BEME Protocol

Effectiveness-review

What works best for health professions students using mobile devices and technology on clinical placements?

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BEME Protocol

1. Details

1.1 Review title

What works best for health professions students using mobile technology and devices on clinical placements?

1.2. Unique BEME identification number

We have not yet received the BEME identification number

1.3. Review-members:

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1.4 Sources of support

The School of Medicine at the University of Liverpool is currently underwriting this project.

2. Abstract

Huge advances in mobile technologies have meant that medical and other health professions students (at both basic and post-primary qualification levels) now make much use of hand-held devices in the workplace. How and when to make *best* educational use of such devices is unclear..

Research published on this topic to date suggests that a comprehensive review would be timely, appropriate, and provide insight about how to make best use of mobile technologies specifically for health professions students within the clinical placement/workplace. The main aim of this project is to synthesize research evidence on the effectiveness of mobile devices and technology in supporting the learning of health professions students whilst on clinical placements: "**What works best for health professions students using mobile devices and technology for educational support on clinical placements?"**

The review-team has conducted Phase 1 of a scoping-exercise on the breadth/depth and key features of the literature on the educational implications of health professions students using mobile devices and technology on clinical placements, finding quantitative, qualitative, and mixed methods research. Phase 2 would extend to cover more databases and the grey literature (to complete the scoping-exercise) and then refined to extract a subset for an effectiveness-review to focus on "what works best, for whom, when and how?" As appropriate, meta-analysis would be used to summarize quantitative findings. Narrative synthesis and/ or thematic analysis would be used, as appropriate, to synthesize qualitative research, developing the approach used for the development of the scoping-exercise.

To maintain an up-to-date evidence-base, monthly searches would be conducted to identify research published during the preparation of the review.

Upon completion of the review, the review-team would be keen to update and maintain accuracy, aiming to produce an update after three years.

3. Background to the topic

Huge advances in mobile technologies have meant that medical and other health professions students (at both basic and post-primary qualification levels) now make much use of hand-held devices in the workplace. How and when to make best educational use of such devices is unclear. The vast number of health-related applications is a potential driver of medical students using mobile devices for studying in their everyday clinical setting (Martyn et al. 2014). Phillippi and Wyatt (2011) reported that, of more than 1,200 'health and fitness' applications in the Apple AppStore at mid-June 2009, one-half were designed for medical professionals. Sarasohn-Kahn (2010) reported that, of the 5,805 'health, medical, and fitness' applications in the Apple AppStore in February 2010, 27% focused on healthcare professionals.

3.1 Scoping-exercise

In 2012, a systematic review highlighted the ways in which smartphones could enhance medical education, patient care, and communication (Ozdalga, Ozdalga, & Ahuja 2012). Whilst 60 articles met the inclusion-criteria (i.e. illustrated specific roles for the smartphone in health care or considered the consequences), only two of these focused on physician-related or medical student-related reference-applications, and only two related specifically to medical education. The latter were limited in setting or size:

- Firstly, a randomized controlled trial showed that the Resuscitation Council UK's iResus application on a smartphone improved doctors' performance in advanced life support simulations (Low et al. 2011), but the setting was a simulation exercise.
- Secondly, responses from only six (of seven) resident physicians (who answered 4-week and 8-week follow-up surveys) about using a smartphone preinstalled with medical applications suggested that such m-learning tools were a good way of accessing learning resources and remote-mentoring to retain doctors in a resource-poor region, i.e. Botswana (Chang et al. 2012).

Limitations of the Ozdalga et al (2012) review included:

- restriction to:
  - 'smartphones' only *((smartphone*, smart phone*, iPhone, android, blackberry, OR windows mobile) AND (medicine))*;
  - English-language publications via Medline, PubMed, and Scopus, only in previous 5 years;
- very broad remit of:

- the use of smartphones in health care and health professions education *(patient care and monitoring; health applications for the layperson; communication, education, and research; physician/student reference-applications)*.

Further development of technology and further research published on this topic since 2012 warrant a more comprehensive review now, which should be timely in providing further insight about the best use of all mobile technologies specifically within clinical placement/workplace settings by health professions students. Key-points from recent research about this topic include:

- A survey of medical students, residents, and faculty across four Canadian universities (n=1,210) indicated widespread use of smartphones and tablets in clinical settings, but the estimated response rate was only 6%-8% (Boruff & Storie, 2014). Third and fourth year medical students (i.e. those more embedded in practice) and medical residents (compared with other more junior medical students, medical postgraduate students, or faculty) used such devices more often, used them for more diverse activities, and used them to buy more resources.
  - Boruff and Storie (2014) also identified that students mostly owned Apple products: 72% owned an iPhone or iPod Touch; 42% owned an iPad; and 42% owned both a smartphone and a tablet. The most common actions on mobile devices were: finding drug information (74%), performing clinical calculations (58%), taking notes (52%), reading journal-articles (50%), finding practice guidelines (50%), reading point-of-care information (49%), and searching for journal articles (47%).

- Mooney et al. (2014) reported on the piloting of an electronic data collection tool (UoM eForms) following the mass introduction of mobile technologies for students at Manchester Medical School (United Kingdom). iPads had been introduced to allow uniform access to core learning materials across multiple clinical sites. An option-appraisal of six commercially available software products for recording workplace-based assessment found too many limitations, against the authors' key criteria for successful implementation. These criteria were: ease-of-use; control and management; offline capability; authentication/identification with individual users; group publishing; data submission; sustainability/extensibility; and expense. Mooney et al then reported on problems and solutions from the piloting of a bespoke electronic data collection tool (UoM eForms). They reported the additional potential for use in: research data collection, feedback, placement-evaluation, quality assurance, and admissions interview-marking.

- Martyn et al. (2014) used concurrent mixed methods research and a case-study design, whereby nursing students in a distance education programme at each of two universities constituted a case for the piloting of the use of iPods, including when on clinical placement. While the researchers acknowledged that, when working well, the devices were convenient for quick access to learning resources, there were several barriers. Four main barriers emerged for this remote learning, i.e.: connectivity, technological literacy, compatibility of resources, and screen-size. Examples of connectivity problems included clinical placement-staff not being happy to provide internet access and students relying on free but limited wireless (Wi-Fi) internet access at local fast-food restaurants. Other barriers to using the device included lack of time whilst on clinical placement to learn how to use it or to deal with compatibility conflicts in resources and the frustration of trying to view text-rich resources on small screens.
    - Boruff and Storie (2014) had also identified Wi-Fi Internet access in hospital or clinic as the commonest barrier (71% of medical students/residents/faculty) to using mobile devices to access medical resources, whereas knowing what was available was a barrier for 56%, lack of time for 26%, and otherwise various operational barriers (technology problems, complicated installation, devices not permitting use of specific software) thwarted them.

3.2 Scoping-review (Phase 1, as at June 2015)

Building on the scoping-exercise, Phase 1 of the scoping-review piloted the feasibility of the proposed search strategy for the search-question :

> **What are the breadth/depth and key features of the literature on the educational implications of health professions students using mobile devices and technology on clinical placements?**

It was anticipated that eligible articles would have been published since the mass adoption of smartphones, e.g. the era of the iPhone (2007). It was recognized though that earlier research may have been conducted globally related to personal digital assistance (PDA) technology, as early as 1992. For this reason, the publication search started from 1988. Comparisons of technology-enabled practices with more traditional non-technical approaches were included.

The search-strategy:

- combined variations on key-words and phrases within (Appendix 1: scoping-review search-terms, June 2015):

- study population (student-type);
- study setting (clinical location);
- electronic device/media;
- learning outcome/activity (including aspects of attitude, behaviour, perception, approach, knowledge, and skills)
  - *to be extended in Phase 2 to include m-learning in column 3 and effect*, before and after testing, pre- post- testing, follow-up stud*, satisfaction, and cost-effect* in column 4*

- included terms such as 'telemedicine' and 'text message' to check if they indicated use of handheld devices
- used databases: Medline & 'ERIC':
  - *to be extended in Phase 2 of the scoping-review to include: SCOPUS, Embase, PsychInfo, Web of Knowledge (core collection), Cochrane Central, Association for Learning Technologies (ALT), British Education Index, CINAHL (Cumulative Index to Nursing and Allied Health Literature)*
- used no language restrictions
- set inclusion criteria:
  - primary or secondary data collection
  - peer-reviewed journal articles or systematic reviews; grey literature such as conference-abstracts or commissioned reports
  - health professions students on a programme for a basic primary qualification
  - on clinical placement/internship/clerkship in the clinical setting/workplace (hospitals, general practice, community clinics, etc.)
  - using handheld device/technology to enhance/support their learning
  - primary or secondary research
  - time-span: 1988-2015
  - language: all
- set exclusion criteria:
  - about health professions students studying for a post-basic/-primary (advanced/postgraduate) qualification, e.g. nursing students described as 'graduate nursing students' if that meant that they were on Master or doctoral research programmes (rather than being graduates of other disciplines who were now taking a basic nursing degree)
  - about healthcare delivery (diagnosis, treatment, etc.), unless this was directly related to the education of students, e.g. applications to help students learn cardiopulmonary resuscitation (CPR)
  - telemedicine
  - desktop computing/technology
  - videoconferencing or 'SMS' texting or other such telecommunications
  - simulated setting not in 'clinical workplace'

- not specified/implied activity in the clinical setting/workplace
- editorial, opinion-piece, commentary-review, news-item, narrative reviews of literature

- yielded a provisional body of evidence for consideration of its breadth/depth and key features, including barriers to, facilitators of, implications of using mobile technology on clinical placements

Duplicates were excluded. Pairs of reviewers selected articles fulfilling the criteria by considering abstracts/titles and resolving discrepancies between them. Before extending and updating the search strategy, Phase 1 of the scoping-review found 392 potentially eligible articles, from which the full articles from 70 abstracts would be considered further *('PRISMA' flow-chart*).

Two reviewers piloted the data-extraction table (for the quality-assessment of the full articles) by using twenty full articles (Appendix 2). Overall, from Phase 1 of this scoping-review (with Phase 2 pending), most abstracts were quantitative, from the second half of the time-period and cross-sectional (Table).

3.3 Scoping-review (Phase 2)

To complete the scoping-review (Phase 2), besides the extra search-terms and databases detailed above, there will be manual searching by consulting:

a) the reference-sections from the core articles found and from any narrative reviews of literature found;
b) key journals including Academic Medicine, Medical Education, Medical Teacher, Advances in Health Sciences Education;
c) key conference proceedings including 'ASME' (Association for the Study of Medical Education), 'AMEE' (Association for Medical Education in Europe), and Ottawa Conference on Medical Education;
d) experts known to be using mobile devices in innovative ways (on clinical placement to promote learning), to help to identify relevant 'grey literature', e.g. unpublished reports, etc.

3.4 Scoping-review (Phase 1) interim findings

The interim findings of the scoping-review appeared to suggest that there were very few randomized controlled trials, the focus was mostly on medical and nursing undergraduates, and many of the abstracts of quantitative research did not even disclose the sample-size let alone crucial aspects of study design. It did not appear *to-date* that there was a comprehensive structured review to provide evidence about when and how best health

professions students in clinical placements should use hand-held devices for educational support, so this would become the focus for an effectiveness-review to be extracted and refined from the completed scoping-review. Nevertheless, interim findings were consistent with Ozdalga et al's (2012) assertion (from a much broader remit) that they: *"found that very few high-quality studies exist to help us understand how best to use this technology"* (p1).

'PRISMA' flow-chart: Best Evidence Medical Education (BEME) scoping-exercise search, 20 May 2015: "What works best for health professions students using mobile technology on clinical placements?" Abstracts selected (n=70)

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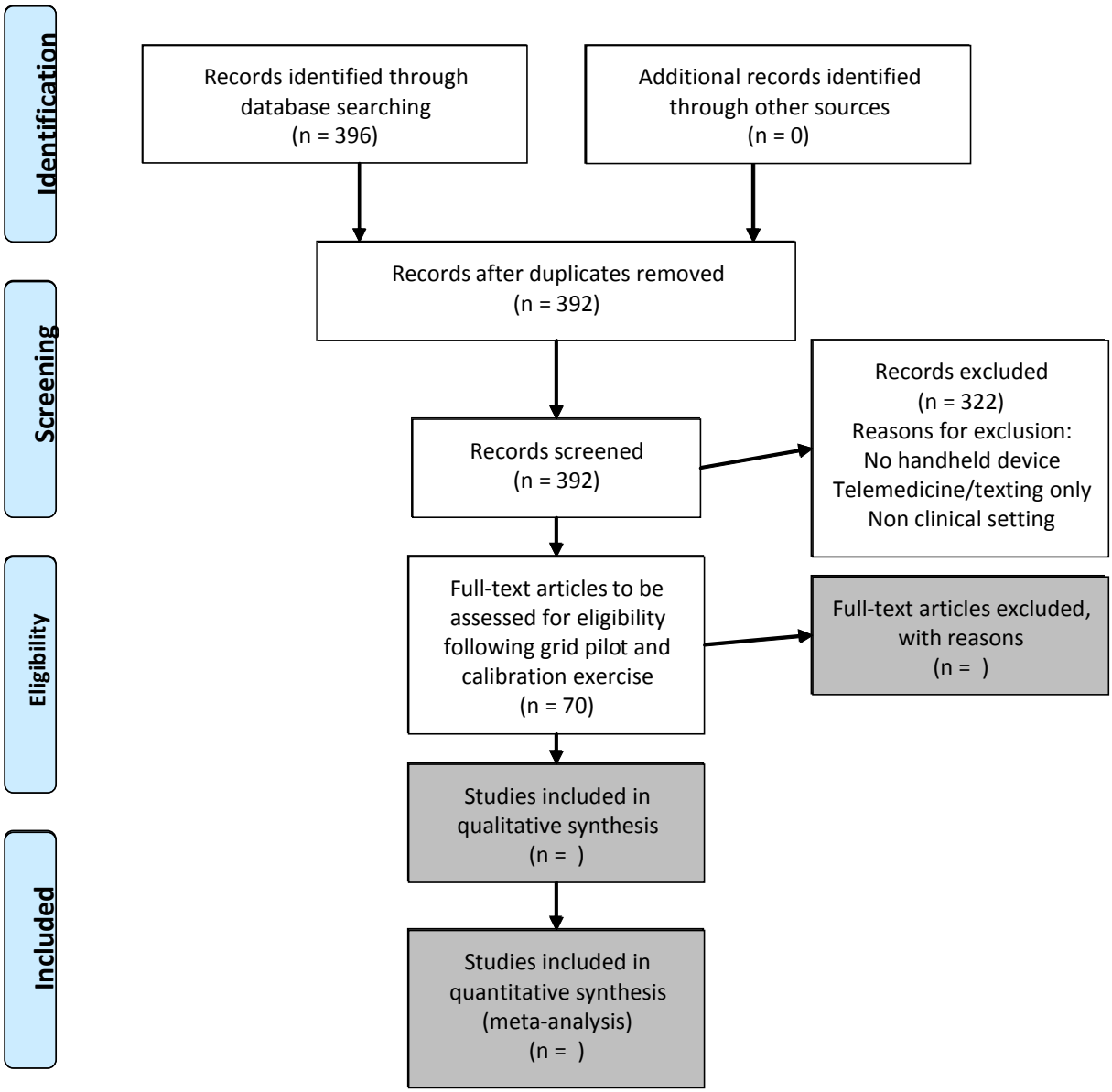

Table 1: Best Evidence Medical Education (BEME) scoping-exercise search, June 2015: Descriptive epidemiology of the abstracts from research articles (n=70) found in the scoping study search from the 1988-2015 search for 'What works best for health professions students using mobile technology on clinical placements?'

	Feature	**%**	**(n)**
Time	In the second half of the time-period	57	(40)
Place	North America	59	(41)
Person	Type of student=medical	44	(31)
	Type of student=nursing	23	(16)
Nature of research	Cross-sectional	44	(31)
	Randomized controlled trial	4	(3)
	Longitudinal	6	(4)
	Data collection: questionnaire/survey	29	(20)
	Data collection: explicit mixed methods approach	13	(9)
	N reported in abstract	53	(37)

4. Review-question for effectiveness-review

The main research question would be:

What works best for health professions students using mobile devices and technology for educational support on clinical placements?

Consequently, this effectiveness-review would focus on the evidence about the educational potential of using hand-held devices in clinical placements. The term 'educational potential' in this review would include aspects of attitude, behaviour, perception, approach, knowledge, and skills related to 'what works, for whom, when, and how?'.

4.1 Aims and objectives

Aim:

To explore the research evidence on how health professions students should best use mobile devices and technology on clinical placements to support their learning.

This review should help to inform the development of learning and teaching strategies in medical schools globally, especially as medical schools increasingly consider the bulk-purchasing of mobile devices and technologies for students (Mooney et al. 2014).

Sub-questions 'objectives' about how health professions students should best use mobile devices and technology on clinical placements to support their learning:

- What broad types of mobile devices and technology are best to use and what are the best features?
- What are the best activities supported by mobile devices and technologies and the best conditions to support these?
- What is the educational potential of health professions students using these devices in their clinical placement, in terms of their: attitude, behaviour, perception, and approach to learning; related outcomes; and related implications?

4.2 Question breakdown

Population	Health professions students
The activity under investigation	Use of hand-held devices (mobile devices and technology) to support learning when on clinical placement / in the workplace
Primary outcome	Attitude, behaviour, perception, approach to learning, knowledge, and skills
Secondary outcome	Satisfaction

4.3 Type of review

Effectiveness-review.

4.4 Definition of terms

As for the scoping-review:

Hand-held device: The term ‘handheld device’ has changed its meaning over recent years. Notwithstanding likely difficulties in ascertaining key features of the mobile device and technology, in this review it is taken to refer to a smartphone or tablet device that:

> *“has additional functions including a camera, global positioning system (GPS), and Wi-Fi capabilities and is running one of the following operating systems: iPhone, Android, BlackBerry, or Windows Mobile”* (Ozdalga et al. 2012).

Health professions student: refers to students in medicine, nursing, and allied health professions studying for the basic primary qualification.

Clinical placement / workplace: refers to the sustained periods that health professions students spend in the clinical setting (hospitals, general practice, community clinics, etc.), i.e. their ‘workplace’ for clinical learning.

5. Search-strategy

5.1 Search

The effectiveness-review would build on the search-strategy of the completed scoping-review (p5-6), by extracting manually the subset of articles that informs the ‘what works, for whom, when, and how?’ of effectiveness, but specifically :

- using inclusion criteria: effect*, before and after testing, pre- post- testing, follow up stud*, satisfaction, cost effect*, Kirkpatrick
- using exclusion-criteria: no mention of outcome or effectiveness

6. Procedure for extracting data

6.1. Formal review-procedure

- Two reviewers would screen the titles and abstracts of all articles against the criteria;
    - If both reviewers agreed on including the article, the full text would be retrieved.
    - If both reviewers agreed on excluding this article, the article would be excluded.
    - If the reviewers did not reach consensus, they would discuss it further and, if necessary, a third member of the team would be assigned to the task and/or the full article would be retrieved for further checking.
- Two reviewers would screen the full articles (after first verifying their eligibility for inclusion) using the data extraction-table (provisional draft: Appendix 2) following a calibration-exercise involving all reviewers testing the classification of about 6-10 articles.
- Quality-assessment of articles would use the appropriate 'CASP' (Critical Appraisal Skills Programme) tables as a guide to an overall 'red-amber-green' (poor-suboptimal-satisfactory or low-medium-high quality) classification.

7. Synthesis of extracted evidence

Due to the nature of educational research, the scoping-review revealed a mixture of research: quantitative, qualitative, and mixed methods of variable quality. If required, meta-analysis would be used to summarize quantitative findings, but much of the research is considered to be unsuitable for quantitative synthesis. Narrative synthesis and/or thematic analysis would be used, as appropriate, to synthesize qualitative research.

To avoid merely focusing on basic description, reporting-guidelines are recommended (Dixon-Woods, Booth, & Sutton, 2007). It is envisaged that this narrative synthesis would be iterative and critically summarise diverse forms of evidence from eligible articles, with due consideration of the four stages of Rodgers et al (2009):

- developing a theory of how the intervention works, why, and for whom;
- developing a preliminary synthesis;
- exploring relationships within and between studies;
- assessing the robustness of the synthesis product.

Rodgers et al (2009) noted that this was to ensure that systematic reviews:

"move beyond producing a simplistic summary of research findings, toward developing a more reflective and reflexive approach" (Rodgers et al., 2009, p. 70). Here, narrative synthesis would be used to synthesize the learning activities of health professions students using mobile devices and technology.

8. Timetable

Process/ entity	Duration (approximate)	Expected starting date	Expected completion date
Form review group	2 weeks	1st June 2014	15th June 2014
Topic registration	2 weeks	16th June 2014	1st July 2014
Protocol writing and submission	8 weeks	1st November 2014	31st December 2014
BEME coding-sheet (developing & piloting it)	10 weeks	1st January 2015	15th March 2015
Scoping literature search	4 weeks	16th March 2015	15th April 2015
Submission of revised protocol			29th June 2015
Decision on revised protocol			7th December 2015
Rewriting protocol as an effectiveness-review			11th January 2016
Running refined search	4 weeks	18th January 2016	12th February 2016
Retrieving full text articles	2 weeks	15th February 2016	26th February 2016
Coding of full articles & data abstraction	8 weeks	29th February 2016	22nd April 2016
Synthesis of findings	8 weeks	25th April 2016	17th June 2016
Review writing	10 weeks	20th June 2016	26th August 2016
Finalising report	2 weeks	29th August 2016	9th September 2016
Report submission	2 weeks	12th September 2016	30th September 2016

9. Statement on conflict of interest

There are no known conflicts of interest that would impact upon this review. Review-members represent a multi-disciplinary team with expertise in medical education, technology-enhanced learning, and research methods. Regular review-meetings would be conducted to discuss progress of the review and identify potential conflicts of interest.

10. Plans for updating the review

It is recognized that the review would take place over a substantial period of time, thus further research would probably be published in the period between initial searching and completion of the final report. Monthly searches would be conducted to identify research published during the preparation of the review.

Upon completion of the review, the Team would be keen to update and maintain accuracy, by providing a supplement to the original review after three years.

11. Changes to the protocol

At this stage, the group does not envisage any further substantial change in the protocol. Unanticipated issues might arise and modifications to the review topic/question, coding-sheets, and/or protocol might become necessary. If this happened: any subsequent changes to the protocol would be carefully recorded, as well as the reasons for these changes and the date the changes took place. Substantial changes to the protocol would be submitted to BEME for approval.

12. Bibliography

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