A scoping review of practical approaches to teaching clinical examination in UK undergraduate medical education

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Abstract

Introduction
Clinical examination (CE) is a cornerstone of modern clinical practice. Proper CE is shown to reduce the risk of medical errors and prevents inappropriate use of diagnostic testing and imaging. Yet despite the impetus on effective training, national studies suggest that final year medical students lack adequate CE sills. There is heterogeneity of healthcare systems, cultures and resources hence it is prudent to assess what interventions are effective within which context. Therefore, the aim of this review was to scope the academic literature for current teaching methods and initiatives in place to teach CE to UK undergraduate medical students.

Method
A search strategy consisting of 11 key terms and Medical Sub-Headings (MeSH) was developed performed in Medline, HMIC, Google Scholar and EMBASE. Two independent reviewers reviewed titles, abstracts or full text articles of relevant papers being assessed for inclusion. A narrative synthesis was undertaken of included papers to examine relationships or themes between studies. The most recent search was undertaken on 30th September 2019.

Results
Four papers were published between 2005 to 2013 describing teaching interventions that have been applied or developed for UK undergraduate medical students. Included articles described interventions all in secondary care settings focussed on musculoskeletal examination (n=3) and chest examinations (n=1) utlising simulation teaching (n=1), computer-assisted learning (n=1) and patient educators (n=2).

Conclusions
This review demonstrates a preliminary review of interventions but the accumulated knowledge is relatively immature. It represents an insight into current research on evaluated teaching methods to teach CE but also serves to
highlights the vast paucity of available literature on evaluated generalizable interventions. Findings suggest a research agenda is needed to inform future efforts to identify initiatives to better teach CE. The results highlight the immediate focus must include developing ways to objectively evaluate and teaching interventions.

Keywords: Clinical examination; Teaching; Simulation; Patient educators; Scoping review

Introduction

Clinical examination (CE) is a cornerstone of modern clinical practice (Grune, 2016; Moßhammer et al., 2017). Proper CE is shown to reduce the risk of medical errors and prevents inappropriate use of diagnostic testing and imaging (Verghese et al., 2015; Elder, Japp and Verghese, 2016). Effective and appropriate CE aids doctor-patient relationship, patient safety and the efficiency of medical treatment (Zolnierek and Dimatteo, 2009; Sayma and Williams, 2016). Whereas inadequate CE has the potential to cause inaccurate diagnoses, delayed treatment and unnecessary radiological or clinical tests (Schiff et al., 2009). Yet despite the impetus on effective training, national studies suggest that final year medical students lack adequate CE sills (Krautter et al., 2015).

Teaching of CE is integrated into medical curricula from the first years of study and competencies are regularly assessed (Bradley, 2002; Sayma and Williams, 2016). However, observational studies find that after the third year of undergraduate education confidence in CE barely increases and another show final year students already begin to cut their CE short (Wu et al., 2007; Haring et al., 2014). Even after qualifying, US observational studies find many doctors examine patients over their gowns without adequate exposure – omitting a fundamental step in comprehensive CE (Sharma, 2011).

Medical educators worldwide are working to improve the quality of CE by implementing CE teaching within global teaching and healthcare settings. There is wide heterogeneity of local healthcare systems, cultures, undergraduate curricula, healthcare structures, constraints and resources. Hence it is prudent to assess what interventions are applicable within the context of the healthcare system within which they work.

There is uncertainty about successful teaching interventions that are currently being delivered in the UK that can be implemented and evaluated in other areas. The aim of this review was to scope the academic literature for current teaching methods and initiatives in place to teach CE to UK undergraduate medical students.

Methods

This scoping review is a rapid collection of information to form a narrative synthesis of the scope and focus of current academic literature in teaching CE (Munn et al., 2018). Scoping reviews purposely have broad parameters with the aim to provide an overview of a topic area whilst also highlighting potential research gaps (Colquhoun et al., 2014). These often act as precursors to systematic reviews. Scoping reviews were first developed by Arksey and O'Malley, and this review will adhere to the amended framework proposed by Levac et al.(Arksey and O'Malley, 2005; Levac, Colquhoun and O'Brien, 2010). The steps are considered in further detail:

Identifying the research question

The question is designed to address current teaching approaches [concept], for undergraduate medical students in the UK [the target population], that teach clinical examination [outcome of interest]. In scoping reviews, the research question is more broadly defined than in systematic reviews in relation to outcomes, study design, comparison groups and inclusion or exclusion criteria. The reason this review was refined to only include UK studies was to align it with
the aims of identifying current teaching approaches adopted in UK undergraduate medical education.

**Search strategy and data sources**
A search strategy consisting of 11 key terms and Medical Sub-Headings (MeSH) was developed and performed in Medline, HMIC, Google Scholar and EMBASE (Table 1). Boolean operators combined search terms to reduce sensitivity and maximise precision. Searches were limited to articles published in the United Kingdom. The most recent search was undertaken on 30th September 2019.

**Table 1. Search strategy performed in Medline, HMIC, Google Scholar and EMBASE**

| Search terms with Boolean operators                                                                 |
|-----------------------------------------------------------------------------------------------------|
| 1. (undergraduate medical students)                                                                   |
| 2. (clinical examination OR medical examination OR physical examination)                             |
| 3. (model OR approach OR teaching OR training OR education)                                           |
| 4. (UK OR United Kingdom)                                                                             |
| 5. (1 AND 2 AND 3 AND 4)                                                                             |

**Literature screening, exclusion and inclusion criteria**
All study designs were included if they described or proposed teaching methods aimed at UK undergraduate medical students. For inclusion the research must: involve UK medical students and adequately describe the teaching programme. Non-English studies, abstracts, letters and editorials were excluded as well as studies that did not clearly describe a teaching method or intervention.

Two independent reviewers (AO and MK) reviewed titles, abstracts or full text articles of relevant papers being assessed for inclusion. Reviewers discussed the review process to discuss challenges and uncertainties related to selection. If required, the search strategy was refined accordingly. All references were exported to Mendeley v1.19.4 (Elsevier) and duplicates removed.

**Data extraction**
Included studies were extracted to a purpose built Microsoft Excel spreadsheet (Microsoft Corporations, Redmond, WA). The main variables for data extraction were agreed with a second reviewer (MK) after independent review of all articles. This determined if the extraction approach was consistent with the objectives of the study.

**Collating, summarising and reporting the results**
For result presentation of scoping reviews the guidance suggested by Peters et al. (2015) was considered. Quality assessment of the included studies was not performed as assessment of the interventions; control groups or outcome measures is not the primary focus for scoping reviews. Tables mapped the distribution of study settings, teaching method or intervention and outcome measures. A narrative synthesis was undertaken by AO to examine relationships between studies (Popay et al., 2006).

**Results/Analysis**
Four papers were published between 2005 to 2013 describing teaching interventions that have been applied or developed for UK undergraduate medical students (Figure 1 and Table 2) (Kilminster et al., 2001; Raj et al., 2006; Swamy et al., 2013; Sayma and Williams, 2016). Studies are from secondary care settings. Included articles described interventions utilising simulation teaching (n=1), computer-assisted learning (n=1) and patient educators (n=2).
Figure 1. Included and excluded flowchart

Table 2. Overview of included studies

| Author                  | Title                                                                 | Examination          | Study Type  | Intervention                                                                 | Efficacy                                      |
|-------------------------|------------------------------------------------------------------------|----------------------|-------------|------------------------------------------------------------------------------|-----------------------------------------------|
| Swamy et al., 2013      | Role of SimMan in teaching clinical skills to preclinical medical students. | Chest                | Crossover   | Using simulated models to teach clinical examination                         | Increase in test scores (p<0.001)           |
| Vivekananda-Schmidt et al., 2005 | Cluster randomized controlled trial of the impact of a computer-assisted learning package on the learning of musculoskeletal examination skills by undergraduate medical student | Musculoskeletal      | Randomized trial | Computer-assisted learning (CAL) package                                     | Intervention group had improved OSCE scores but no long term |
These studies were all interventional studies, three of which had control groups. Three of the studies focussed on the musculoskeletal examination whilst the other focused on chest examinations (n=1). The teaching methods described fell into two categories, explored below:

**Simulation/ Computer assisted learning**

Two articles investigated the benefits of simulation or computer aided learning to teach clinical examination (Vivekananda-Schmidt *et al.*, 2005; Swamy *et al.*, 2013; Sayma and Williams, 2016). Swamy *et al.* conducted a crossover study where groups were taught chest examinations on either a simulation model or by practicing on one another, then each group swapped. When the two groups were compared, there was no significant difference in the pre- and post-test scores but mid-test scores were significantly improved (P< 0.001) for the group using SimMan first. Another study aimed to improve medical student competency in musculoskeletal CE by supplementing musculoskeletal clinical rotations with computer-assisted learning with the Virtual Rheumatology CD (Vivekananda-Schmidt *et al.*, 2005). In a multi-centre sample of 354 students, objective structured clinical examination scores (OSCE) were significantly better in the intervention groups (P = 0.002).

**Patient educators**

Two studies comprising of 110 participants utilising patient educators (PEs) to deliver teaching on musculoskeletal examination found that adequately trained PEs can deliver clearly structured teaching. Raj *et al.* (2006) randomised students to receive teaching of hand and knee examinations by either PEs or by consultant rheumatologists. Scores of both groups were high, and although the consultant-led group received higher scores there was no statistically significant difference between both groups for either hand or knee OSCE’s (P>0.7). A teaching programme that incorporates PEs to deliver teaching on back pain was developed by Haq *et al.* (2005). Results from this study show small but consistent improvements in care, most significantly in students’ ability to elicit information (P <0.06).

**Discussion**

This scoping review identified four peer reviewed articles on interventions or initiatives on teaching CE to undergraduate medical students. This review used a broad inclusion criterion which included studies describing initiatives that had been proposed or tested and evaluated that address the teaching of CE. This study provides an insight into the current research on evaluated teaching methods to teach CE but also serves to highlights the vast paucity of available literature on evaluated generalizable interventions. It shows the lack of scientific research in the field of medical education in regards to evaluating teaching intervention process and outcome. The heterogeneity of interventions in terms of setting, outcome measure and methodological approach made it difficult to summarise these findings the but a narrative synthesis of interventions (proposed or existing) is presented. It is acknowledged this review did not formally evaluate the quality of the literature, however other principles of systematic review were maintained, and quality review can be considered in further reviews. It was felt the dearth of evidence did not justify
statistical pooled analyses.

**Relationship with current literature**

Upon completion of undergraduate medical education students are expected to achieve a suitable degree of proficiency in completing comprehensive and effective CE (Rousseau, Könings and Touchie, 2018). This is becoming increasingly important for doctors to assess and manage an increasingly co-morbid and complex patient population. Detailed history and examination is shown to accurately diagnose 60% of patients early in their hospital admission and throughout an inpatient stay one in four patient’s diagnoses and subsequent management can be amended based on further CE (Reilly, 2003; Paley et al., 2011). Despite this, quality of CE of final year medical students about to qualify are deemed not up to required standards (Krautter et al., 2015).

Historically, bedside teaching has been seen as the primary teaching method by which most aspects of clinical practice including CE had been taught (Peters and Ten Cate, 2014). Learning at the bedside appears to be the ideal environment for acquiring CE skills according to multiple learning theories (Torre et al., 2006). This was widely used across medical schools and was thought to represent as much as 75% of all clinical training in 1960 (Crumlish, Yialamas and McMahon, 2009). Although benefits to bedside teaching are well-known, time allocated to bedside teaching has been consistently declining to represent just 16% of clinical teaching time by the 1990s (Ahmed, 2002). Even attitudes of medical students toward the role of bedside teaching are changing. It has shifted from the primary learning medium to a supplementary resource (Begum et al., 2016). With the declining volume of bedside teaching being delivered, a shift in medical education has seen a growth in alternative learning methods including computer-based or simulation learning and patient educators (Jones and Rai, 2015).

Simulation-based medical education has been shown to be beneficial for learners, educators, and patients in improving healthcare professionals performance (Motola et al., 2013). Simulation allows artificial representation of real scenarios with the aim to facilitate learning through immersion, reflection, feedback, and practice whilst removing the risks of practicing in a real-life situation (Datta, Upadhyay and Jaideep, 2012). Students can be exposed to emergencies that are both relatively rare (tension pneumothorax) and serious (sepsis) in order to ensure good CE to identify and initiate correct treatment in a timely manner (Malone et al., 2010). Relying on exposure to these emergency scenarios during training years may result in an inconsistent method of learning CE as it is entirely dependent on availability of cases (Al-Elq, 2010). Enabling repetition of common and less commonly occurring CE paired with skills assessment and specific feedback, results in better skills performance (Issenberg et al., 2002). Ensuring patient safety and fewer available patients for learning, have ushered the introduction of simulation in medical education. Whilst simulation-based learning is not a substitute for learning with real patients, it is a useful tool for educating and ensuring competency of health-care professionals before working with real patients (Lawson et al., 2018).

Trained Patient educators (PEs) have been sued to teach several CE including musculoskeletal, digital rectal and intimate PV or breast examinations. This teaching methods combines the roles of teacher and patient which benefits the patients in terms of improved self-worth (Raj et al., 2006). PEs are a valuable resource in teaching CE, and when compared directly with consultant-led teaching was found to be comparable. With equivalent learning outcomes to those of rheumatology consultants PEs are a promising way to augment musculoskeletal education in the face of expanding student numbers and limited consultant time. There will need to be cultural changes as a study canvassing opinions of over 300 consultants found that they were of the opinion that medical students should be taught by consultants (Darragh, Baker and Kirk, 2015). More than half did not even think that it was appropriate for junior Doctors (SHO or Registrar grade) to teach. If PEs are to become a mainstay in CE teaching deliver teaching instead of senior doctors, then this method of delivering curriculum content needs to be evaluated to guarantee that the level of educational outcomes is satisfactory (Haq, Fuller and Dacre, 2005).
Future research
There must be further assessment of efficacy of interventions aiming to improve the learning of CE in the UK. There must be in-depth studies in the field of medical education that will assess process and outcomes of interventions. Given the paucity of literature found, a wider review of other countries is warranted to synthesise what is available at present to provide a foundation of current knowledge.

Conclusion
This review presents a synthesis of interventions in practice in the UK to teach CE to undergraduate media students. However, the accumulated knowledge is relatively immature and there is a paucity of high quality evidence-based initiatives. The findings suggest a wider research agenda is needed to inform initiatives to better teach CE. The results highlight that the immediate focus must include developing processes or parameters to evaluate and quantify teaching interventions.

Take Home Messages
- Despite the impetus on effective training, national studies suggest that final year medical students lack adequate CE skills.
- There are currently very few studies in the scientific literature describing interventions in UK practice.
- Currently simulation and patient led-teaching are used to good effect and well received by students.
- The immediate focus must include developing processes or parameters to evaluate and quantify teaching interventions.

Notes On Contributors
Dr Omar is a junior doctor working in the South Thames region. He completed his training at Cardiff University. Dr Omar has a keen interest in medical education and leadership within the NHS and how the two can be utilised to improve patient outcomes. (ORCID iD: https://orcid.org/0000-0001-5667-0263)

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**Appendices**

None.
Declarations

The author has declared that there are no conflicts of interest.

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Ethics Statement

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