et al., 2017; Ryan et al., 2019; Tang et al., 2021), artificial intelligence (Chon et al., 2018), mannequins (Saeed et al., 2023), peers (Bevan et al., 2019; Grover et al., 2022; Martinez et al., 2015; Park et al., 2018), consultants (Noel et al., 2016), or junior colleagues or students (Siddharthan et al., 2017; Siddiqui et al., 2018) as model patients. Involving junior trainees who are not yet preparing for examinations in mock examination delivery

allows them to understand the examination process, guiding their future studies (McKenna, 2018; Mediratta et al., 2022; Siddiqui et al., 2018).

Contentious aspects of mock examination best practice include frequency (Kimbrough et al., 2018; Wiggins et al., 2008), virtual or in-person (Chhabra et al., 2020; Goodman et al., 2021; Shebrain et al., 2021), use of a pass/fail mark (Fiedler et al., 2020; Fischer et al., 2016; Grech & Buttigieg, 2012; Higgins et al., 2016; Ryan et al., 2019; Shebrain et al., 2021), familiar or unfamiliar examiner (Fiedler et al., 2020; Garofalo et al., 2023; Subhas et al., 2009), and when to initiate mock examination participation (Fingeret et al., 2016; Higgins et al., 2016; Kimbrough et al., 2018; London et al., 2014; Lu et al., 2020; McKenna, 2018).

#### IV DISCUSSION

Various social, cognitive, environmental, teacher and curriculum supports were utilised to enhance preparation for clinical examinations. Mock examinations were extensively utilised and valued by trainees. Despite variations in approach, mock examinations served to demystify examinations, reduce trainee anxiety and improve confidence. They fostered communication skills, professionalism, clinical reasoning, effective feedback, and identified candidates at risk of failure (Cahn et al., 2023; Garofalo et al., 2023; Peters et al., 2020).

Examiner-led teaching may convey a more accurate understanding of examination expectations (Cooper et al., 2013), while experienced clinicians may provide more effective physical examination teaching (Ramani, 2008). The benefits of near-peer teaching include a lower-stakes, safer learning environment with a sense of shared purpose (Tamachi et al., 2018) and more up-to-date teaching (Ramani et al., 2016). Incorporation of near-peer teaching into programmes requires adequate preparation, without which near-peer teachers may adopt ineffective teaching methods (Ramani et al., 2016). Examiners also benefit from developing feedback practices (Bevan et al., 2019; Low et al., 2013; Rochlen et al., 2021; Young et al., 2014) to improve the quality of feedback given to trainees (Ramani & Krackov, 2012). However, studies in this review do not provide guidance on how feedback should be delivered to enhance examination teaching (Rochlen et al., 2021). Alsahafi and colleagues suggest that feedback should be balanced, specific, and constructive (Alsahafi et al., 2023). Students may also struggle to engage with feedback following examination failure (Jay et al., 2023), especially if feedback is perceived as lacking credibility (Ramani et al., 2019a). Supporting a wider culture of safety, growth, and trusting relationships could support engagement in the feedback process (Ramani et al., 2019a, 2019b).

Curriculum alignment is a prominent feature in educational research, ensuring that learning objectives, activities, and assessments align to support student performance (Biggs, 2002). Although success in the clinical examination may be considered the ultimate goal by trainees (Rudland et al., 2008), if students do not acquire the necessary long-term knowledge, skills and attributes, the clinical examination will have failed in its intended goal of safeguarding the public and improving outcomes for patients (Baker, 2021; Tang et al., 2021; Weller et al., 2014; Yudkowsky & Szauter, 2021). Trainees must be able to apply knowledge and skills to complex real-world situations. The *Curriculum Design Coherence Model* (McPhail, 2021) could help educational designers think more systematically about how to teach theoretical forms of knowledge, ensuring that trainees are adequately prepared to apply this knowledge to a wider variety of clinical situations.

No included studies considered the effects of work hours or clinical exposure on clinical reasoning, medical professionalism, or physical examination skills. While increasing clinical experience is initially associated with improved examination outcomes (Noel et al., 2016), it may have a detrimental effect on trainee education beyond a certain point (Nagasaki et al., 2022; Nickerson et al., 2020; Tang et al., 2021). Studies in this review also discuss barriers to trainee and faculty involvement in examination teaching, including excessive clinical workload and long hours (Aboulian et al., 2010; Benjamin et al., 2019; Garofalo et al., 2023; Harry et al., 2017; Saeed

et al., 2023). However, more research is needed to understand the impact of duty hours in Australasia.

The review revealed that personal factors, such as being an English-as-a-second-language speaker and variations in communication styles due to cultural background, are related to examination success. Studies in this review show poorer outcomes for IMGs and English-as-a-second-language trainees (Low et al., 2013; Waldauf et al., 2017). IMGs may adopt communication styles deemed inconsistent with examination style and receive lower marks from examiners despite no difference in content (Low et al., 2013; Wass et al., 2003). Focused teaching on examination-style communication with the explicit teaching of the hidden curriculum (Karthaus & Schmidt, 2016; Lenz et al., 2018; MacDonald & Ellis, 2011; Mahajan & Stark, 2007; McKenna, 2018) may help to combat the disadvantage caused by subtle differences in communication.

There is concern that the cost of examination preparation courses presents a barrier to candidates from lower socio-economic backgrounds or underrepresented ethnicities. The wide range of prices for commercial preparation courses for IMGs raises the possibility of financial exploitation, given the high stakes surrounding examination success (Girotti et al., 2020) and the minimal evidence of the effectiveness of these courses (Cahn et al., 2023; Cooper et al., 2013; Gondhalekar et al., 2021; Kimbrough et al., 2018). These courses are extensively used by candidates from a variety of different disciplines and that breadth adds an additional layer of complexity (Brescia et al., 2022; Fischer et al., 2016; Jones et al., 2015; Kimbrough et al., 2018; Smith et al., 2013).

Bias, racism, and discrimination are also widespread at both medical school, junior doctor, and physician levels, leading to increased risk of practitioners from marginalised backgrounds leaving the profession, reducing diversity in the health workforce (Cormack et al., 2024), and impacting the integrity of clinical examination grades (McManus et al., 2013; Esmail & Roberts, 2013). Therefore, it is essential to consider the growing concerns about bias, inequity, and discrimination in examinations (McManus et al., 2013; Wass et al., 2003; Cormack et al., 2024).

There is an increasing understanding of how racism and microaggressions impact self-worth, self-efficacy, and sense of belonging, blunting career trajectories and resulting in less diverse groups, thereby perpetuating this cycle (Cerdeña et al., 2022; Klein et al., 2022). Strategies to combat this cycle include formal education on structural discrimination and implicit bias (Gonzalez et al., 2023; Royce et al., 2023), as well as tackling bias within the teaching environment (Curtis et al., 2025). Educators must act respectfully in the moment to name these behaviours as unprofessional and redirect the individual towards more professional behaviour, followed by a debriefing at a safe time and space (Young et al., 2020). Promoting cultural and psychological safety in the learning environment is essential to reduce bias and discrimination and promote equity and respect in health professions (Curtis et al., 2025; Mateo & Williams, 2020).

The literature consistently highlights the impact of high-stakes clinical examinations on trainee mental health, relationships, and social activities (Onlock et al., 2023; Weller et al., 2014) and the adverse effects of failure (Ferguson et al., 2014; Jay et al., 2023; Ryan et al., 2019), which may be under-recognised by educators (Goodman et al., 2021). Addressing the culture of fear within examination preparation is a potential avenue for improving trainee mental health outcomes (Onlock et al., 2023). Repeated exposure to examination stress to reduce performance anxiety is an approach used in surgical training (Aboulian et al., 2010; Fischer et al., 2016; London et al., 2014; McKenna, 2018; Pennell & McCulloch, 2015; Subhas et al., 2009) while other specialities focus more on the deleterious effects of social isolation and propose ways to enhance connection including formal mentorship (Jerrom et al., 2017; Lenz et al., 2018; Mahajan & Stark, 2007; Onlock et al., 2023).

## **V STRENGTHS AND LIMITATIONS OF THIS STUDY**

This narrative review is the first review to look holistically at clinical examination preparation approaches from various specialities, training levels, and countries. Studies considered examination candidates from different stages of training in the medical profession. The first

author's (EG) clinical experience may have influenced the selection of medical training studies (Jowsey, 2016). Eighty-five per cent of the studies identified in this narrative review are from English-speaking countries, which may contribute to bias in the findings.

## **VI CONCLUSION**

This narrative review of 63 studies identified several approaches for supporting clinical examination candidates that were associated with improved trainee confidence. The key themes considered by these studies included pedagogical approaches and teaching techniques to enhance learning of physical examination techniques, curriculum alignment, the experience of examination candidates, and methods for demystifying the clinical examination.

The studies examined various interventions aimed at enhancing learning and facilitating feedback and reflection for candidates. Mock examinations, despite a wide variation in approaches, were a popular approach to aid clinical examination preparation, used to increase trainee familiarity with the clinical examination format, and support trainee confidence and stress management. This review has highlighted disparities in outcomes for international medical graduates and trainees who speak English as a second language. Further research is needed into methods of enhancing cultural and psychological safety in examination preparation teaching.

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The authors declare no conflicts of interest.

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### **Author contributions:**

All authors have contributed to the paper in accordance with ICMJE recommendations.

- substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of data for the work;
- 1. AND drafting the work or revising it critically for important intellectual content;
- 2. AND final approval of the version to be published;
- 3. AND agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved
- 4. Acknowledge the copyright statement

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## 1 Appendix 1: Summary of papers included in the review

|    | <u>Author, year.</u><br><u>Country, Discipline.</u><br><u>Level of training.</u><br><u>Examination</u>                                                                                                                         | <u>Methods and</u><br><u>study design</u>                                                                                                | <u>Aims of study and description</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <u>Sample</u>                                                                                                | <u>Key findings</u>                                                                                                                                                                                                                                                                                                                                                                                                                |
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| 1  | <u>Author, year:</u> Saeed et al., 2023, <u>Country:</u> Pakistan, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Medical student, <u>Examination:</u> End of year objective structured clinical examination (OSCE) | Mixed methods: Focused group discussions, perceived self-efficacy, OSCE grade for intervention group compared to previous year's cohort. | To measure the effectiveness of hybridizing video-based learning with simulation for the teaching of clinical skills on the perceived self-efficacy of students, the student's satisfaction with the learning pedagogy, and their performance in their clinical exams (OSCE). The intervention: videos involving clinical cases with embedded questions to prompt learning then in person simulation of examination skills on a mannequin followed by debrief and repeated deliberate practice with feedback from a facilitator. Comparison: routine teaching with clinical skills practice on a mannequin. | Intervention: n= 100 4th year medical students (2020/21). Control: N=100 4th year medical students (2019/20) | Hybridisation of video learning and simulation lead to increased self-efficacy scores for the 4 clinical examinations. The structure of the intervention was supported by students. Students received higher OSCE scores in the neurological and abdominal stations in the intervention group.                                                                                                                                     |
| 2  | <u>Author, year:</u> Sloan, 2023, <u>Country:</u> UK, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination                                                     | Pre and post course survey of trainee confidence.                                                                                        | To evaluate the effect of a clinical examination course on trainee confidence in the MRCPCH clinical examination. A mock examination day consisted of 6 stations over a morning and afternoon session.                                                                                                                                                                                                                                                                                                                                                                                                      | n=22 registrars. 7 trainees completed pre course survey. 18 trainees completed the post course survey.       | 100% of attendees reported increased confidence with the clinical examination.                                                                                                                                                                                                                                                                                                                                                     |
| 3. | <u>Author, year:</u> Benjamin et al., 2019, <u>Country:</u> USA, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Resident, <u>Examination:</u> Clinical examination (CEX) assessment                                 | Quantitative knowledge assessment. Direct clinical skills observation: CEX. Qualitative evaluation: module-feedback survey.              | Evaluation of a new curriculum to teach residents examination skills for children with neuromuscular disability. Curriculum: powerpoint with embedded video, a knowledge assessment and clinical examination assessment with facilitator feedback and resident feedback for iterative course improvement                                                                                                                                                                                                                                                                                                    | n= 37 final year paediatric residents over 8-month period.                                                   | Residents scored more than 80% in all domains of the CEX, lower scores for detecting abnormal signs, communicating during the physical exam, and modifying the examination to the needs of the patient. Higher scores for communicating sensitively. Residents gave specific feedback for course improvement (including more findings or more modules or more specific examination techniques). Benefits of examination checklist. |

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| 4. | <u>Author, year:</u> Waldauf et al., 2017,<br><u>Country:</u> Europe,<br><u>Discipline:</u> Intensive Care, <u>Level of training:</u> Registrar, <u>Examination:</u> European Diploma in Intensive Care part 2 (EDIC2) | Prospective cohort study. Survey: preparatory course participation, self-reported demographic data, outcomes for results for part 1, part 2 examination. | To describe the factors that are associated with success in part 2 European Diploma in Intensive Care oral examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 427 candidates for oral EDIC 2 on 26 March 2015 and 5 November 2015 in 7 examination centres. Completed data for 341 (80%) available for analysis. | Factors associated with chance of success: English as native language (odds ratio 4.3 (95% CI 1.7–10.7)), use of Patient-centered Acute Care Training e-learning programme module (odds ratios 2.0 (1.2–3.3)), working in an EU country (odds ratios 2.5 (1.5–4.3)), and better results in the written part of the European Diploma in Intensive Care (for each additional SD of 6.1 points odds ratios 1.9 (1.4–2.4)).                                                 |
| 5. | <u>Author, year:</u> Martinez et al, 2015,<br><u>Country:</u> USA,<br><u>Discipline:</u> Internal medicine, <u>Level of training:</u> Resident, <u>Examination:</u> no specific examination                            | Cohort study. Knowledge assessment pre and post intervention. Survey including self-reported confidence pre and post intervention.                       | To describe the development of an innovative peer-assisted learning (PAL) model to teach five musculoskeletal areas and review effectiveness of this model in improving learner knowledge and confidence. Day 1 of course: residents reviewed study guide material and presented a teaching session to peers in small groups with support from consultant, followed by practice OSCEs where residents could be the standardised patient, observer or learner with feedback from two faculty. The second day, residents presented the same teaching session to interns then acted as standardised patients for interns and provided feedback using a checklist. | 42 interns and 44 senior residents on internal medicine rotation. Paired data available for 66 trainees and non-paired data for 77 trainees.       | Peer assisted learning of musculoskeletal examination lead to increased senior resident confidence in physical examination and treatment planning and increased musculoskeletal knowledge. The content was relevant and an area that is not usually well taught. Peer assisted learning provided valuable feedback and the opportunity for senior residents to improve teaching skills. The intensity of the intervention was excessive for many participants.          |
| 6. | <u>Author, year:</u> Grech & Buttigieg, 2012,<br><u>Country:</u> Malta,<br><u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination                        | Descriptive study. Description of an examination set up. Pass/fail grades for mock examination.                                                          | To describe a mock examination to prepare candidates for the MRCPCH clinical examination. Mock examiners and role players met prior to the examination, were briefed, and examination procedures discussed. Mock examiners were consultants and subspecialists. Junior paediatric trainees observed. Two patients (children) were used for each station to minimise fatigue. The mock examination followed real examination timing, structure,                                                                                                                                                                                                                 | 7 paediatric trainees.                                                                                                                             | 3 candidates received pass marks. 4 candidates received fail marks. A mock examination day is feasible. Meticulous timing is needed. Consider strategies to avoid children becoming bored or tired or uncooperative. Real patients, actors and other registrars are all options to provide an examination experience. Benefits of mock examination include familiarising candidates with the examination environment, assisting candidates to develop coping strategies |

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|    |                                                                                                                                                                                                                                                                                      |                                                                    | and contents with minor modifications. Written feedback and pass/ fail grade provided to candidates.                                                                                                                                                                                                                                                                                                                              |                                                                                                             | during high stress situations, identifying areas of weakness, feedback to guide study and practice.                                                                                                                                                                                                                                                                                                                                                                                 |
| 7. | <u>Author, year:</u> Onlock et al., 2023, <u>Country:</u> Canada, <u>Discipline:</u> Range of topics, <u>Level of training:</u> Resident, <u>Examination:</u> Royal College of Physicians and Surgeons of Canada, College of Family Physicians of Canada certification examinations. | Qualitative study. Individual semi-structured interviews.          | To describe the experiences of residents in their certification examination year to understand the impact on resident well-being, including the impact of the COVID-19 pandemic                                                                                                                                                                                                                                                   | 21 residents and physicians in independent practice from McMaster University and the University of Toronto. | 5 themes identified: 1. Examinations are a source of stress. 2. Examination preparation is associated with significant physical and mental health impacts. 3. There is a culture of fear around examinations. 4. Residents had to balance the benefits of examination preparation for career progression against the significant time and negative impacts preparation required. 5. Protective factors include personal and professional supports. Discussion of hidden curriculum. |
| 8. | <u>Author, year:</u> Caretta-Weyer, 2021, <u>Country:</u> USA, <u>Discipline:</u> Emergency Medicine, <u>Level of training:</u> Resident, <u>Examination:</u> Emergency Medicine Oral Board Examination (ABEM)                                                                       | Description of a simulation day.                                   | To describe a team-based approach to a simulation course for the Emergency Medicine Oral Board Examination. Course: quarterly oral board examination sessions. Residents review topics using open access resources before the session, complete a knowledge test, act as the trainee then as observer for second oral examination practice, then group debrief, then as a team discuss learning issues with team-based exercises. | Not reported                                                                                                | Improved resident satisfaction and comfort with the Emergency Medicine Oral Board Examination format and improved critical appraisal skills for free online resources. <a href="https://www.emra.org/books/emra-simulation-guide/how-to-use">https://www.emra.org/books/emra-simulation-guide/how-to-use</a> .                                                                                                                                                                      |
| 9. | <u>Author, year:</u> Neal et al., 2017, <u>Country:</u> USA, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Paediatrics curriculum, not specific examination                                                              | Survey - quantitative and qualitative data. Cross-sectional study. | To identify the most important cardiology-specific curriculum objectives from the American Board of Paediatrics curriculum according to a cross-sectional sample of trainees and paediatricians in Kentucky                                                                                                                                                                                                                       | 136 survey respondents (23 residents.) 1219 surveys sent out (response rate 10.2%).                         | Objectives in “most selected” content pertained to initial diagnosis (recognition of abnormality/disease) (n = 16), possible emergent/urgent intervention required (n = 14), building a differential (n = 8), and planning a workup (n = 4). Conversely, themes for “least selected” content included co-management with subspecialist (n = 15), knowledge useful in patient-family communication (n = 9), knowledge that can be referenced (as needed) (n = 7), and                |

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|     |                                                                                                                                                                                                                              |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                     | longitudinal/ follow-up concerns (n = 5). Residents tended to rate content related to recognition of clinical findings lower than fellows or paediatricians.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 10  | <u>Author, year:</u> Noel et al., 2016, <u>Country:</u> Canada, <u>Discipline:</u> Family medicine, <u>Level of training:</u> Resident, <u>Examination:</u> College of Family Physicians of Canada certification examination | Prospective longitudinal cohort study of practice simulated office oral examination results. | To evaluate whether simulated office oral examinations provide predictive information about readiness to sit the certification examination. Simulated office orals are a structured clinical examination with high content structure and face validity, with reasonable reliability. Examiners also acted as the patient and had a training session to ensure standardisation of acting and marking. Trainees underwent two simulated office oral examinations per year, and each examination was scored according to a rubric with a mark generated. Candidates received written feedback and a grade. A risk assessment plot was generated from the current practice simulated office oral z score vs the change in simulated office oral grade from previous assessment. | 65 eligible residents, 23 attended all 4 sessions.                                                                                  | Residents scored higher on the practice oral examinations as they progressed through their training with a linear relationship between time and score. This suggests this mock examination could be used to assess training progress and predict risk of passing the certification examination to identify trainees at risk for targeted support.                                                                                                                                                                                                                                                                                                                                                                   |
| 11. | <u>Author, year:</u> Crockford et al., 2004, <u>Country:</u> Canada, <u>Discipline:</u> Psychiatry, <u>Level of training:</u> Resident, <u>Examination:</u> Royal College certification examination in Psychiatry            | Qualitative study. Surveys before and after certification examination.                       | To examine which methods best prepare psychiatry trainees to sit the oral certification examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 44/68 responders to pre-examination survey. 29/44 responded to post examination survey. 100% of respondents passed the examination. | Most valuable learning experience: Observed interviews with an average of 16.3 informal and 7.3 formal interview practices in 6 months prior to examination. Suggestions for improvement in preparation: interview practice with real Royal College examiners, frequent interviews spread out over the 4 years of training not just final 6 months. Suggest having 2 examiners to observe practice interviews and give several points of specific feedback. Second most valuable: reading time. Third most valuable: specific teaching on interview skills, formulation skills, case vignettes - should be conducted over several years. Fourth most valuable: teaching on anxiety and stress reduction techniques. |

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| 12  | <u>Author, year:</u> Mediratta et al., 2022, <u>Country:</u> UK, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination                                                        | Description of course and mock examination. Pre / post course surveys for examination candidates and role-players. | To describe the registrar-led RIPPLE teaching programme and evaluate whether addition of a registrar-led virtual mock examination affected trainee confidence with examination preparation. The RIPPLE programme is a 6-week intensive virtual teaching course of small group teaching sessions led by post examination registrars and consultants with topics adapted to the RCPCH examination curriculum. The virtual mock examination involved 4 cases over 1.5 hours. | 22/26 trainees on RIPPLE course attended virtual mock examination. 6 trainees acted as role players. | Virtual course participants felt the quality and relevance of cases was high and felt that the mock examination increased their chances of passing. Role-players felt participation would help to guide their future study and their understanding of the examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 13. | <u>Author, year:</u> Stone et al., 2021, <u>Country:</u> Ireland, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> Royal College of Physicians of Ireland Part 2 Clinical Examination in Paediatrics | Pre and post course survey of trainee experiences of the course.                                                   | To evaluate a new clinical examination course held over 8 weeks in 2020, run by non-consultant hospital doctors and delivered to 14 Irish hospitals with 69 participating registrars.                                                                                                                                                                                                                                                                                     | 41/69 residents completed before survey. 32/69 completed after survey.                               | Online interactive lecture format delivered via zoom (during COVID-19 era) by paediatric trainees. Topics included: endocrinology, neurodevelopment, respiratory medicine, metabolic medicine, what to expect from the new examination format, neurology, nephrology, gastroenterology and cardiology. Suggestions from trainees for improvement: socially distanced small group tutorials, short quizzes, videos demonstrating clinical examination for complex patients, online bedside tutorials and history taking/communication type scenarios, "content directed towards potential examination questions" and "make sessions more interactive". Taught by registrars so may be limited specialist knowledge but care taken to ensure teaching matched curriculum. |

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| 14. | <u>Author, year</u><br>Ferguson et al., 2014, <u>Country:</u> UK, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination   | Local examination pass rate before and after the revision course initiative.                                                                | To evaluate a new clinical examination revision course held over 6 weeks with the aim of improving the examination pass rate. The course was a 6-week revision course delivered by the postgraduate medical education department combined with more coordinated case practice with consultants. | 22/28 trainees from the region passed after the initiative vs 13/30 trainees prior to initiative.                                                                                                                             | A 6-week revision course delivered by the postgraduate medical education department combined with more coordinated case practice with consultants was associated with an increased pass rate in the local area, higher than the national average compared to the previous system of ad hoc preparation organised by senior trainees and consultants.                                                                                                                                                                                                         |
| 15. | <u>Author, year:</u> Smith et al, 2013., <u>Country</u> UK, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination         | Questionnaire on trainee confidence in musculoskeletal (MSK) examination and resources for MSK learning and MRCPCH examination preparation. | To evaluate trainee self-reported confidence in MSK examination, access to MSK teaching, and resources used for MSK learning and MRCPCH examination preparation.                                                                                                                                | 35 trainees completed the survey. Unclear how many surveys sent out.                                                                                                                                                          | Trainee confidence for MSK examination was slightly higher than for neurology but lower than respiratory/ cardiology/ abdominal/ developmental stations. Trainee resources used (most to least frequent): bedside teaching, pGALS DVD, textbooks, MRCPCH clinical examination revision course, attending paediatric rheumatology clinics or a joint injection list. 46% thought a 1-day MSK revision course would be best for examination preparation compared to 34% who thought an e-learning module would be the best way to prepare for the MSK station. |
| 16. | <u>Author, year:</u> Siddhartha et al, 2017., <u>Country:</u> USA, <u>Discipline:</u> Internal medicine, <u>Level of training:</u> Resident, <u>Examination:</u> no specific examination | Scores on musculoskeletal OSCE. Survey feedback.                                                                                            | To evaluate the effectiveness of a workshop designed to teach musculoskeletal (MSK) examination skills to medical residents using medical students as standardised patients.                                                                                                                    | 13/22 residents (convenience sample) who attended lectures and MSK workshop evaluated by OSCE compared with 17 residents not exposed to workshop or lectures. Average time from workshop exposure to assessment was 197 days. | Residents exposed to the musculoskeletal workshop scored significantly better than unexposed residents on the clinical skills test score 20.9 vs 17.1, $P = 0.007$ . Medical students who served as standardized patients also scored significantly better than unexposed peers. 100% of residents and medical students who participated in the workshop agreed or strongly agreed it was a valuable educational experience.                                                                                                                                 |

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| 17. | <u>Author, year</u> , Ryan & Edwards, 2022, <u>Country</u> : UK, <u>Discipline</u> : Paediatrics, <u>Level of training</u> : Registrar, <u>Examination</u> : MRCPCH clinical examination               | Post course survey with option for qualitative comments.                                                                                                                                                    | To evaluate the effectiveness of a 6-week clinical examination virtual training program covering cardiology, respiratory, neurology, rheumatology, nephrology, endocrine and child development, and including sessions on simulated paediatric and neonatal communication sessions in which trainees could practice within examination timings and receive constructive feedback.                                                                                                                                     | Paediatric registrars from 4 Scottish deaneries attended virtual training course. Number of participants not reported. | 100% of participants would recommend the course. 10% rated the course as very good, 90% as excellent. Participants commented on the realistic scenarios, wide variety of subspecialties and appreciated the constant communication from course coordinators.                                                                                                                                                                                                                                                                                     |
| 18. | <u>Author, year</u> : Chon et al., 2018, <u>Country</u> : Germany, <u>Discipline</u> : Surgery, <u>Level of training</u> : Medical student, <u>Examination</u> : Medical school surgical rotation OSCE | Pre and post OSCE scores, pre and post multichoice question (MCQ) scores, survey of similarity between ALICE and OSCE, comparison between different medical student years and ALICE group vs control group. | To evaluate whether an Artificial Learning Interface of Clinical Education (ALICE) improves declarative and process knowledge in preparation for a surgical trauma OSCE. Control group students prepared for and sat a clinical trauma OSCE. In the ALICE group, students sat an MCQ and trauma OSCE then underwent OSCE preparation with ALICE with 4 virtual clinical scenarios, then re-sat the MCQ and OSCE, discussed the case with other medical students then debriefed with an instructor.                    | 160 3rd / 4th year medical students. 60 students in control group and 100 students in the ALICE group.                 | Exposure to ALICE was associated with significantly improved scores on declarative knowledge testing with MCQs and significantly improved performance scores on the post ALICE OSCE. Trainees improved their process knowledge from case 1 to case 4 within the ALICE simulator. ALICE content was found to be similar to the real OSCE in terms of test scores and medical student survey responses. The control group and exposure group had no significant difference in final OSCE score. High level of student motivation when using ALICE. |
| 19. | <u>Author, year</u> : Rashid et al, 2011., <u>Country</u> : UK, <u>Discipline</u> : Range of topics, <u>Level of training</u> : Medical student, <u>Examination</u> : Medical school final year OSCE   | Anonymised feedback questionnaire.                                                                                                                                                                          | To evaluate a revision programme delivered by junior doctors to final year medical students to assist with preparation for the end of year OSCE. Revision programme was designed based on tricky topics identified by junior doctors and used a variety of methods including didactic lectures, small group seminars, videos, interactive modules, and revision notes. Course took place 6 weeks before final OSCE although revision notes were available 4 months prior. All taught and organised by junior doctors. | 125 / 457 students sitting the final OSCE enrolled in revision course. 118 students completed feedback questionnaires. | 37/118 students did not feel confident about the upcoming OSCE, 54/118 knew what to expect from OSCE, 32/118 felt they had already had adequate preparation for OSCE prior to course. >80% of students gave positive feedback on lectures, seminars, and the overall course. 95.9% felt more confident about upcoming OSCE after course. 73.2% felt junior doctor led teaching was comparable to consultant led teaching.                                                                                                                        |

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| 20. | <u>Author, year:</u> Levine et al., 2017, <u>Country:</u> Israel, <u>Discipline:</u> Range of topics, <u>Level of training:</u> Medical students, <u>Examination:</u> USMLE step 2 clinical skills                   | Anonymised pre- and post- course online surveys, demographic data, overall USMLE step 2 clinical skills pass rate.                                             | To evaluate the effectiveness of a 2-day workshop consisting of didactic lectures and experiential practice (role play and video-recorded mock examination stations) in preparing students for the USMLE step 2 clinical skills examination.                                                                           | 76 participating students during the evaluation period (2013 to 2016). 64 students consented and completed both surveys.                | The workshop was associated with significant increase in overall knowledge of the USMLE step 2 clinical skills exam, student sense of preparedness to sit the exam, confidence in ability to pass the examination and comfort with standardised patient assessment with no effect of student gender or country of birth. The workshop was also associated with significant improvement in student competence and confidence in all clinical domains surveyed. The pass rate for students in the course was 95% in 2015 and 92% in 2016 compared to an average of 82% for students from this university over 2007 - 2011 before development of this workshop. Communication aspects of workshop were highly ranked, physical examination aspects less highly ranked.         |
| 21. | <u>Author, year:</u> Ryan et al., 2019, <u>Country:</u> USA, <u>Discipline:</u> Range of topics, including paediatrics, <u>Level of training:</u> Medical students, <u>Examination:</u> USMLE step 2 clinical skills | Results of the practice clinical skills examination and the USMLE step 2 clinical skills examination. Student survey responses (qualitative and quantitative). | To evaluate the effectiveness of a pilot practice clinical skills examination (3-hour practice examination in examination conditions with 6 cases conducted with standardised patients and written feedback and score after the practice exam) in preparing students for the USMLE step 2 clinical skills examination. | 173/184 eligible students undertook practice USMLE clinical skills examination (class of 2018). 63 completed post examination feedback. | The local fail rate decreased from 4.5% to 2.1% for the year of the course compared to an increase from 3.8% to 5.1% nationally (not statistically significant). More than half of students failed the practice exam. All 4 students who failed the USMLE step 2 CS examination failed one or both components of the practice exam. All students who passed the practice exam passed the USMLE step 2 CS exam. 59.5% of students felt the practice exam prepared them for the real exam. A third of students recommended removing the "pass/fail" designation while a third of students thought it should be kept. Students commented that the practice was more difficult than the real examination and failure induced anxiety. Limitations: delay in receiving feedback. |

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| 22. | <u>Author, year:</u> Siddiqui et al., 2018, <u>Country:</u> UK, <u>Discipline:</u> Range of topics including paediatrics, <u>Level of training:</u> Medical student, <u>Examination:</u> Practical assessment of clinical examination skills (PACES) | Student and examiner pre- and post- mock examination questionnaires. | To evaluate the effectiveness of a peer-led mock PACES examination (6 x15 minute clinical scenarios with standardised patients (medical students from other years)) on student confidence and sense of preparedness for the real PACES examination. | 41/72 pre-course surveys and 57/72 post-course surveys completed.                 | Mock examination was associated with a significant improvement in student confidence and preparedness for the PACES examination. Benefits of the mock examination included identifying preparation gaps, developing situational awareness. 91% of students felt a mock examination was more useful than didactic lectures or bedside or small group teaching. Peer teachers reported improved teaching skills and clinical knowledge.                                                                                                                                                                                                                                                                                         |
| 23. | <u>Author, year:</u> Cooper et al., 2013, <u>Country:</u> UK, <u>Discipline:</u> Emergency Medicine, <u>Level of training:</u> Registrar, <u>Examination:</u> Fellowship of the College of Emergency Medicine (FCEM) final examination               | Email questionnaire.                                                 | To evaluate candidate preparedness for the FCEM exam, and the value of resources used for preparation.                                                                                                                                              | 86/203 trainees who sat the examination in 2006 and 2007 responded to the survey. | 66/86 candidates who responded passed the FCEM exam first attempt. Around 75% reported feeling well or very well prepared for the exam. A yearly mock clinical exam practice was highly valued but not available to 22%. Respondents mentioned the need for better dissemination of practical examination guidance. Respondents commented that many consultant trainers had never sat or examined the FCEM exam, and many were disengaged. Resources for OSCE preparation in descending order of ranking included: practice of OSCE scenarios, small group practice, yearly OSCE practice, making an OSCE template, and practicing at every opportunity for all aspects of the OSCE including history, examination, teaching. |
| 24. | <u>Author, year:</u> Brescia et al., 2022, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> Thoracic surgery oral board examination (ABST)                                                   | Email questionnaire.                                                 | To characterise the learning practices and preferences including the use of Thoracic Surgery Residents Association (TSRA) educational resources by thoracic surgical current trainees and recent graduates including for oral board examination.    | 143 (27%) current trainees and 180 (23%) recent graduates provided responses.     | Among recent graduates who sat the ABST oral board examination and passed first attempt, 82% (97/118) used Thoracic Society resources to study compared to 48% (25/52) who passed 2nd or 3rd attempt or had not yet sat the examination ( $p<0.01$ ). The three most beneficial resources for the oral board examination recommended by recent graduates were in-person Oral Board Exam prep course (e.g., Osler) for 29% (44/153),                                                                                                                                                                                                                                                                                           |

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|     |                                                                                                                                                                                                                                                     |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                        | TSRA educational resources for 25% (38/153), and practice with peers for 20% (30/153). Clinical Scenarios in Cardiothoracic Surgery and the Review of Cardiothoracic Surgery were considered the most beneficial TSRA resources.                                                                                                                                                                                                                                                                                                                                                                                 |
| 25. | <u>Author, year:</u> Bevan et al., 2019, <u>Country:</u> UK, <u>Discipline:</u> Range of topics, <u>Level of training:</u> Medical students <u>Examination:</u> End of year summative medical school OSCE                                           | Survey.                         | To evaluate whether involvement in repeated ProSCE sessions (peer-led multirole practice OSCEs in which a group of 3 medical students alternate being student, examiner and patient over 6 student-written cases, followed by peer feedback) was effective in improving student confidence, guiding revision and improving outcomes in the end-of-year summative OSCE, and students perceived aptitude in providing feedback and confidence as a clinical teacher.       | 32/36 attended at least one ProSCE. 15 ProSCEs were run over 2018. Total of 1080 stations run (72 stations per ProSCE). 22/32 students completed the anonymous survey. | All survey respondents found participation somewhat to very useful. ProSCE was ranked highly for guiding revision and increasing confidence. Student was ranked as the most useful role. Repeated attendance was not associated with other outcomes. Feedback included benefits of a safe environment to practice skills, weekly feedback, and improved confidence. Recommendations for improvement included teaching students how to give feedback, improving quality of marking schedules and keeping closer to real examination in terms of structure and format. 100% of participants passed the final exam. |
| 26. | <u>Author, year:</u> Garofalo et al., 2023, <u>Country:</u> Canada, <u>Discipline:</u> Neurology, <u>Level of training:</u> Resident, <u>Examination:</u> The Royal College Comprehensive Objective Examination in Neurology (Adult and Paediatric) | Survey and resident interviews. | To evaluate the effectiveness of a virtual practice OSCE (prePOSCE) in increasing awareness of and comfort with the Royal College Examination process and to improve neurology-specific knowledge skills and competencies in final or near final Neurology Residents. The virtual practice OSCE consisted of 7 stations modelled after the set-up of the virtual Royal College Comprehensive Objective Examination in Neurology. Evaluators provided immediate feedback. | 79 students from 16 universities registered for the programme.                                                                                                         | 92% of residents agreed they would recommend the programme to their peers and that the programme added to their study preparation. Positive and negative comments relating to the IT set up of the stations and timing issues were shared. Residents commented it was good to be examined by examiners they didn't know. The stations were comparable to the real examination, but greater standardisation would help.                                                                                                                                                                                           |

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| 27. | <u>Author, year:</u> Gondhalekar et al., 2021, <u>Country:</u> UK, <u>Discipline:</u> Range of topics, <u>Level of training:</u> International Medical Graduate, <u>Examination:</u> PLAB (Professional and Linguistic Assessments Board) examination | Description of information available on course websites.                                                                  | To describe the range of courses and support available to help international medical graduates to prepare for the practice component of the PLAB examination (an in-person multi-station objective structured clinical examination).                                        | 13 courses identified, all run by commercial bodies, none run by Universities or the NHS. | Course prices ranged from £24.99 to £649.99 (USD35 to USD900). Course locations included sites in the UK as well as Dubai, UAE, Lagos, Nigeria, Egypt, India, Pakistan, Bangladesh and Myanmar. Evidence for course effectiveness based on testimonials and unverified claims. Tutor years of experience 13 - 17 years - only reported for 4 courses. Several courses advertise tutor roles for those who pass the PLAB and offer guaranteed NHS jobs and help with visas. Course duration ranged from 1 to 28 days.                                                                                                                            |
| 28. | <u>Author, year:</u> Lenz et al., 2018, <u>Country:</u> Germany, <u>Discipline:</u> Range of topics, <u>Level of training:</u> Medical student, <u>Examination:</u> Medical school oral examinations                                                  | Online survey of medical faculty and international students. Guided interviews with lecturers and international students. | To perform a comprehensive needs analysis for current international students and use the findings to devise a course to support students to develop their communication and oral examination skills and reduce isolation.                                                   | Interviews: n=9 students, n=11 lecturers. Survey: n = 100 students, n= 67 lecturers.      | Interviews identified that lecturers and international students were aware that international students faced issues with social isolation and with communication during oral examinations. A teaching programme was developed with several iterations and eventually focused on aspects of oral examination skills with a focus on using Bloom's taxonomy to explicitly teach culture-specific communication techniques relevant to oral exams. A buddy-system was also developed to reduce social isolation. 45/543 international students attended the training sessions. 90% of respondents would recommend the training sessions to others. |
| 29. | <u>Author, year:</u> Shebrain et al., 2021, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).                                        | Anonymous online survey.                                                                                                  | To describe a virtual (Zoom) mock oral examination delivered during the COVID-19 era to prepare surgical residents for their oral certifying examination in general surgery with pass/fail marks and specific written feedback to residents within 2 days of the mock exam. | 16 general surgery residents, 9 faculty, 100% response rate.                              | 88.9% of faculty but only 68.8% of residents felt the virtual format was less stressful for residents. 22.2% of faculty compared to 43.8% of residents preferred V-MOE over the IP-MOE. >80% of faculty and residents preferred immediate feedback at the end of sessions.                                                                                                                                                                                                                                                                                                                                                                      |

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| 30. | <u>Author, year:</u> Jerrom et al., 2017, <u>Country:</u> UK, <u>Discipline:</u> Internal Medicine, <u>Level of training:</u> Registrar, <u>Examination:</u> Practical Assessment of Clinical Examination Skills (PACES) | Local and national PACES examination pass rates. Baseline and follow up trainee survey. | To identify barriers to success in the PACES examination in Coventry and Warwickshire. To introduce dedicated training for the PACES examination to improve PACES pass rates and longer-term confidence in the role of senior doctor. Course introductions included a buddy scheme for mentoring with trainees who have passed the exam, a WhatsApp group to coordinate sessions and confidentially share locations of possible practice cases, several formal teaching sessions with volunteer trainees to act as patients to teach history-taking and communication skills, a consultant-led curriculum based targeted PACES teaching session added on to the end of each formal teaching session. In the second cycle, a rota of consultant-led bedside teaching sessions was introduced. | 35/40 baseline questionnaires completed.                                                                                                           | In 2014–2015 in Coventry and Warwickshire, 9/16 medical trainees had successfully completed the PACES examination. On baseline survey, 48% of trainees rated available teaching sessions as "poor". 61% had attended no bedside teaching in the preceding 12 months. Trainees commented on a lack of support structure in preparation for the PACES examination, leading to difficulty finding patients for practice and a desire for formal teaching in history and communication. Rating as "good or very good" for exposure to bedside-teaching improved from 17% to 59% after second cycle. relevance of curriculum-based teaching rated as 'good' or 'very good' improved from 9% to 34% following second cycle. 17/22 trainees passed the PACES examination following these interventions (77% vs 56.3% at baseline). |
| 31. | <u>Author, year:</u> Young et al., 2014, <u>Country:</u> UK, <u>Discipline:</u> Range of topics, <u>Level of training:</u> Medical student, <u>Examination:</u> End of year summative medical school OSCE                | Survey.                                                                                 | To evaluate the feasibility, acceptability and potential benefits of an entirely peer student-led mock OSCE consisting of an introductory lecture, a peri-arrest training session and two OSCEs (8 stations each). OSCE stations were developed by 4th year students with supervision by a clinician to reflect content and breadth of stations that could be expected in the final OSCE and to ensure accuracy and alignment with the curriculum. Tutors received training in delivering structured feedback. Students received a summary booklet containing key station learning points and individual written feedback.                                                                                                                                                                   | 245/288 (85% of year–3 group) students participated in mock OSCE. 241 completed survey. 61/103 4th year student tutors completed feedback surveys. | 100% of respondents classified the quality of the OSCE stations and teaching booklet as good or very good. 98.8% classified the intro lecture as good or very good. Themes included improved confidence, value of detailed feedback, desire for increased frequency of similar sessions. Tutors described themes including benefits to them of consolidated knowledge, improved teaching skills, and the desire to give back to the programme.                                                                                                                                                                                                                                                                                                                                                                              |
| 32. | <u>Author, year:</u> Peters et al., 2020, <u>Country:</u> USA, <u>Discipline:</u> Radiation oncology, <u>Level of training:</u>                                                                                          | Pre and post mock examination mixed methods survey.                                     | To describe the implementation of a mock oral board examination (OBE) for radiation oncology residents and assess resident and attending attitudes to the mock oral                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100% response rate - pre intervention 14/14 PGY 2 - 5 residents and post                                                                           | 100% of residents felt the MOBE increased their clinical knowledge and comfort with clinical reasoning. No significant difference in resident comfort in the 5 clinical skill themes (very small numbers). All attendings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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|     | Resident,<br><u>Examination:</u><br>American Board of Radiology Oral board examination                                                                                                                                                                          |                              | board examination and barriers to implementation.                                                                                                                                 | intervention 9/9 PGY 3 - 5 residents. 10/14 faculty members were involved in mock oral exams of whom 7 responded to surveys.                                                | classified the mock oral board as very beneficial. Barriers to mock oral board included time commitment for attendings and residents.                                                                                                                                                                                                                                                                                                                                                                |
| 33. | <u>Author, year:</u> Malhotra et al., 2008, <u>Country:</u> Canada, <u>Discipline:</u> Internal Medicine, <u>Level of training:</u> Resident, <u>Examination:</u> RCPSC comprehensive objective examination in internal medicine (RCPSC IM exam) oral component | Focus group interviews.      | To describe resident attitudes to the implementation of the mini-CEX into training requirements.                                                                                  | 12 residents participated in the study, 5 from the PGY-1 year and 7 from the PGY-2 year. All residents had completed at least 2 mini-CEX encounters.                        | Themes included anxiety around assessment, benefit of feedback for identifying weak areas, concern that the CEX focusses more on evaluation rather than teaching, benefits of assessment situated in real world, benefits of repeated mini-CEX for reducing anxiety, useful for preparation for the Royal College oral exam.                                                                                                                                                                         |
| 34. | <u>Author, year:</u> Grover et al, 2022., <u>Country:</u> UK, <u>Discipline:</u> Range of topics, <u>Level of training:</u> Medical student, <u>Examination:</u> End of year summative medical school OSCE                                                      | Anonymised survey responses. | To evaluate whether a student-led virtual nation-wide series of weekly OSCE teaching sessions could improve student confidence for the in-person end of year medical school OSCE. | 15 examiners (final year medical students). 85 medical students (57 clinical, 28 preclinical students and 8 from overseas university). 64/85 students identified as female. | 69.4% of participants agreed that online OSCE practice could sufficiently prepare them for in-person OSCE examinations. 97.6% agreed that virtual OSCE practice would still be useful after the pandemic. There was a statistically significant improvement in student confidence in all 3 stations (history taking, communication and data analysis) after the OSCE sessions. 83.1% of students and 53% of examiners agreed that the virtual format was as interactive as in person practice OSCEs. |
| 35. | <u>Author, year:</u> Harendza et al., 2023, <u>Country:</u> Germany, <u>Discipline:</u>                                                                                                                                                                         | Questionnaire.               | To develop a new telemedicine training workshop to assess clinical reasoning, history- taking and communication and focused presentation skills and provide                       | Sept 2022. Total of 62 students (47 from the University of Hamburg and 15                                                                                                   | The most useful parts of the training were: opportunity to practice focused history taking and diagnostic reasoning, feedback from patients on communication skills, feedback                                                                                                                                                                                                                                                                                                                        |

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|     | Range of topics,<br><u>Level of training:</u><br>Medical students,<br><u>Examination:</u><br>Medical student<br>licensing<br>examination (M3)                                                            |                                                   | feedback to guide preparation for the M3 - a 2-day oral clinical exam. This training involved 8 telemedicine cases modelled on real patients with diseases commonly examined in the real examination with 8 participants to assess. Students rotated through 4 patients each. The simulated patients completed a questionnaire on student communication skills after each consult. Students were then provided with further investigations and asked to list possible differential diagnosis with confirming and disconfirming features and to rank likelihood. Each student then presented the cases to another student who would then need to present that case (handover simulation). Then cases were discussed with a senior physician to refine clinical reasoning then final debrief. Students received written feedback. | from the University of Freiburg).                                                                                                                                                                                                                       | from teacher on presentation skills. Open learning atmosphere very important (mistakes are learning opportunities). Opportunity to act as an assessor for another student useful. Debriefing groups showed evidence of recognising essential aspects of clinical reasoning. Students reflected on lack of similar opportunities to practice structured case presentation. Students felt this training was very suitable for examination preparation and would recommend it.                                                                                                                                                                                                                       |
| 36. | <u>Author, year:</u> Lu et al., 2020, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE). | Survey and results of mock oral examination.      | To evaluate a multi-institution mock oral examination (MOE) to assist in preparing General Surgical residents for their final oral certifying examination. The mock oral examination consisted of 3x 20minute stations assessed by 2 examiners with a final grade assigned according to a clear marking rubric plus further feedback based on the ACGME competencies of Medical Knowledge, Patient Care and Interpersonal Communication Skills, as well as provide specific feedback regarding their communication skills.                                                                                                                                                                                                                                                                                                      | 33 general surgery residents and 37 faculty members from 3 institutions. 51 unique test scenarios and their corresponding grading rubrics were developed for the mock oral examination. Response rates: 91% for residents, and 57% for faculty members. | Overall pass rate was 79% (92% for year 5 vs 52% for year 3 residents). Moderate inter-rater reliability among examiners (percentage agreement 70.6, Kappa 0.47). Higher medical knowledge ratings assigned by faculty examiners correlated with stronger trainee performance. 86% of faculty members and 90% of residents were satisfied with the overall MOE experience. > 80% of faculty members agreed that the MOE prepared residents for the ABSCE, identified strengths and weaknesses in specific topic areas, and served a valuable role for resident assessment. 23% of residents felt confident in passing the examination before the mock examination vs 33% after (not significant). |
| 37. | <u>Author, year:</u> Fischer et al., 2016, <u>Country:</u> USA, <u>Discipline:</u>                                                                                                                       | ABSITE scores, first time pass rate on certifying | To evaluate the introduction of a monthly mandatory certifying examination prep course (CE prep program) including review                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Survey sent to 57/59 residents who attended the                                                                                                                                                                                                         | Absolute ABSITE score and mock oral annual examination grades were both significantly improved after the CE Prep                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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|     | <p><u>Surgery, Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).</p>                                                                                               | <p>exam, mock oral annual examination grades, survey.</p> | <p>of resident perceptions and effect on certifying examination first time pass rate. Course: monthly 2-hour sessions led by faculty covering different body systems examinable in final examination with one resident selected to undergo a mock oral followed by feedback and group discussion of learning points. Residents also undertook an annual mock oral examination with 3 x 30 min stations examined by two faculty with written feedback and pass/fail grade assigned.</p> | <p>programme between 2007 and 2015. 46/59 residents had attempted certifying examination at the time of analysis.</p>                                                         | <p>program was initiated (P values &lt; 0.001 and 0.003, respectively). There was a significantly higher operative volume after CE prep program was initiated. First time certifying examination pass rate was 76% (19/25) before the CE prep course vs 100% (21/21) after CE prep program (p=0.025). Residents felt equally prepared for the certifying examination before and after CE prep programme introduction. The monthly prep programme was rated as very helpful as were faculty feedback and the annual mock oral exam. 38.5% pre-CE Prep versus 78.3% post-CE Prep, P = 0.009 residents took a commercial preparation course. Mock oral exams were ranked highly in terms of preparation in developing professionalism and exposure to common test scenarios. A variety of other resources were used to study for certifying exams including different textbooks.</p> |
| 38. | <p><u>Author, year:</u> Rudland et al., 2008, <u>Country:</u> New Zealand, <u>Discipline:</u> Range of Topics, <u>Level of training:</u> Medical student, <u>Examination:</u> End of 5th year medical school summative OSCE</p> | <p>Focus group interview. Questionnaire (anonymised).</p> | <p>To explore how medical students prepare for a summative OSCE including how they identify what to learn, the role of the clinical environment and the impact of the OSCE (an 18 x 5minute station summative OSCE) on study behaviours.</p>                                                                                                                                                                                                                                           | <p>Focus group: 9 students from the top 20 performers in the end of year OSCE. Questionnaires completed by 151/179 students following completion of the end of year OSCE.</p> | <p>Students identified a variety of ways to study: List of examinable topics, past papers, and study notes booklet were preferred options. &lt;5% of students identified patient contact, identifying own weaknesses or talking to peers. Group practice for OSCEs was used by 74% of students vs 9% using patient contact. Benefits of a practice OSCE identified included time management, understanding OSCE structure, developing questions to ask. Group practice was preferred over patient contact due to easier time management, option of repeated rehearsal with feedback from a peer, limited opportunity for clinical practice, challenges of organising inpatient practice, increased flexibility with student group practice, student practice is more authentic for OSCE experience compared to speaking to a real</p>                                             |

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| 39. | <u>Author, year:</u> Rochlen et al., 2021,<br><u>Country:</u> USA,<br><u>Discipline:</u> Anaesthesiology,<br><u>Level of training:</u> Resident,<br><u>Examination:</u> American Board of Anaesthesiology (ABA) oral APPLIED examination | Faculty pre and post intervention surveys. Resident pre and post intervention survey.                   | To evaluate a workshop to train anaesthesiology faculty to deliver mock oral examinations including examination administration, assessment, and feedback to residents. In the workshop, two board examiners shared their expertise in the oral examination structure, attributes assessed on the examination with the aim of improving quality and consistency of the administered exams and enhancing the feedback process. This was done through a 30 min didactic lecture and a 30 min role play. A mock examination tip sheet was shared. | 11/148 faculty attended the workshop. 22 pre intervention and 55 post intervention surveys completed. 32/55 faculty members who completed the survey viewed only the tips sheet. 42 faculty in total experienced at least one part of the intervention. 72 residents completed post intervention survey. | 43% of residents (31 of 72) answered either yes or maybe to the question asking whether they noticed a difference in how the examination was administered by the faculty after the intervention. Comments included noticing examiners using less prompting and giving better feedback and asking why more often. 9/11 faculty who attended the workshop committed to making a change in the way they delivered mock oral exams. There was increased confidence with using the evaluation sheet, providing feedback, and understanding the evaluation definitions after the workshop although still >50% of faculty who attended the workshop did not feel confident in these areas. 50% (21 of 42) of those who completed at least one part of the intervention reported trying something different, vs 8% (1 of 12) who did not attend workshop. Changes made included reducing facial feedback/ prompts, increasing feedback on attributes and asking more questions to determine thought process. |
| 40. | <u>Author, year:</u> Stanley et al., 2006, <u>Country:</u> UK, <u>Discipline:</u> Internal Medicine,<br><u>Level of training:</u> Registrar,<br><u>Examination:</u> Practical assessment of clinical examination skills (PACES)          | Arrival time as a marker of organisational skills. Pass rate on MRCP clinical examination - PACES exam. | To examine whether arrival time (as a marker for organisational ability) at a course to teach clinical skills to prepare registrars for the MRCP PACES clinical examination was correlated with pass rate.                                                                                                                                                                                                                                                                                                                                    | 152/155 registrars who attended 4 separate courses and were planning to sit the next PACES exam.                                                                                                                                                                                                         | Mean arrival time 8:17am. 81/152 registrars passed the exam, mean arrival time 8:14am. 71/152 registrars failed the exam, mean arrival time 8:20am. P=0.006. There was a significant trend to increased pass rate with earlier arrival time. Female doctors had a higher pass rate and arrived earlier (not significant).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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| 41. | <p><u>Author, year</u>, Low et al., 2013, <u>Country</u>: UK, <u>Discipline</u>: Family medicine, <u>Level of training</u>: Registrar, <u>Examination</u>: Royal College of General Practitioners (MRCGP) clinical skills assessment examination</p>                | Questionnaire.                                                | <p>To evaluate a mock clinical skills examination day, identify factors associated with passing the clinical skills examination to allow targeted support to those at risk of not passing first time and to improve the skills and knowledge of GP trainers to ensure trainees received better support and feedback. The morning of the examination day consisted of teaching for GP trainers on the clinical skills examination including its assessment, a benchmarking video exercise, ways to support trainees and common pitfalls. The afternoon was a 4-station mock clinical skills examination with GP trainers acting as patients, examiners or observers with cases focused on communication skills. Trainees who scored less well on mock examination are invited to one-to-one feedback with educational supervisors.</p> | 30 GP trainees and 60 GP trainers.                                                                                                                          | <p>No association with most demographics and mock examination scores. Significantly higher average score for trainees who trained in the European Union vs international medical schools, for trainees who were born in the UK vs outside the UK ( 82% compared to 65% in the group born outside of the UK (<math>P&lt;0.001</math>)), for trainees of British nationality (80% compared to 60% for those of other nationalities (<math>P&lt;0.001</math>)), for trainees who were English-speaking - mean of 80% among those whose main spoken language at home was English compared to 62% who spoke English as well another language, or a language other than English (<math>P&lt;0.001</math>). Self-reported difficulty with communication problems caused by accent was negatively associated with average mock clinical skills examination score. Generally positive feedback from trainees and trainers.</p> |
| 42. | <p><u>Author, year</u>, Park et al., 2018, <u>Country</u>: Korea, <u>Discipline</u>: Range of topics, <u>Level of training</u>: Medical student <u>Examination</u>: Korean Medical Licensing Examination (KMLE) clinical skills assessment examination and OSCE</p> | Marks on a 13-station clinical skills assessment examination. | <p>To determine whether a 3-day clinical skills training workshop was associated with higher scores on the 13-station 4th year clinical skills assessment compared to routine medical school clerkship rotations. The clinical skills training workshop consisted of one day in which the medical students developed cases, teaching materials, and marking rubrics and produced a training video on their case, role play on three cases with changing roles and opportunities for feedback and development of marking rubric and teaching materials around the cases, then a final day of intensive training on organ system based physical examination including videos and role plays and facilitator feedback.</p>                                                                                                               | 113 medical students with 28 involved in the workshop and 85 not involved. Both groups sat a clinical skills examination before and after the intervention. | <p>Clinical skills examination scores increased in both groups from first to second clinical skills exam. The intervention group performed significantly better in history-taking post intervention but similarly in other domains. The intervention group scored better in some specific clinical cases, including one case which had been part of the focus of the workshop. Very small effect differences.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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| 43. | <u>Author, year:</u><br>Kimbrough et al.,<br>2018, <u>Country:</u> USA,<br><u>Discipline:</u> Surgery,<br><u>Level of training:</u><br>Resident,<br><u>Examination:</u><br>General Surgery<br>certifying<br>examination   | Survey.        | To describe the current scope of general surgery mock certifying examination (MOE) use by general surgery programme directors to understand attitudes and perceptions, structure, implementation, barriers.                                                                                                                                                                                                                                                                             | 98 program directors responded. No significant difference in pass rates or program size between survey respondents and national data. | 74% conducted department-run mock orals, 1% utilized commercial or another institutions' program, 19% employed a combination of both, and 5% respondents had no MOE program. The majority required upper-level resident participation with a smaller proportion requiring lower-level resident participation. The majority offered mock orals 2 to 3 times annually. Approximately 2/3rds of programmes aimed to follow the certifying examination format. 88% believed mock oral exams are very important for residents. Barriers included availability of faculty and cases. About half continue to update mock exams for ongoing improvement. |
| 44. | <u>Author, year:</u><br>Karthaus & Schmidt,<br>2016, <u>Country:</u><br>Germany, <u>Discipline:</u><br>Range of topics,<br><u>Level of training:</u><br>Medical student,<br><u>Examination:</u> Oral<br>state examination | Questionnaire. | To evaluate a course designed to help students in preparation for the oral part of the state examination. The course consisted of 4 OSCE stations over 2 hours in which 1 student acts as the doctor and 3 students act as observers/ assessors then give feedback and ask questions with support and further assessment from the tutor. An information sheet on dress code and examination behaviour dos and don'ts is shared (including specific tips on approach and grammar usage). | six courses, with a total of 84 participants. Overall, 76 completed questionnaires (91%).                                             | All aspects of the course were highly rated. Students asked for more frequent courses to allow gradual build up to exam. Students asked for more time for the cases including more time for questions and demonstration of examination by tutor. Students also asked for more cases covering more organ systems.                                                                                                                                                                                                                                                                                                                                 |

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| 45. | <u>Author, year:</u> Sibbin et al., 2016,<br><u>Country:</u> Australia<br><u>Discipline:</u> Internal Medicine, <u>Level of training:</u> Registrar<br><u>Examination:</u> Royal Australasian College of Physicians (RACP) Clinical Examination | Accuracy of assessment of jugular venous pressure (JVP). | To assess whether the intensive examination preparation associated with the RACP clinical examination was associated with a change in diagnostic accuracy of JVP assessment in examination candidates. Candidates were asked to assess the JVP on patients in the ICU on central venous pressure monitoring before and after sitting the clinical exam.           | 12/14 eligible candidates involved. Twelve candidates recorded 183 observations of 49 patients before and 161 observations of 73 patients after the examination. | Significant improvement in specificity (pre-examination 0.56, post-examination 0.71 P = 0.03) and diagnostic odds ratio (pre-examination 2.23, post-examination 9.72 P = 0.02). There was improvement in candidates' ability to detect a JVP that was not raised but no detectable improvement in the bedside assessment of JVP as a continuous variable.                                                                     |
| 46. | <u>Author, year:</u> Wiggins et al., 2008,<br><u>Country:</u> USA,<br><u>Discipline:</u> Ophthalmology, <u>Level of training:</u> Resident,<br><u>Examination:</u> American Board of Ophthalmology Oral Examination                             | Repeated surveys over time.                              | To assess the effects of repeated mock oral examinations on resident comfort with oral exams and their confidence. To determine the optimum frequency of mock oral examinations. The hospital conducted a regular 4-monthly oral examination and asked residents to fill out a survey after each mock oral examination to assess changes in confidence over time. | 10 residents participated over the 2-year study period.                                                                                                          | With repeated mock oral exams, residents felt better able to prepare for exams, had lower anxiety levels (with anxiety still present), felt more confident in passing and felt better able to think on their feet, and with more accurate self-assessment over time. There was no difference in candidate perceptions of their level of clinical knowledge. The best scores were with exposure to at least 3 mock oral exams. |

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| 47. | <u>Author, year:</u> Kleiven et al., 2016, <u>Country:</u> Australia and New Zealand, <u>Discipline:</u> Radiation Oncology, <u>Level of training:</u> Registrar, <u>Examination:</u> Radiation Oncology Royal Australian and New Zealand College of Radiologists (RANZCR) oral examination | Post examination survey. | To describe the experiences of registrars in preparing for and sitting the Radiation Oncology oral examination. | 21 responses (total response rate of 21%). Reminder emails not sent due to ethics concerns. | High mean anxiety level reported with some candidates more and some less anxious than expected. 17/21 candidates mentioned mock examinations as the most useful form of preparation. Recommend practicing with someone who has sat the examination previously. Other resources: practicing with a study partner, spending time with radiation therapists, using previous registrar notes, Trans-Tasman Radiation Oncology Group protocols and EVIQ. Talley and O'Connor, teaching medical students and practicing with a medical oncology registrar. Only one candidate did not receive regular practice sessions from their supervisor. 13/21 candidates received weekly practice from their supervisor. Case practice was considered representative of the real examination by 17/21 candidates. Advice included planning for the examination and doing a high volume of mock cases, importance of practice for confidence, and how to talk under pressure. Self-assessment not accurate for predicting passing exam. |
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| 48. | <p><u>Author, year:</u> MacDonald &amp; Ellis, 2011, <u>Country:</u> New Zealand, <u>Discipline:</u> Psychiatry, <u>Level of training:</u> Registrar, <u>Examination:</u> Australian and New Zealand College of Psychiatrists (ANZCP) oral examination</p> | <p>Recordings of supervision meetings. Individual interviews with trainees. Focus groups with supervisors and trainees.</p> | <p>To review what happens during mandated supervision hours to understand how supervision contributes to or impairs oral examination preparation for psychiatry registrars by recording 50 hours of supervision meetings.</p> | <p>50 hours of recordings of supervision meetings, six supervisors and thirteen trainees, obtained over 2000–2003. Individual interviews were conducted with eight trainees and repeated a year later. Four focus groups, two with supervisors and two with trainees conducted.</p> | <p>Four themes related to the examination: The examination as a reason for studying and learning good psychiatric practice (hidden curriculum that this knowledge is only needed because of the examination rather than because it is essential, supervision regarding knowledge acquisition might be neglected outside examination prep period). Differentiating between exam-type answers and non-examination type answers. Almost a ritual format not seen in day-to-day life Referring to what the examiners want - treating them as demanding, hostile people with high unrealistic expectations so the supervisor can preserve a trusting relationship and attributed criticism to “the examiners” – ‘the examiners would want you to do it this way.’ This allows supervisors to stay in supportive role - focus on how to please the examiners to pass exam. How to pass the examination - prioritisation, timing, being concise, thoughtful, and sensible - ways of presenting material to pass, being aware of how you are perceived by the examiners. Contrast between exams testing ordinary practice and exams expecting the level of a consultant psychiatrist. Supervisors talk about examination only wanting everyday practice but the focus on presentation suggests that examination work is very different to everyday practice.</p> |
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| 49. | <u>Author, year:</u> Harry et al., 2017, <u>Country:</u> UK, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination    | Questionnaire.                              | To evaluate a teaching programme to assist in preparation for the MRCPCH clinical examination. The course started two months before the examination and consisted of weekly lectures focused on mapping to the curriculum, specific aspects of each clinical examination, teaching communication skills, use of subspecialists to teach including the standard expected in the examination for their subspeciality. The course also offered to share information about bedside teaching and to help connect trainees with people who could offer bedside tutorials. No practice OSCE offered. | 127 trainees have participated in the programme over five years (August 2009–2014).              | This course replaces a previous system of ad hoc teaching. Barriers include difficulty attending course due to clinical workload, working outside of the main center, insufficient number of sessions, lack of a mock OSCE, lack of sustainability with course run by a small, focused group. Funding challenges. Development plans: mock OSCE, sustainability and funding, mentorship for trainees who have previously not passed. Programme strengths: communication teaching (n = 14) and general teaching (n = 11).                                                                                                                                                                                                                                              |
| 50. | <u>Author, year:</u> Mahajan & Stark, 2007, <u>Country:</u> UK, <u>Discipline:</u> Paediatrics, <u>Level of training:</u> Registrar, <u>Examination:</u> MRCPCH clinical examination | Focus group and semi structured interviews. | To identify and describe the barriers to progression through training faced by doctors trained on the Indian Subcontinent and working in Yorkshire, UK while receiving postgraduate training in paediatrics.                                                                                                                                                                                                                                                                                                                                                                                  | 12/16 trainees consented to take part. 9/12 in focus groups, 3/12 in semi-structured interviews. | 6 themes identified. Themes relating to clinical examination preparation include issues with communication (using and understanding colloquialisms and slang, having enough time to gather and express thoughts, being able to express thoughts succinctly in examination situation); issues with the college examinations (emphasis on different conditions, different approach to thinking about patients, difficulty with performance in communication during exam); support (lack of understanding of their experience from supervisors, lack of information about workplaces, lack of a social circle to support study). Trainees suggested specific training in communication skills, an induction program to explain common issues and long-term mentorships. |

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| 51. | <u>Author, year:</u> Jones et al., 2024, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).  | Quantitative. Outcome of ABS-CE and ABS-QE. | To examine the effect of examination (ABS-CE or ABS-QE first) on first pass rates for the ABS-CE and ABS-QE for a cohort of first-time examination trainees for whom order of examination sitting was decoupled due to COVID-19 factors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 947 candidates who sat both exams for the first time were compared, out of 1534 candidates who were affected by 2020 QE administration. | Examination sequence was not associated with outcomes for the QE written examination but was associated with outcomes for the clinical examination - sitting the QE before the CE was associated with a 2.5 times greater chance of passing the CE than sitting the CE before the QE (OR=2.54; 95%CI, 1.46–4.68, P=0.002) despite candidates who sat the QE before the CE having significantly lower ABSITE scores. |
| 52. | <u>Author, year:</u> London et al., 2014, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE). | Quantitative (first time pass rates).       | To evaluate the effect of the Advanced Certifying Examination Simulation (ACEs) program on first time pass-rate for the ABSCE. ACEs program consisted of monthly public mock oral examinations for 3 <sup>rd</sup> , 4 <sup>th</sup> , and 5 <sup>th</sup> year residents (1 <sup>st</sup> and 2 <sup>nd</sup> year residents observing). 3 residents per session randomly chosen to participate and answer one question. 7 minutes to answer question then 5 minutes of feedback focused on exammanship of answer as well as answering audience questions. Each resident will participate 4 times a day and will also participate in annual formal mock oral exam. Compared to the previous annual conventional mock oral examination consisting of 3x 30minute stations administered by two examiners in a closed room done yearly from 3 <sup>rd</sup> to 5 <sup>th</sup> year. | 26 residents participated in the ACES program over 2009 to 2012, 30 residents participated in conventional mock oral over 2003 to 2008. | ACEs program was associated with an increase in first time pass rates (100%) vs 83.3% with only annual mock oral examination. Highly rated by surgical trainees (2 <sup>nd</sup> most useful training component behind surgical skills workshop). No difference in groups based on ABSITE scores or USMLE step one scores.                                                                                          |

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| 53. | <p><u>Author, year:</u> Higgins et al., 2016,<br/> <u>Country:</u> USA,<br/> <u>Discipline:</u> Surgery,<br/> <u>Level of training:</u> Resident,<br/> <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).</p>  | Quantitative (pass rates) and qualitative (survey).                                                | To evaluate the effects of a public multi-institutional mock oral examination on the first-time pass rates for the ABS-CE. The intervention was a mock oral examination offered to three surgical institutions in Chicago written and administered by faculty from all 3 institutions. The mock examination consisted of 3 cases in 3 different rooms, 3 questions per case = 9 questions total. Scripted prompts and scoring sheets used. Trainees received feedback on knowledge as well as appearance and mannerisms and whether they passed or provided any responses that were predetermined critical failures. Demographics, mock examination scores in both 4th and 5th year, ABSITE scores and first-time pass rate on ABS QE and CE collected. | 63 Residents participated in their programme over 2002 - 2012. 38/63 completed the anonymous online survey.                                                                           | 52.6% of residents passed the mock examination in their 4th year and 47.5% passed the mock examination in their 5th year. ABS-CE pass rate was >80% for groups that both passed and failed mock exam. No correlation between passing the mock oral examination and passing the ABS CE for residents who sat in either 4th or 5th year. No correlation with ABSITE score and pass on ABS-QE or CE. USMLE step 1 scores were significantly higher for residents who passed ABS-QE on first attempt. No correlation between USMLE Step 1 scores and first-time pass rate on CE. 73.6% used a formal preparatory course for ABS-CE preparation. 25/38 residents studied for 1-10 hours a week for the month prior to the ABS CE. 77.1% ranked the mock oral examination as very or extremely helpful in preparation. |
| 54. | <p><u>Author, year:</u> Fingeret et al., 2016,<br/> <u>Country:</u> USA,<br/> <u>Discipline:</u> Surgery,<br/> <u>Level of training:</u> Resident,<br/> <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).</p> | quantitative (pass rates, mock oral examination scores and demographics) and qualitative (survey). | To evaluate the effect of participation in a sequential biannual multiregional mock oral examination with directed feedback on first time pass rates on the ABS CE. The mock oral examination consisted of three 30 min sessions involving four cases (including image interpretation). Two judges unfamiliar with the candidate provided scores and written feedback based on knowledge base, appearance, attire, demeanor, professionalism, and communication skills. Total of 48 cases developed so candidates can sit the mock examination repeatedly without experiencing case repetition.                                                                                                                                                         | 4th and 5th year residents from three centres in New York. 128 mock oral examinations were administered to 88 (71%) of 124 eligible residents. 96 (75%) completed course evaluations. | Overall, first time pass rate was 82% with no difference between course participants (85%) and non-participants (77%) in pass rate $p=0.052$ . Factors associated with first time pass rate on ABS-CE included: participation in mock oral examination in year 4, performance on ABS QE, sequential participation in mock oral examination and best mock oral examination performance score. Candidates classified as at risk of not passing had a first pass rate of 36% compared to candidates classified as likely to pass (96% pass rate). Cost effective but time intensive for examiners and volunteers. High degree of course satisfaction noted in anonymous survey.                                                                                                                                     |

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| 55. | <u>Author, year:</u> Aboulain et al., 2010, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE). | Quantitative (pass rates) and qualitative (survey).          | To evaluate the effect of a public mock oral examination series on trainee satisfaction and first-time pass rates on the ABS CE. 6 public mock oral exams per year to PGY4 to 6 trainees, each trainee sitting 2 examinations per year. Topic announced 2 weeks in advance to stimulate reading around the subject. 8 min of question answering time and 4 min of feedback. Audience received questions and suggested answers prior to the exam. Audience and examiners provided extra critique to participants at the end of the mock exam. Surveys provided to examinees and audience members and faculty. | Mock exams delivered over 2006 - 2009. 201 surveys were collected, 170 from the audience and 31 from examinees.                                                 | High level of satisfaction with the mock oral examination program 4.8 (95% CI = 4.7-4.9) for examinees and 4.6 (95% CI 4.6-4.6) for the audience (p = 0.12). First time pass rate prior to public mock oral program 88% (38/43 trainees from 2001 to 2005). From 2006 to 2009 first time pass rate was 19/19 (100%) (p= 0.3, NS).            |
| 56. | <u>Author, year:</u> Subhas et al., 2009, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).   | Quantitative (scores on mock exam) and qualitative (survey). | To evaluate a multi-institution mock oral examination programme offered annually to 3rd and 4th year trainees and twice yearly to 5th year trainees. Follows real examination format - each resident evaluated for 30min in three separate rooms, up to 4 scenarios per room, with 5 minutes for feedback. Examiners are not known to trainees. Collective debrief at the end. Recording of resident examination and feedback sent to their supervisor.                                                                                                                                                      | Scores available for 107/147 residents from 5 participating institutions over 10 years. Survey sent to 60/147 graduates. 19 respondents (31.6%).                | First pass rate 89% for ABS CE. 16/19 reported mock examination was helpful for examination preparation. 84% reported mock exams were important for familiarisation. 74% reported mock exams were important for teaching examination behaviour. 69% reported mock exams were important for dealing with stress. 58% took additional courses. |
| 57. | <u>Author, year:</u> Guzman et al., 2008, <u>Country:</u> USA, <u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Surgery Certifying Examination (ABSCE).   | Quantitative (pass rates) and qualitative (survey).          | To evaluate a new preparation course for the ABS CE consisting of monthly, simulated, mentored, and doubly critiqued (verbal and video) oral examinations (MSMC).                                                                                                                                                                                                                                                                                                                                                                                                                                            | 48 residents 2001 - 2002 = historical controls. 2003 - 2006 = prospective cohort of residents involved in the monthly mock oral examination preparation course. | First time pass rate 55.6% in the historical control group and 91.3% in the monthly mock orals group (p=0.038). 100% of participants in monthly mock orals reported these were helpful. Helpful aspects included Creation of structured self-study schedules, and improvements in clinical reasoning and communication skills.               |

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| 58. | <u>Author, year:</u> Goodman et al., 2021,<br><u>Country:</u> USA,<br><u>Discipline:</u> Surgery,<br><u>Level of training:</u> Resident,<br><u>Examination:</u> American board of surgery Otolaryngology Training Examination                                               | Qualitative (survey).                                                                    | To evaluate a virtual mock oral examination program for Otorhinolaryngology residents in response to the restrictions of the COVID-19 pandemic. Faculty were given an instruction sheet and asked to choose 2-3 topics from possible list. Participation for residents was mandatory. Residents were advised to approach 1-3 faculty to set up mock examination times within a 30-day period. Residents knew which topic each examiner would be taking. Mock examinations were not formally graded, but examiners provided unstructured feedback.                                                                                                                                                                                                                                                                                                                                                                                                                                            | 20 residents and 28 faculty participated in the MOE. 18 of 20 (90%) residents and 24 of 28 (86%) faculty completed post-examination surveys.                                                                                                                                                                                                                | 16/20 residents completed 3 scenarios. 15/20 completed more than 2 cases per scenario. The mock examination was perceived as helpful by faculty (mean score 8.8) and residents (mean score 9.06). Both groups were highly likely to recommend the program and to recommend the program again in the future. Only 7 of 18 (39%) residents and 11 of 24 (46%) faculty considered virtual mock oral examination to be a fair replacement for in person mock examination. Areas for improvement included: standardising web platform, standardising grading and standardising case scenarios. Examinee anxiety was significantly higher than faculty perception of examinee anxiety. |
| 59. | <u>Author, year:</u> Tang et al., 2021,<br><u>Country:</u> China,<br><u>Discipline:</u> Range of topics,<br><u>Level of training:</u> Resident,<br><u>Examination:</u> The standardized training of resident physicians (STRP) clinical practice ability examination (CPAE) | Quantitative (first pass rates) and qualitative (discussions with trainees and faculty). | The STRP is a 3-year training program for residents in Zhejiang, China. The "plan-do-check-action" plan was designed to comprehensively improve the 3-year training program. Success was analysed through review of the first pass rate of the clinical practice ability examination. Plan involves a quality improvement team developing personalised training plans for trainees, developing simulated exams and assessments, reviewing data and following up on poorly performing trainees. Do involved incentivising supervisors to support trainees, providing more training opportunities for trainees, setting up a simulated examination and following up with a focused repeat simulated examination for trainees in the bottom 20%, involving standardised patients. Using excellent trainees to create instructional training videos as exemplars for poorly performing trainees. Poorly performing trainees were also invited to a seminar to identify learning issues and their | 3rd-year residents Taking STRP in SAHZU and other hospitals in Zhejiang Province during 2016–2018 or 2017–2019 and first time taking the CPAE in 2018 or 2019. Overall STRP assessment results of 12,036 residents were collected. 308 residents received normal training and took the CPAE in 2018. 326 residents received PDCA and took the CPAE in 2019. | Local first pass rate 262/308 = 85.06% compared to overall first pass rate of 87.87% in Zhejiang province in 2018. In 2019, overall, first pass rate was 90.79% in Zhejiang province compared to 92.94% at the local hospital (significant increase from 2018).                                                                                                                                                                                                                                                                                                                                                                                                                  |

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|     |                                                                                                                                                                           |                                                                  | supervisors were notified. Check: the quality improvement team calculated the first pass rate and identified what worked and what didn't. Action: developing structured training programs, detailed resident ability tables, increasing training time and developing a centralised training IT system.                                                                                                                                                                                  |                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 60. | Author, year: Jones et al., 2015, Country: USA, Discipline: Surgery, Level of training: Resident, Examination: American Board of Surgery Certifying Examination (ABSCE).  | Quantitative (pass results and participation in review courses). | To evaluate how pass rates on the ABS CE are affected by participation in commercially available board review courses using a survey on the American board of surgery website with a prompt immediately before candidates obtained their examination results. Candidates were asked about specific courses and how helpful these were perceived. They had the option to select 'I choose not to answer'. Results were compared to examination performance, demographics, ABS QE scores. | 1,396 candidates who took one of five ABS CEs offered from October 2012- June 2013, including 1,067 first-time candidates and 329 who had failed CE previously. 1256 candidates (90%) responded to the survey. 10 respondents excluded (missing information). | Overall pass rate 79.9%, Significantly higher for first time sitters compared to repeat sitters (82.1% vs 72.6%, $p<0.001$ ). 77.9% of candidates attended a review course (higher for repeat sitters). No association with participation in a review course and passing CE overall, for first time sitters or for repeat sitters. No association with passing for any particular review course. ABS QE score significantly associated with chance of passing CE. 64% of trainees believed that sitting a review course was helpful for examination preparation.                                                                                    |
| 61. | Author, year: McKenna, 2018, Country: UK, Discipline: Surgery, Level of training: Registrar, Examination: Fellowship of the Royal College of Surgeons' (FRCS) Examination | Qualitative (semi-structured interviews).                        | To evaluate an annual mock oral examination for neurosurgical trainees and review the educational benefits, barriers causing low engagement and ways to enhance the program.                                                                                                                                                                                                                                                                                                            | 6 participants, a pre fellowship cohort and a post fellowship cohort.                                                                                                                                                                                         | 6 themes identified: Insight into exam. Performance. Simulation. Stress. Differentiation strategies for junior and senior trainees. Assessment vs learning. hidden curriculum of learning the performance of examinations. Public mock orals - Benefit of observing peers, receiving formative feedback, acting as examiners for peers, experiential learning. - Benefit of gaining insight into examination format and process and standards. Benefits of learning from poor performances. Repetitive exposure to reduce complexity and anxiety. Gaining insight into what you don't know. Use different approaches for junior and senior trainees |

|     |                                                                                                                                                                                                                                |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                                                                                                                                                                                                                                |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                               | including more specific teaching, limiting which topics are offered to junior trainees. Training examiners in giving feedback.                                                                                                                                                                                                                                               |
| 62. | <u>Author, year:</u> Chhabra et al., 2020,<br><u>Country:</u> USA,<br><u>Discipline:</u> Emergency Medicine, <u>Level of training:</u> Resident, <u>Examination:</u> American Board of Emergency Medicine                      | Qualitative Feedback survey. | To evaluate a mock examination day converted to a video teleconferencing platform (Zoom). The mock examination consisted of two single cases and one triple case with stimuli including imaging shown via PowerPoint share screen and was scored using the ABEM's scoring tool. Zoom breakout rooms were used to allow simultaneous administration to multiple trainees. Examiners had 20 min of training prior to starting the oral mock exam.                                    | 15 residents participated in over 4 sessions 8/8 examiners completed the post examination survey. 11/15 residents completed post examination feedback survey. | 50% of examiners preferred a virtual mock examination format, 25% preferred in person. 50% had difficulty with keeping time. All examinees felt the mock examination helped with examination preparation. One examinee had issues with internet connectivity. 3 had issues with viewing images. 36% wanted in person mock exams in future vs 27% wanting virtual mock exams. |
| 63. | <u>Author, year:</u> Fiedler et al., 2020,<br><u>Country:</u> USA,<br><u>Discipline:</u> Surgery, <u>Level of training:</u> Resident, <u>Examination:</u> The American Board of Thoracic Surgery (ABTS) certifying examination | Qualitative survey.          | To evaluate a multi-institution virtual mock examination for preparation for the thoracic surgery certifying examination. The mock examination consisted of 2 sessions each lasting 45 minutes made up of 2 cardiac scenarios and 2 thoracic scenarios. Two unknown examiners per examinee. Question stem cocreated prior by faculty. No official examiners allowed to be involved. Examinees received immediate verbal feedback as well as a pass/fail mark and written feedback. | 14 cardiothoracic surgery trainees across 6 training institutions participated as examinees with 14 examiners.                                                | 100% found the virtual mock oral examination helpful. 4/14 found the virtual MOE limited how realistic the mock examination was. 13/14 would recommend the virtual mock exam. 100% of faculty thought the virtual mock examination was helpful for trainees. Asked for better timers. Recommended increasing examination frequency.                                          |

## Appendix 2

| Themes                                | Codes                                                                                                          |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Demystifying the Clinical Examination | Technological barriers<br>Safe learning environments<br>Quality feedback<br>Value of opportunities to practice |
| Curriculum                            | Challenging topics<br>Curriculum alignment<br>Teacher focus<br>Quality improvement                             |
| The Clinical Examination Candidate    | Candidate background and experience<br>Social connection<br>Work study balance<br>Access to resources          |
| Pedagogy and Teaching Techniques      | Theory-Informed practice<br>Scaffolding<br>Educational Support<br>Technology-Enabled and Enhanced              |

### Appendix 3.

#### Thematic grouping of the articles included in the review

| Theme                                 | Study                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No. of studies |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Pedagogy and teaching techniques      | Aboulian et al., 2010; Benjamin et al., 2019; Bevan et al., 2019; Brescia et al., 2022; Caretta-Weyer, 2018; Chhabra et al., 2020; Chon et al., 2018; Cooper et al., 2013; Crockford et al., 2004; Ferguson et al., 2014; Fiedler et al., 2020; Fischer et al., 2016; Garofalo et al., 2023; Gondhalekar et al., 2021; Goodman et al., 2021; Grech & Buttigieg, 2012; Grover et al., 2022; Guzman et al., 2008; Harendza et al., 2023; Harry et al., 2017; Jerrom et al., 2017; Jones et al., 2015; Karthaus & Schmidt, 2016; Kleiven et al., 2016; Lenz et al., 2018; Levine et al., 2017; London et al., 2014; Low et al., 2013; Lu et al., 2020; MacDonald & Ellis, 2011; Mahajan & Stark, 2007; Malhotra et al., 2008; Martinez et al., 2015; McKenna, 2018; Mediratta et al., 2022; Noel et al., 2016; Park et al., 2018; Peter et al., 2020; Rashid et al., 2011; Rochlen et al., 2021; Rudland et al., 2008; Ryan et al., 2019; Ryan & Edwards, 2022; Saeed et al., 2023; Shebrain et al., 2021; Siddharthan et al., 2017; Siddiqui et al., 2018; Smith et al., 2013; Stone et al., 2021; Subhas et al., 2009; Tang et al., 2021; Waldauf et al., 2017; Wiggins et al., 2008; Young et al., 2014. | 54             |
| Curriculum                            | Aboulian et al., 2010; Benjamin et al., 2019; Bevan et al., 2019; Crockford et al., 2004; Fischer et al., 2016; Garofalo et al., 2023; Grover et al., 2022; Guzman et al., 2008; Harendza et al., 2023; Harry et al., 2017; Higgins et al., 2016; Jerrom et al., 2017; Karthaus & Schmidt, 2016; Kimbrough et al., 2018; Levine et al., 2017; London et al., 2014; Low et al., 2013; Lu et al., 2020; MacDonald & Ellis, 2011; Malhotra et al., 2008; Martinez et al., 2015; Mediratta et al., 2022; Neal et al., 2017; Rashid et al., 2011; Rudland et al., 2008; Ryan et al., 2019; Shebrain et al., 2021; Sibbin et al., 2016; Sloan, 2023; Smith et al., 2013; Saeed et al., 2023; Stone et al., 2021; Subhas et al., 2009; Tang et al., 2021; Young et al., 2014                                                                                                                                                                                                                                                                                                                                                                                                                                    | 35             |
| The clinical examination candidate    | Aboulian et al., 2010; Cooper et al., 2013; Crockford et al., 2004; Ferguson et al., 2014; Fingeret et al., 2016; Fischer et al., 2016; Garofalo et al., 2023; Gondhalekar et al., 2021; Goodman et al., 2021; Grech & Buttigieg, 2012; Harry et al., 2017; Jones et al., 2024; Karthaus & Schmidt, 2016; Kleiven et al., 2016; Lenz et al., 2018; Levine et al., 2017; London et al., 2014; Low et al., 2013; Lu et al., 2020; Mahajan & Stark, 2007; Malhotra et al., 2008; McKenna, 2018; Onlock et al., 2023; Peters et al., 2020; Rochlen et al., 2021; Rudland et al., 2008; Ryan & Edwards, 2022; Saeed et al., 2023; Stanley et al., 2006; Stone et al., 2021; Subhas et al., 2009; Tang et al., 2021; Waldauf et al., 2017; Wiggins et al., 2008                                                                                                                                                                                                                                                                                                                                                                                                                                                | 34             |
| Demystifying the clinical examination | Aboulian et al., 2010; Bevan et al., 2019; Caretta-Weyer, 2018; Chhabra et al., 2020; Chon et al., 2018; Cooper et al., 2013; Fiedler et al., 2020; Fingeret et al., 2016; Fischer et al., 2016; Garofalo et al., 2023; Goodman et al., 2021; Grech & Buttigieg, 2012; Grover et al., 2022; Guzman et al., 2008; Harendza et al., 2023; Higgins et al., 2016; Jones et al., 2024; Karthaus & Schmidt, 2016; Kimbrough et al., 2018; Kleiven et al., 2016; Levine et al., 2017; London et al., 2014; Low et al., 2013; Lu et al., 2020; MacDonald & Ellis, 2011; Mahajan & Stark, 2007; Martinez et al., 2015; McKenna, 2018; Mediratta et al., 2022; Noel et al., 2016; Park et al., 2018; Peters et al., 2020; Rochlen et al., 2021; Rudland et al., 2008; Ryan et al., 2019; Saeed et al., 2023; Shebrain et al., 2021; Siddharthan et al., 2017; Siddiqui et al., 2018; Sloan et al., 2023; Stone et al., 2021; Subhas et al., 2009; Tang et al., 2021; Wiggins et al., 2008; Young et al., 2014                                                                                                                                                                                                      | 45             |