Review Title

A BEME Review of the Effectiveness of Teaching Strategies Used in the Clinical Setting on the Development of Clinical Skills Among Health Professionals

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Team capability to deliver project: The team has varied and extensive experience in the field of health professions education and includes an international cohort of authors.

Pierce is a full time clinician and medical educator. He is a graduate of the Teaching Scholars Program at the University of Colorado Anschutz and has presented workshops at national meetings on curriculum development and published novel findings about the teaching of high value care principles in the inpatient clinical setting. He and his colleagues developed and teach for medical residents an elective that combines a hypothesis-based physical exam with point of care ultrasound to improve diagnosis and clinical decision-making. His background in mathematics and economics, combined with his serving as a front-line provider and teacher, bring a quantitative and practical perspective to the group.

Corral has a PhD in Education, has international medical education administrative experience, and brings a prior experience with literature reviews, and mixed methods and qualitative analysis skills. She has reviewed one BEME review submission for BEME in 2015. She also has an extensive network of international collaborators in the field of medical education and has been crucial to bringing together the review team.

Aagaard is a well-established medical education leader and investigator who developed and runs the Academy of Medical Educators at the University of Colorado, which provides support and faculty development in curriculum, education research, and medical education leadership. She has published widely on medical education including primary studies, and a review of, several clinical teaching models. She and Dr. Janet Corral lead the University of Colorado BICC, and as such are members of two BEME sub-committees.

Harnke works in the field of library science and brings the expertise needed to conduct a robust literature search. He has published four systematic reviews, including one involving mixed-methods.

Irby is an international leader in medical education and has published extensively in the medical literature. He also served as the Vice Dean of Education and Director of the Office of Medical Education at the University of California, San Francisco for many years. He continues to serve as a committee member for several international education organizations including the Association for Medical Education in Europe and the Josiah Macy Foundation.

Myhre is an internationally known medical educator and is the Associate Dean of Distributed Education for the University of Calgary in Alberta. He has helped to develop policy for the Undergraduate Education Committee of the College of Family Physicians of Canada and is currently working on another BEME review. He serves as an associate editor for the Canadian Medical Education Journal and has received

numerous and substantial grants to develop medical education initiatives and programs.

Stickrath serves as the Assistant Dean for Education at the Colorado Springs Branch of the University of Colorado. He has published and presented at several major conferences an approach to maximizing the clinical learning that occurs during bedside teaching rounds. He has overseen the development of a longitudinal clinical curriculum for 24 third year medical students at the newly created Colorado Springs Branch of the University of Colorado Anschutz. He also serves a major role both teaching for and overseeing the curriculum for the Academy of Medical Educators at the University of Colorado.

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Abstract

Introduction: Much of the education of health professionals occurs in the clinical setting. However, the literature that describes teaching strategies in the clinical setting is limited, and the effectiveness of these strategies is not well known. As a result, teaching and learning in the clinical environment may be sub-optimal.

Aims and Objectives: We aim to conduct a realist synthesis review focused on teaching strategies used in the clinical setting that aim to improve the clinical skills of health professionals in the following domains: medical knowledge, clinical reasoning, communication, empathy, patient-centeredness, and physical examination. Our review will contribute to practical knowledge that can be applied by health professions educators and frontline teachers. We plan to determine what strategies worked, for whom, and under what circumstances.

Methods: We plan to conduct a search of thirteen databases and supplement with a hand search of citations and the grey literature. We will extract data from all studies that describe a teaching strategy utilized in the clinical setting for teaching clinical skills in the domains of interest. We will report on each strategy's effectiveness in the domains of satisfaction, knowledge, and skills. We will synthesize the findings to report the limitations of existing studies, the context in which these strategies are effective, and the outcomes they achieve. We will identify gaps in the existing literature to propose areas needing future study.

Revised May 4, 2017

Background

This BEME review will analyze the literature for the best teaching strategies in the clinical setting. Based on the authors' librarian-supported review of the existing literature, there is no current, comprehensive review of effective teaching strategies for teaching in the clinical setting. We define effectiveness as improved learner outcomes in one or more domains of: professionalism, clinical reasoning, medical knowledge, physical examination, empathy, patient-centeredness, and communication. We would ideally restrict our analysis to only those studies with outcomes classified as level 2a or higher on Kirkpatrick's pyramid. This level of the hierarchy corresponds to a change in a learner's attitudes, knowledge, behavior or organizational practice. However, we appreciate the importance of learner perceptions toward, and teacher satisfaction with, teaching strategies. Both are important factors in successful implementation of any strategy. We therefore include in our analysis learners' and teachers' reaction to, or satisfaction with, teaching strategies and the learning environment they create.

This review makes an essential contribution to the literature. A significant portion of health professions education occurs in the clinical setting. Many teaching strategies have been developed, espoused, and employed within clinical settings, including: "SNAPPS" mnemonic, the "One-minute preceptor", "Aunt Minnie", "Teaching on the Run", "Five Step Microskills", and "MiPLAN". (Kroenke 1992, Ramani 2003, Janicik 2003, Shankel 1986, LaCombe 1997, Cunningham 1999, Aagaard 2004, Wolpaw 2003, Lake 2004, Stickrath 2013). However, the literature only provides efficacy for some of these approaches. Although a prior review assessed published educational interventions in the inpatient setting, the authors found a paucity measuring effectiveness (DiFrancesco 2005). The few studies they identified with measurable outcomes were primarily focused on interventions aimed at specific disciplines, for example cardiology or anti-coagulation management. Other studies have examined outcomes in areas of anatomy (Chan 2014) and psychiatry (Teherani 2013), specific content areas such as the physical examination (Easton 2012), or were focused on teaching in the ambulatory setting alone (Irby 1995, Heidenreich 2000). Clinician-educators, and their trainees, deserve evidence-supported, effective teaching strategies for use in the clinical setting.

Our review builds upon a robust base of recent reviews on other important topics applicable to teaching trainees for clinical practice, including: clinical reasoning in mostly classroom settings (Schmidt 2015), classroom-based methodologies including team-based learning and case-based learning (Fatmi 2013, Thistlethwaite 2012), experiential learning (Yardley 2012), feedback (Veloski 2006), role modeling (Passi 2013), and direct observation (Craig 2011).

Aim and Objectives

We propose conducting a realist synthesis review focused on teaching strategies used in the clinical setting for the teaching of clinical skills in the following areas: medical knowledge, clinical reasoning, communication, empathy, patient-centeredness, and physical examination. Our review will contribute to practical knowledge that can be applied by health professions educators and teachers on the frontline. We plan to determine what strategies worked, for whom, and under what circumstances.

The final BEME review product will provide descriptions of effective teaching strategies for the clinical health professions education context. Specifically, we will:

1) Specify which teaching strategies have demonstrable benefits to support their continued use
2) Describe the context of implementation of these strategies
3) Provide a thematic review of study designs and the strengths of the learning outcomes reported to guide further research in this area.

The findings of our review will be valuable for: health professions education leaders working to reform curriculum, teaching methods and faculty development offerings; clinician educators providing direct teaching; and health professions education researchers aiming to improve educational processes and outcomes.

Primary review questions/aims

Our primary research question is:
> Which strategies used in the clinical setting for teaching health professionals the clinical skills related to medical knowledge, clinical reasoning, communication, empathy, patient-centeredness, and physical examination are effective?

The related sub-questions are:
1. For teaching strategies with associated literature describing their effects on educational outcomes,
   a. What are the educational outcomes that they impact?
   b. Where do these outcomes fall in Kirkpatrick's hierarchy?
   c. What are the competency domains (professionalism, clinical reasoning, medical knowledge, physical examination, empathy, patient-centeredness, and communication) within which learner outcomes have improved?
2. What are the study designs that provided evidence of effectiveness?
3. What are the contexts in which the effective teaching strategies were implemented?

Our two main aims, related to these research questions, are the following:

1. Provide a narrative description of the most impactful ways of implementing effective teaching strategies in the clinical setting.
2. Make recommendations regarding successful study designs and provide directions for future research.

Methods

Search strategy

We will use a standard search strategy, adopted from the approach taken in several previous BEME reviews. We will include published and unpublished studies that describe and evaluate the effects of teaching strategies used in the clinical setting, as defined below. We will search a comprehensive set of databases to identify published articles, book chapters, and dissertation abstracts (see Table 1 below). In order to capture studies relevant to the current era, we will limit our search, except where otherwise noted below, to the time period from January 1, 1970 to May 31, 2017.

Table 1

Databases
1. OVID MEDLINE
2. EMBASE
3. CINAHL
4. Proquest* (dissertation abstracts)
5. ERIC (Education Resources Information Center)
6. Ovid HealthSTAR
7. PsycINFO
8. Google Scholar
9. WorldCat
10. Library of Congress
11. Web of Science
12. MedEdPortal

* January 1, 1997 – May 31, 2017

Bibliographies of relevant publications and review articles will also be scanned and journals and abstracts from conference proceedings will be searched to identify unpublished trials. Because of resource limitations that preclude translation, only articles published in English will be reviewed.

For published studies with inadequate detail to allow the reviewers to complete the coding form, the primary reviewers will contact the listed authors via email, mail, or phone to try to obtain missing information. If insufficient data is available, the study

will be rejected from the review.

Our proposed method for the final search strategy is as follows: we will use a combined approach using keywords searched for within the article, title, abstract, and text. We will also use MESH terms. The general search strategy is included in the "Search Strategy" section of the Appendix.

Our search strategy will consist of two steps. First, we will aim to identify teaching strategies in the published literature that are not already known to the authors. We will use a search in three domains to capture teaching strategies of interest. First, we will search for synonyms for the words "learner." Second, we will search for synonyms for key outcomes of interest such as clinical decision-making, medical knowledge, communication, and professionalism. Third, we will search for synonyms of the word "strategy." The overlapping collection of the results from these three separate searches will serve as our starting database.

For our second step, we will perform a new search for all articles containing the names of teaching strategies known to the authors. These known strategies are shown in the appendix as "Search Strategy Step 2." We will combine the database yielded from this second step with the existing database yielded from step one of the search strategy.

As a quality control, we will review the list of references for all articles that undergo full article review. We will use these reference lists to identify any other teaching strategies that were either not identified by step one of our search strategy or pre-specified in step two of the search. We will add these teaching strategies to our list of search terms for step two and then repeat step two again. Any newly identified articles will be added to the complete database, will be evaluated for inclusion or exclusion, and will be included in the final review if they meet our inclusion criteria.

We established the specific keywords in two ways. First, we used MESH terms for each of the three domains to capture an extensive list of articles. Then, we compared the number of articles retrieved using the specific keywords within each domain to the number of articles returned using only the MESH term for that domain. Based on these comparisons, we identified "clinical competence" as the MESH term that retrieved a vastly larger number of articles than the search that used only our keywords. The primary author then reviewed the titles of a sub-set of articles associated with the MESH term "clinical competence" that did not contain our pre-identified keywords. The primary author extracted from this list of articles additional keywords of relevance to the proposed analysis and added them to the list of keywords to be used for the final search strategy. This list of words was then sent to the author group for review. Synonyms and additional keywords that were felt to be missing were added to generate the final search strategy.

As a second method of quality control, the primary author flagged articles that did not clearly meet the identified exclusion criteria during title review of all articles

yielded from the second iteration of the scoping search. Authors from the group then individually submitted lists of articles of known familiarity relevant to the study topic. Their submissions were then combined into a single list, which was compared to the list generated during title review of the results obtained from the second scoping search. Articles missing from the subset of relevant articles identified during review of the scoping search results were used to identify additional keywords using "term harvesting". These additional keywords were then added to the list for the final literature search.

Feasibility
An initial scoping search using the proposed search terms listed in our topic registration form yielded 236 articles of interest. The primary author reviewed the abstracts of these articles and identified 85 for possible inclusion for our review. Based on input from all authors, we subsequently expanded our search terms to include the MESH term "clinical competence". A second scoping search yielded approximately 7400 unique articles. Based on only reviewing titles (conducted by the first author [CP] and senior author [CS]), we estimated that approximately 3%, or 225 of the 7400 articles, would be sufficiently relevant.

With our subsequent search strategy revisions, we obtained approximately 5500 articles from the MedLine database, after eliminating duplicates. We anticipate this number will roughly double when we include the other databases. Based on our previous 3% yield, we estimate between 400 and 600 articles will require full review. With two authors reviewing each article in its entirety (and assuming 20% require adjudication by a third party), we anticipate each author conducting a full review of 125-175 articles. Of these, we estimate approximately 1/5 (25-35) will be associated with our pre-specified outcomes of interest and will be included in the final summary data.

Types of studies

We will include studies published between January 1, 1970 and May 31, 2017 that examine the effectiveness on educational outcomes of defined teaching strategies applied to the teaching of clinical skills in the clinical setting. We define "clinical setting" as an office, clinic, ward, hospital, or accident and emergency department (A&E), that involves the provision of care to actual patients or clients (not standardized patients) by licensed healthcare providers. We include mental health providers, nurses, pharmacists, speech therapists, veterinarians, and physical and occupational therapists. The licensed providers must also be simultaneously serving as teachers for health professions trainees, who must be co-present and participating directly in patient care.

We will exclude publications that evaluate teaching strategies that rely on simulated patient encounters or virtual patient encounters, as these topics have been studied in other BEME reviews. To prevent an excessively broad scope, we restrict our review to publications describing the teaching and learning of non-procedural tasks

(see definition below). Because we are interested specifically in the learning that occurs in clinical settings, we will also exclude publications that evaluate teaching strategies that were applied only in the classroom and not in the context of direct patient care activities. We will exclude articles that merely describe new curricula, discuss course redesigns, or detail changes to the structure of the curriculum or the method of its delivery. Last, we will exclude studies that describe summary data of teaching methods or strategies obtained by programmatic or observational surveys related to curriculum design and/or content. In doing so, we hope to capture only those teaching strategies that could be used for a single clinical encounter by anyone serving in the role of "teacher".

Types of participants

We will include in our analysis only studies that involve both health professionals and their teachers. These health professionals are broadly defined and include learners and practitioners in the following areas or training programs: medicine (in its broadest definition—involving all specialties that engage in the diagnosis and treatment of human patients with physical illness using medications), surgery, psychiatry, psychology, nursing, occupational and physical therapy, pharmacy, speech therapy, and veterinary medicine.

We define a teacher as any individual who is considered more "senior" in training in the sense that the teacher possesses additional expertise or knowledge—beyond that of the learner—in the same field in which the learner is actively learning. Using this definition, we are able to include, for example, studies that examine the effectiveness of applied teaching strategies where housestaff (interns, residents, or registrars) teach medical students. We will include studies examining "peer to peer" training, i.e. those studies that describe transfer of knowledge between individuals at the same level of training. We will also include studies that involve "continuing education" and "maintenance of certification" of individuals who are receiving instruction in the same field in which they are already fully licensed or certified to practice.

We divide learners into three groups. The first group consists of trainees in the principal clinical years—points in training where learners are principally engaged in seeing patients in a clinical setting, but the learners primary purpose is for gaining clinical experience. This group of learners may be assisting with patient care, but they are not acting as primary practitioners. The second group consists of practitioners who have a limited license to practice but still require direct oversight or supervision. We would label this group as "supervised practitioners." The third group consists of learners who are fully licensed for independent practice in the same field in which they are learning. Common terms used to describe the learning in this third group would include "continuing education" and "recertification."

Types of skills

We will include only studies that describe and evaluate strategies for the teaching of skills in the following domains: professionalism, clinical reasoning, medical knowledge, physical examination, empathy, patient-centeredness, and communication. In our view, skills in these specific domains tend to be strongly and commonly associated with "non-procedural" or "cognitive" tasks. "Procedural" tasks, in comparison, rely heavily on a different set of skills—one that includes, among others, hand-eye coordination, motor memory, and the proper sequencing of mental and motor activities. Consequently, for the purposes of this review, we believe it is crucial to provide a clear definition of what we consider to be procedural tasks. We use the existing definition from Foley and Smith, cited by Sawyer et al, of a "procedure" as the mental and motor activities required to execute a manual task. We thus define "non-procedural" as those tasks or skills that involve direct communication with patients about their symptoms, diagnosis, or treatment; gathering of information about a patient's physical state by inspection, auscultation, palpation, or percussion; or communicating in written, typed, electronic, or oral form about a patient's diagnosis and treatment plan with other healthcare professionals or trainees. We more specifically define procedural tasks as those activities that involve or simulate the piercing of a patient's skin with a needle or scalpel, insertion of instruments or tubes into orifices of the body, acquiring a tissue or blood specimen from a patient, manual re-positioning of the human anatomy back to its natural state following a traumatic injury, the application of electricity or delivery of radiation to the human body, obtaining images of patients or their internal anatomy, and delivering a pregnancy. We make this distinction because the teaching strategies used for procedural tasks often differ from, and may not have direction translation to, the teaching of non-procedural skills.

Types of outcomes

When assessing outcomes, we will include only studies that provide information about the effectiveness of teaching strategies being directly applied to the clinical setting. The method or strategy should be described either within the same publication that is reporting the measured outcomes, or it must be described elsewhere in the published or unpublished health professions literature and appropriately referenced.

We are interested primarily in learner outcomes related to skills in the domains of professionalism, clinical reasoning, medical knowledge, physical examination, empathy, patient-centeredness, and communication. Because learner and teacher reactions towards teaching strategies may be important to effective implementation, we will also capture information about satisfaction and level of comfort with the strategy, where it is measured and reported.

We will first classify described learner outcomes according to Kirkpatrick's model, described below. We will then map outcomes into one of the skills domains above

using descriptions of accreditation groups and the published literature as a reference. We will resolve any outcomes classification disagreements between reviewers by group consensus.

Classification of outcome measures using Kirkpatrick's model
Outcome measures will be based on Barr and colleagues' (2005) version of Kirkpatrick's classic educational outcomes model, which has six levels. These are outlined below. The definitions are modified from those of Reeves et al (2014) in their BEME review protocol on the topic of interprofessional education.

Level 1 – Reaction: This level consists of learners' views on the learning experience. It includes areas such as satisfaction, level of comfort, perception of the learning environment, and learner anxiety levels. Examples include reaction to material organization, presentation, and content. It also includes reaction to teaching methods and aspects of the institutional organization such as sequencing of curricular content, course materials, and quality of teaching.

Level 2a - Modification of attitudes/perceptions: These outcomes relate to changes in attitudes or perceptions of participant groups towards patients/clients, or towards patients'/clients' condition, circumstances, care and treatment. Under the domains of professionalism and communications, it would also include changes in perceptions towards communication with, or behavior towards, other healthcare providers.

Level 2b - Acquisition of knowledge/skills: For knowledge, this classification level relates to the acquisition of medical knowledge. For skills, this classification relates to demonstrated empathy, patient centeredness, physical examination, clinical reasoning, or professionalism skills.

Level 3 - Behavioral change: Measurements in this category will document the improvement in the outlined domains, along with a demonstrated and consistent change of behavior in the workplace. In addition, outcomes must document learners' new willingness to apply new knowledge and skills in the domains of communication, physical examination, clinical reasoning, professionalism, or empathy to the direct care of patients.

Level 4a - Change in organizational practice: Measurements in this classification relate to wider changes in the organization/delivery of care that are attributable specifically to the teaching strategy. Examples include more effective dissemination (when compared to standard practices) of the acquired knowledge and skills to others within the same organization, or direct participation in the teaching of other learners the knowledge and skills that were acquired as a result of the teaching strategy.

Level 4b - Benefits to patients/clients: This, the highest tier in the classification, contains measurements of the health and well being of patients/clients that are a direct result of the teaching strategy, transmitted through its effects on actual learner behaviors. These impacts consist of objectively measured or self-reported patient/client outcomes. Examples are health status measures, disease incidence, duration of disease, cure rates, mortality, complication rates, readmission rates, adherence rates, patient or caregiver satisfaction, continuity of care, and costs of

care borne by the patient. *We anticipate little if any data measuring the effectiveness of teaching strategies on patient outcomes, but we will include this outcome if identified by our review.*

Data analysis
Primary Screening: The first and senior author will use Covidence to perform a title review for the primary screening. In instances of ambiguity based on title review, these authors will review the abstract, or the full article when the abstract is not available. If neither the abstract or full article is available, we will contact the listed author to request a copy and/or request the article via inter-library loan. Each of these authors will independently track articles of potential relevance. If either of these two authors identifies an article as potentially relevant, it will be added to the database to undergo full article review. There will be no adjudication at this step, as this approach is maximally inclusive and excludes only articles that both authors agree are not relevant.

Full Article Review: Covidence will be used to assign articles requiring full review. All articles will initially undergo review by two members of the team (excluding Harnke, who is conducting the primary search). Authors will first and independently determine whether or not an article should be included in review. They will track this decision and any reasons for exclusion in Covidence. For any article that meets the inclusion criteria, authors will use the standardized data collection tool (shown below) to capture all relevant information, including strength of the study methodology. In instances of disagreement between reviewers about inclusion, we will send the article in question to a third reviewer. The decision to include or exclude the article of question in the final review will be determined by the majority view—i.e. the opinion held by 2 of the 3 reviewers. We will use a scoring system of 1-3 (unacceptable, acceptable, and exceeds professional standards) to assess the quality of reviewed studies. These definitions are defined as follows:

Unacceptable (1): Serious gaps in documentation or fatal flaws in study methodology, description of methods, data acquisition, or analysis. A publication that describes a teaching strategy and its effects on outcomes but has no tables showing the objective data to support its claims for effectiveness or does not define the details of the intervention (who received it, duration of intervention, how intervention was done, etc.) would fit in this category.

Acceptable, meets standards (2): Few gaps in documentation of methods and minor flaws study design, description of data acquisition, or the analysis. Examples would include studies with historical controls or observations done pre/post intervention but lacking a comparison group. Outcomes data may be self-reported and/or subject to observer bias (study participants also collecting the outcomes data) or inter-observer variability.

Exceeds professional standards (3): No perceived gaps in study design, documentation of methods, flaws in description of data or the analysis. Examples

would include studies with outcomes for intervention and non-intervention groups both before and after the intervention. They may include some self-reported outcomes, but should also include outcomes data gathered from a third-party observer using a standardized assessment tool or observers who undergo standardization training. Alternatively they may include written test results or direct observation of skills using standardized scoring instruments.

We will use the same process using adjudication by a third reviewer for resolving disagreements between the two initial reviewers about study quality.

For the full article review for all remaining included studies, we will capture the data of interest using RedCap, an internationally recognized and utilized electronic data collection program. This program will facilitate entry and extraction of the data we will use for the systematic analysis. The development process for the data collection has been iterative. Initially, a paper data collection was created using previous published BEME data collections forms as a guide (Veloski 2006 and Reeves 2016). Modifications of the pilot version were made based on authors' comments. The form has been built into an electronic template within RedCap. All authors will have an additional opportunity to trial this electronic version, and further changes will be made based on this input prior to its finalization. A sample of this data collection form is included at the end of the protocol. It is possible this data collection tool will undergo minor further revisions to address unforeseen issues identified during data extraction during the full review process. The authors will provide a copy of the final data collection tool.

Analysis of Articles Marked for Inclusion

Our preliminary analysis of 500 articles showed that the teaching strategies utilized are numerous, and the measured outcomes and assessment tools are highly variable. Consequently, we will conduct a qualitative review of all articles marked for inclusion using the Kirkpatrick levels of outcomes and study design to group and report study findings. In keeping with a recent BEME review, we intend to use the CASP (Critical Skills Appraisal Programme) qualitative checklist as the basis for appraising these studies (Reeves 2016).

The format of data presentation will include three sections. Table 1 will list all of the described teaching strategies with their measured effectiveness as defined above. This table will list for each strategy the primary clinical setting or settings in which it has been utilized and the number of studies showing its effectiveness. It will also list in a separate column the Kirkpatrick's classification of each strategy's measured outcomes. This table will provide the basis for discussion about the strength of evidence in support of various teaching strategies.

Table 2 will list the different study designs utilized for the studies demonstrating effectiveness. It will serve as the basis for discussion about effective study designs and proposals for future study designs. It will also highlight and aid in the

discussion of any important educational outcomes or domains that have not been assessed.

Table 3 will capture the thematic analysis of the context of implementation of the strategies. It will serve as the focus for the discussion around the most effective implementation of these teaching strategies.

Samples of the tables are shown on the following page.

A BEME Review of the Effectiveness of Teaching Strategies Used in the Clinical Setting on the Development of Clinical Skills Among Health Professionals

Table 1 Sample

Teaching Strategy	Clinical setting	Number of studies and level of evidence	Level(s) of Kirkpatrick's
One Minute Preceptor	Outpatient/clinic		
SNAPPS	Outpatient/clinic		
Aunt Minnie	Outpatient/clinic		
Teaching on the Run	Both		
MiPlan	Inpatient/ward		

Table 2 Sample

Strategy	Study design	Trainee type (physician/nursing /pharmacy/etc)	Trainee level (PCY*, SP**, FL/IP***)	Outcomes measured	Outcomes not measured	Limitations
A						
B						

*PCY = Principal clinical years, not licensed to practice
**SP/LP = Limited license or license requiring supervision for practice (required to have direct supervision or oversight)
***FP/IP = Fully licensed to practice independently, without supervision

Table 3 Sample

Strategy	Context of implementation	Context in which not studied	Potential barriers to implementation
A			
B			

For the final paper, we will include in the appendix a list of all included articles with the detailed descriptions of their methodology, participants, outcomes measures, and outcomes.

Timeline

May 2016-Nov 2018	Topic Registration (June '16)	Protocol acceptance (March '17)	Month 1 (April '17)	Month 6 (Oct '17)	Month 18 (Oct 30 '18)
Pilot study					
Refining BEME coding sheet					
Literature search					
Data extraction and coding					
Manuscript draft					
Final report					

Plan for updating the review: With a hope that the review will stimulate more research in this area, the team would plan to conduct an update of the review 4 years after its original publication.

Conflicts of Interest: Drs. Stickrath and Aagaard helped to develop the MiPLAN model for bedside teaching. Drs. Pierce, Aagaard, and Stickrath have an observational study in progress designed to assess the effectiveness of the MiPLAN model.

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Appendix

Search strategy step 1: Identify additional, unknown teaching strategies

Concepts	Participants/Teaching Environment	Clinical competencies/Outcomes	Teaching Strategies
Text Words	"Resident(s)" or "residency" "intern(s)" "trainee(s)" "apprentice(s)" or "apprentices" "apprenticeship" "clerk(s)" "clerkship(s)" "medical student(s)" "student(s) of medicine" "pharmacy student(s)" "student(s) of pharmacy" "nursing student(s)" "student(s) of nursing" "medical learner(s)" "pharmacy learner(s)" "nursing learner(s)" "students" "learners"	"clinical competence" or "clinical communication" "clinical reasoning" "clinical decision making" "clinical diagnosis" or "clinical diagnostic" "clinical thinking" "clinical problem solving" "clinical documentation" "clinical teaching" "patient exam(s)" or "patient examination(s)" "patient history" or "patient histories" "patient assessment" "patient professionalism" "diagnostic reasoning" "treatment plan(s)" "humanism" "humanistic development" "patient interaction" "learner centered" or "learner centred" **All below paired individually with "ability", "skill(s)", "knowledge", "competence", and "higher level"** "communication" "reasoning" "decision making" "interpersonal or "inter-personal" "diagnosis" or "diagnostic" "problem solving" "documenting" or "documentation" "synthesizing" "clinical" "thinking" "conception" or "conceptual" "teaching"	"bedside teaching" "teaching at bedside" "mnemonic" "memory aide" "near-peer" **All terms below are paired with one of the following and must be adjacent within three words of: "training", "education", "educational", "pedagogy", "pedagogic", "pedagogical", "andragogy", andragogic", "andragogical", "instructional", "learning", or "teaching"** "strategy" "model" "method" "plan" "intervention" "prompt" "cue"
MeSH	Students, Medical/ or exp Preceptorship/	Clinical Competence/	exp models, pedogogicalal/

Search strategy step 2: Identify all publications related to known teaching strategies*

Named models
SNAPPS MiPLAN Aunt Minnie MoLIE One Minute Preceptor Learning on the fly CAARE MORE

*Authors will search references of all articles meeting inclusion criteria to identify additional teaching strategies not specified in this box or identified using search strategy step 1 above.

Search strategy step 3: Combine all results from search strategy 1 and search strategy 2.

Sample MEDLINE search
Search date: 10/13/2016

Database(s):
Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R)
1946 to Present
Search Strategy:

#	Searches	Results	Annotations
1	(((Resident or residents or residenc* or intern or interns or trainee* or apprent* or clerk or clerks or clerkship* or (medical or biomedical or nurs* or pharmac*)) adj2 (student* or learner)) or student* or learner* or (field adj3 stud*)).tw,kw. or Students, Medical/ or exp Preceptorship/	250624	
2	(((communication or reasoning or decision making or interpersonal or inter-personal or diagnos* or problem solving or document* or synthesiz* or clinical or thinking or conception or conceptual or teaching) adj2 (ability* or knowledge or skill* or competenc* or higher level)) or (clinical adj2 (skill* or communication or reasoning or decision making or diagnos* or problem solving or synthesiz* or thinking or documentation or teaching)) or ((patient* or physical) adj1 (exam or exams or examination* or history or histories or assessment or reassessment)) or (patient adj1 physical) or professionalism or differential diagnos* or diagnostic reasoning or treatment plan* or Humanism or humanistic development or Patient interaction* or (learner adj3 (centered or centred))).tw,kw. or Clinical Competence/	409079	
3	(((train or training or educat* or pedagog* or didactic or andragog* or instruct* or learn* or teach*) adj3 (strateg* or model* or method* or plan* or intervention* or prompt or cue)) or (bedside adj2 teaching) or mnemonic or memory aide or near-peer).tw,kw. or exp models, educational/	90168	
4	(SNAPPS or MiPLAN or Aunt Minnie or MoLIE or One Minute Preceptor or Learning on the fly or CAARE MORE).tw,kw.	61	
5	1 and 2 and 3	5562	
6	4 or 5	5598	
7	remove duplicates from 6	5517	

Coding form sample, version 4.0

Section A: Title review (COVIDENCE)
Pierce and Stickrath

A1: Reference manager ID (Covidence ID)

A2: **Primary reviewer** [*tracked by software*]
= 1 CPierce
= 2 CStickrath
= 3 Other

A3: **Date** *article was reviewed* [*tracked by software*]

A4: Status
= 1 Include in review (STOP and mark for inclusion)
= 2 Uncertain (STOP and explain in notes in A6)
= 3 Exclude (Select reason below in A5)

A5: Reason for exclusion (based on title review)
= 1 No teaching strategy used
= 2 Strategy NOT used in a clinical setting, as defined by protocol
= 3 Involves only structural change to curriculum delivery (more teachers, more physical resources, more time, etc)
= 4 Not English language
= 5 Article not relevant to health professions education
= 6 Duplicate article
= 7 Other (Explain in NOTES in A6)

A6: Notes [*free text entry box*]

Section B: For articles included after title review (COVIDENCE)
All authors

B1: Reference manager ID (Covidence ID)

B2: Reason for exclusion
= 1 Opinion or commentary
= 2 Program description with no outcomes data
= 3 No teaching strategy used
= 4 Does not include as outcome any of the following competencies: professionalism, clinical reasoning, medical knowledge, physical examination, empathy, patient-centeredness, and communication
= 5 No measured effect on learner performance, teacher satisfaction, or teacher

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rating
= 6 Addresses teaching EXCLUSIVELY a procedure or procedural skills
= 7 Other (STOP and Explain in B4) _____

B3: Status
= 1 Include in review (STOP and mark for inclusion)
= 2 Uncertain (STOP and explain in B4)
= 3 Exclude

B4: Reviewer's notes [*free text entry box*]

Section C: For articles included after full article review (REDCAP)
All authors

Design and Analysis
C1: Type of study (check only one)

OBSERVATIONAL [*build logic to associate selection below with assigned point scale*]
= 11 Descriptive, case series, case study (1 point)
= 12 Cross-sectional (studies, surveys) (1 point)
= 13 Case-control (retrospective) (2 points)
= 14 Cohort (prospective or retrospective) (2 points)
EXPERIMENTAL/INTERVENTIONAL
= 21 External controls (including historical) (3 points)
= 22 Parallel controls (not randomized) (3 points)
= 23 Sequential, self (x-over, time series) (3 points)
= 24 Randomized (parallel controls) (4 points)
QUALITATIVE
= 31 Ethnographic (0 points) {qualitative research approach that involves participant observation of events or culture. Field notes are then used to make qualitative statements about the culture or events observed}
= 32 Grounded theory (0 points) {qualitative research approach that involves an iterative process whereby generative questions guide research, data is gathered to identify theoretical concepts, links are developed from theory to the observed data, and then researchers try to develop an overarching theory. Often employs selective coding and concept maps}
= 33 Narrative (0 points)
REVIEW OR META-ANALYSIS
= 40 **NON-**systematic review of literature
= 41 **SYSTEMATIC** review of literature
= 42 Meta analysis
OTHER
= 80 Other design or mixture in one study, describe:
= 90 Unclear (STOP and explain in C9. Then return to C2)

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C2. Scope of study (empirical studies only) (check one)
= 1 One site (department) limited sample
= 2 One organization, multi-site one year
= 3 One organization, multi-site multi-year
= 4 Multiple organizations
= 5 National/international, limited
= 6 National/international, multi-site, -year
= 8 Other (STOP and explain C9. Then return to C3)

C3. Teaching strategy used or described (Select all that apply)
= 1 One minute preceptor (OMP)
= 2 SNAPPS
= 3 "On the run"
= 4 "MiPLAN"
= 5 "Aunt Minnie"
= 6 "Five Step Microskills"
= 9 Other _____(STOP and explain in C9)
= 10 None (EXCLUDE. STOP and explain in C9.) [*if C3==10, set C10 = 3*]

C4. Effect of strategy on learner performance (for ANY outcome of interest)
= 1 No measured effect. No impact.
= 2 Positive effect but statistically NOT significant ($P >= 0.05$)
= 3 Negative effect but statistically NOT significant ($P >= 0.05$)
= 4 Positive effect and statistically *significant* ($P < 0.05$)
= 5 Negative effect and statistically *significant* ($P < 0.05$)
= 6 NOT MEASURED (STOP and explain in C9)
= 9 Unclear, unable to determine. (STOP and explain in C9. Then return to C5.)

C5: Effect of strategy on teacher satisfaction (for ANY outcome of interest)
= 1 No measured effect. No impact.
= 2 Positive effect but statistically not significant ($P >= 0.05$)
= 3 Negative effect but statistically not significant ($P >= 0.05$)
= 4 Positive effect and statistically significant ($P < 0.05$)
= 5 Negative effect and statistically significant ($P < 0.05$)
= 6 NOT MEASURED (STOP and explain in C9)
= 9 Unclear, unable to determine. (STOP and explain in C9. Then return to C6.)

C6: Effect of strategy on learner(s) rating of teacher(s)
= 1 No measured effect. No impact.
= 2 Positive effect but statistically not significant ($P >= 0.05$)
= 3 Negative effect but statistically not significant ($P >= 0.05$)
= 4 Positive effect and statistically significant ($P < 0.05$)
= 5 Negative effect and statistically significant ($P < 0.05$)
= 6 NOT MEASURED (STOP and explain in C9)
= 9 Unclear, unable to determine. (STOP and explain in C9. Then return to C7.)

C7. Method of application of strategy

C7a. Orientation of **each individual learner** to the teaching strategy
= 1 WRITTEN ONLY {Provision of strategy in written or descriptive form only. NO associated in-person or online/virtual orientation session for learner}
= 2 IN-PERSON, SINGLE SESSION {single in-person session or workshop to orient learner to strategy}
= 3 IN-PERSON, MULTIPLE SESSIONS {multiple in-person sessions or workshops to orient learner to strategy}
= 4 VIRTUAL, SINGLE SESSION {single online or computer-based (slides, video) orientation}
= 5 VIRTUAL, MULTIPLE SESSIONS {multiple online or computer-based orientation sessions}
= 6 MIXED METHODS {combination of in-person and online/computer-based)
= 8 Other (STOP and explain in C9. Then return to C7b.)

C7b: Orientation of **teacher** to strategy {"teacher" includes faculty or any trainee who is serving in a defined role as teacher for other learners}
= 1 WRITTEN ONLY {Provision of strategy in written or descriptive form only. NO associated in-person or online/virtual orientation session for teacher}
= 2 IN-PERSON, SINGLE SESSION {single in-person session or workshop to orient teacher to strategy}
= 3 IN-PERSON, MULTIPLE SESSIONS {multiple in-person sessions or workshops to orient teacher to strategy}
= 4 VIRTUAL, SINGLE SESSION {single online or computer-based (slides, video) orientation to orient teacher to strategy}
= 5 VIRTUAL, MULTIPLE SESSIONS {multiple online or computer-based orientation sessions to orient teacher to strategy}
= 6 MIXED METHODS {combination of in-person and online/computer-based)
= 7 Other (STOP and explain in C9. Then return to C7c)

C7c: Was there third-party observation of **teacher** to assess the implementation of teaching strategy?
= 1 NO (Skip to C8)
= 2 YES (Go to C7d) [*if C7c == 2, prompt with C7d and C7e*]
= 3 Unclear (STOP and explain in C9. Then return to C7d.)

C7d: Was feedback provided to the **teacher** based on the observation? [*show only if C7c == 2*]
= 1 NO
= 2 YES

C7e: How was the observation conducted? [*show only if C7d ==2*]
= 1 In-person/live by a third-party observer
= 2 Video taped
= 3 Audio taped

= 4 Not specified (STOP and explain in C9. Then return to C8.)

C8. Data Collection and Analysis
= 1 Unacceptable (1): Serious gaps in documentation or fatal flaws in study methodology, description of methods, data acquisition, or analysis. A publication that describes a teaching strategy and its effects on outcomes but has no tables showing the objective data to support its claims for effectiveness or does not define the details of the intervention (who received it, duration of intervention, how intervention was done, etc) would fit in this category. Article seems likely to receive a "reject" or "major revisions" judgment were it undergoing peer review for a major educational journal
(STOP and explain in C9)
= 2 Acceptable, meets standards (2): Few gaps in documentation of methods and minor flaws study design, description of data acquisition, or the analysis. Examples would include studies with historical controls or observations done pre/post intervention but lacking a comparison group. Outcomes data may be self-reported and/or subject to observer bias (study participants also collecting the outcomes data) or inter-observer variability. Article seems likely to receive an "Accept with minor revisions" judgment were it undergoing peer review for a major educational journal
= 3 Exceeds professional standards (3): No perceived gaps in study design, documentation of methods, flaws in description of data or the analysis. Examples would include studies with outcomes for intervention and non-intervention groups both before and after the intervention. They may include some self-reported outcomes, but should also include outcomes data gathered from a third-party observer using a standardized assessment tool or observers who undergo standardization training. Alternatively they may include written test results or direct observation of skills using standardized scoring instruments. Article would be likely to receive an "Accept as is" judgment were it undergoing peer review for a major educational journal."

C9. Reviewer's notes [*free text entry box*]

C10. Status
= 1 Include in review (STOP and mark for inclusion)
= 2 Uncertain (STOP and explain in B4)
= 3 Exclude [*automatically selected if C3==10*]

D: Strategy of implementation and strength of evidence

D1. Clinical Setting in which strategy employed
= 1 Outpatient environment (clinic or office, including urgent care clinic, veterinary office, ambulatory care facility)
= 2 Non-hospital, non-office/clinic based healthcare setting (Nursing home, rehabilitation facility)

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= 3 Hospital/Inpatient environment (Hospital, ward, inpatient psychiatry unit, emergency department/A&E)
= 4 Operating room or operating theatre
= 5 Mixed (any combination of the above) (STOP and explain in D16)
= 6 Unclear of not specified (STOP and explain in D16)
= 8 Classroom with no immediate access of learners to actual patients (EXCLUDE. STOP. SKIP TO D16 AND FINISH. Explain in D16) [*if D1==8, set D14= 3 and D15 =* 1]

D2. Types of clinical skills the strategy is being used to teach {"procedures" are any activities that involve or simulate the piercing of a patient's skin with a needle or scalpel, insertion of instruments or tubes into orifices of the body, acquiring a tissue or blood specimen from a patient, manual re-positioning of the human anatomy back to its natural state following a traumatic injury, the application of electricity or delivery or radiation to the human body, obtaining images of patients or their internal anatomy, or delivering a pregnancy}
= 1 Non-procedural skills
= 2 Procedural skills (STOP. SKIP TO D16 and FINISH. Explain in D16) [*if D2==2, set D14 =3 and D15 = 2*]
= 3 Unclear or not specified (STOP and explain in D16)

D3. Types of patients involved in setting where strategy is actively employed
= 1 Standardized patients (EXCLUDE. STOP. SKIP TO D16 and FINISH. Explain in D16). [*if D3==1, set D14 = 3 and set D15 = 3*]
= 2 Virtual patients (EXCLUDE. STOP SKIP TO D16 and FINISH. Explain in D16). [*if D3==2, set D14 = 3 and D15 = 4*]
= 3 Actual human being treated for acute and/or chronic disease(s)
= 4 Actual animal patients being treated for acute and/or chronic disease(s)
= 5 Unclear from methods description (STOP and explain in D16)

D4. Physical location where the teaching strategy is utilized, relative to the patients being treated
= 1 In the physical presence of patients
= 2 Physically removed from patients, but still in a clinical setting (as defined by the protocol)
= 3 Both 1 and 2
= 4 Unclear or not-specified (STOP and explain in D16)

D5. Surrogate measures of impact of the teaching strategy (check all that apply): {include outcomes that were directly measured by observation or audio/video-recording, reported by the learner/teacher/patient, or determined by documentation review}
= 1 Learning climate or learner centeredness
= 2 Frequency of feedback provided by teacher
= 3 Quantity of feedback provided by teacher
= 4 Specificity of feedback provided by teacher
= 5 Diagnostic thoroughness {number of items in learner's differential}

= 6 Quality of diagnosis {accuracy of items in learner's differential}
= 7 Total time required by learner to complete task of interest
= 8 Rating of learner's performance on task
= 9 Frequency or quantity of learner initiated questions related to recognized or identified learning gaps
= 10 Frequency of quantity of learner-initiated reading (that is relevant to the skill the faculty is overseeing or to a gap identified in the student's performance)
= 11 Quality of **learner** oral communication with any of the following: teacher, other learners, patients, other providers, patient's caregiver(s), or patient's family
= 12 Quality of **learner** written or electronic documentation
= 13 Quality or quantity of content taught {number of teaching points made, clarity of teaching points, etc}
= 14 Efficiency of teaching {time (measured or perceived) spent by learners or teachers on teaching activities, or time spent on the patient care activity in which teaching is embedded}
= 15 Overall rating of teaching quality
= 16 Other _____ (STOP and explain in D16)

D6. Level of training of teacher(s):
= 1 Faculty member {Chief Residents NOT considered faculty, classify as 2 or 3 below}
= 2 "Near peer": Trainee at least one full year more senior in training than the learner. {Examples include: 1) Third year trainee in any specialty/discipline who is teaching first year trainee in same specialty/discipline; 2) Second year trainee with license requiring supervision teaching a trainee in the principal clinical years}
= 3 "Peer": Trainee that is less than one year more senior in training than the learner {Examples include: 1) Third year medical student teaching third year medical student; 2) Second year trainee with license requiring supervision teaching second year trainee with license requiring supervision}
= 4 Mixed group of teachers {more than one of the above. An example would be a setting where both faculty and trainees requiring supervision are using the same teaching strategy to teach students in the principal clinical years}
= 5 Other_____ (STOP and explain in D16).
= 6 Unclear or not specified (STOP and explain in D16)

D7. Learner level of training: consider the learner's level of training relative to the field in which they are being instructed for making this determination. For example, licensed nurses re-training as physicians would not be classified as "fully licensed" unless they had obtained their physician licenses. Physicians trained in emergency medicine would not be considered fully licensed if they were obtaining training in a new specialty area such as psychiatry.
= 1 Principal Clinical Years {points in training where learners are principally engaged in seeing patients in a clinical setting, but the learners primary purpose is for gaining clinical experience}
= 2 Supervised practitioners/Limited license to practice {practitioner who still requires direct oversight or supervision}

= 3 Fully licensed for independent practice {"recertification" or "continuing education" are words that may apply to this group}
= 4 Mixed group of learners (STOP and explain in D16)
= 5 Unclear of not specified (STOP and explain in D16)

D8. Which level of Kirkpatrick's hierarchy do the outcome(s) measured best fit? (if multiple outcomes are measured, pick the highest level measured)
= 1 Level 1: Reaction. Learner or teacher view towards experience
= 2 Level 2a: Attitudes. Modification of learner's attitudes or preferences
= 3 Level 2b: Skills. Learner's acquisition of skills or knowledge {physical examination, written documentation, oral presentations, medical knowledge, clinical reasoning}
= 4 Level 3: Behavioral change. Transfer of learning to practice {empathy, professionalism, patient centeredness, or communication skills}.
= 5 Level 4a: Change in organizational practice.
= 6 Level 4b: Benefits to patients/clients. Mortality, satisfaction, illness severity measure.
= 7 Unclear or not specified (STOP and explain in D16)

D9a. Number of learners in the learning experience
= 1 Specified [*if D9a == 1, prompt for entry. Accept only whole numbers*]
= 9 Unclear or not specified (STOP explain in D16)

D9a1. Number __ [*accept whole numbers only*]

D9b. Number of learners in the learning experience who have reported, measured outcomes
= 1 Specified [*if D9b ==1, prompt for entry. Accept only whole numbers.*]
= 9 Unclear or not specified (STOP explain in notes D16)

D9b1. Number __ [*accept whole numbers only, calculate (D9b1/D9a1) and generate as D9c the percentage of learners with measured, reported outcomes*]

D9c. Percentage of learners with measured, reported outcomes [*automatically generated as (D9b1/D9a1)*]

D10. For an individual learner, the total duration of his/her learning experience described in the study that involved the described strategy. If exposure time is variable, select the median time for all learners. If median is not provided, select the mean amount of time
= 1 Less than 1 day
= 2 Equal to or more than 1 day and less than 1 week
= 3 Equal to or more than 1 week and less than four weeks
= 4 Equal to or more than four weeks and less than 1 year
= 5 Equal to or more than 1 year
= 6 Unclear or not specified (STOP and explain in D16)

D11. During the described learning experience, the AVERAGE frequency with which the teaching strategy was used for an individual learner
= 1 More than once per day
= 2 Only one time per day
= 3 Less often than once per day but more often than once per week
= 4 Equal to or less often than once per week, but more often than once per month
= 5 Less often than once per month
= 6 Unclear, too variable for average to be determined, or not specified (STOP and explain in D16)

D12. Health professions discipline or service (check one)
= 1 Family medicine [*classify as cognitivist*]
= 2 Pediatrics [*classify as cognitivist*]
= 3 General internal medicine (do NOT include procedural sub-specialties here) [*classify as cognitivist*]
= 4 Medical subspecialties {examples include but not limited to cardiology, gastroenterology, pulmonary, renal, infectious disease, allergy/immunology} [*classify as cognitivist*]
= 5 Obstetrics and gynecology [*classify as proceduralist*]
= 6 General surgery [*classify as proceduralist*]
= 7 Psychiatry [*classify as cognitivist*]
= 8 Psychology [*classify as cognitivist*]
= 9 Nursing [*classify as cognitivist*]
= 10 Physical or occupational therapy/physical rehabilitation [*classify as cognitivist*]
= 11 Veterinary medicine [*classify as cognitivist AND proceduralist*]
= 12 Pharmacy medicine
= 13 Other _____ [*free text entry box*]

 D13. Nation (check one)
= 1 The Netherlands
= 2 Canada
= 3 USA
= 4 UK
= 5 Australia/New Zealand
= 6 France
= 7 Germany
= 8 Norway
= 9 Sweden
= 10 Japan
= 11 Other _____ [*free text entry box*]

D14: Status
= 1 Include in review (STOP)
= 2 Uncertain (STOP and explain in D16)
= 3 Exclude [*automatically set to 3 if D1==8, D2==2, D3==1, or D3==2)*

D15: Reason for exclusion [*automatically set by logic above*]
= 1 Strictly classroom based used of teaching strategy with no immediate access to direct patient care [*automatically set to 1 if D1 ==8*]
= 2 Procedural skills [*automatically set to 2 if D2==2*]
= 3 Standardized patients only [*automatically set to 3 if D3 ==1*]
= 4 Virtual patients only [*automatically set to 4 if D3 ==2*]

D16: Reviewer's notes [*free text entry box*]

D17: Summary of teaching strategy and method of delivery. Include here a description of the teaching strategy and the method of its delivery**.** [*free text entry box*]

E: Measurement of learner outcomes

E1. List each outcome measured below. For each outcome, provide a description of the outcome. [*Table E1 with three columns. Set column 1 = E1, column 2 = E2a (all that are selected), column 3 = E2b (all that are selected) Adds rows as needed based on user input*]

E2a. For each outcome listed in E1, select the domain. Repeat for each outcome. Check all that apply.
= 1 Professionalism
= 2 Clinical reasoning
= 3 Medical knowledge
= 4 Physical examination
= 5 Empathy
= 6 Patient centeredness (making the patient's preferences central to decision-making)
= 7 Communication with patients, other professionals or providers, or patient caregivers
= 8 Other _____ (STOP and explain in E4)

E2b. For each outcome listed in E1, select the method or methods used to determine outcome. Check all that apply.
= 1 Survey of learner
= 2 Survey of directly involved teacher
= 3 Direct observation of student by directly involved teacher
= 4 Direct observation of student by third party (neither participating teacher not student)
= 5 Written exam performance of student
= 6 Reflective writing performance of student
= 7 Objective Structured Clinical Exam (OSCE) performance of student
= 8 Videotaped review of student's performance using objective scoring instrument

= 9 Audiotaped review of student's performance using objective scoring instrument
= 10 Survey of patient
= 11 Survey of other participating healthcare practitioner (peer or multidisciplinary staff)
= 12 Chart review by directly involved teacher
= 13 Chart review by third party (neither participating teacher or student)
= 14 Other ____ (STOP and explain E4)

Return to E1 for all listed outcomes. Repeat until all outcomes listed, then proceed to E3.

E3. **Impact**. Note statistically significant results. If none, note the quantitative or qualitative results of the study [*free text entry box*]

E4. Reviewer's notes [*free text entry box*]

Z. Data automatically captured by review program at each round

Z1: Date of publication
Z2: **1st Author, last name, first initial**
Z3: Contact information of corresponding author
       Z3a: Name and title of corresponding author
       Z3b: Mailing address of corresponding author
       Z3c: Email address of corresponding author
       Z3d: Phone of corresponding author
       Z3e: Fax of corresponding author
Z4: Date of data entry
Z5: Initials of data entry person
Z6: Citation source
 = 1 MEDLINE
 = 2 EMBASE
 = 3 CINAHL
 = 4 Proquest
 = 5 ERIC (Education Resources Information Center)
 = 6 Ovid HealthSTART
 = 7 PsycINFO
 = 8 Google Scholar
 = 9 WorldCat
 = 10 Library of Congress
 = 11 Web of Science
 = 12 MedEd portal
 = 20 Cited, article, electronic
 = 30 Manual search
 = 40 Cited, article, manual
 = 80 Other _____

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Z7: **Primary reviewer**

= 1 CPierce

= 2 JCorral

= 3 EAagaard

= 4 DIrby

= 5 DMyhre

= 6 CStickrath

= 7 BHarnke

= 8 Other _____

Z8: **Date** article was reviewed

References

1.   Aagaard E, Teherani A, Irby DM. Effectiveness of the one-minute preceptor model for diagnosing the patient and the learner: proof of concept. *Academic medicine : journal of the Association of American Medical Colleges.* 2004;79(1):42-49.

2.   Barr H, Koppel I, Reeves S, Hammick M, Freeth D (2005) *Effective Interprofessional Education: Assumption, Argument and Evidence*. Blackwell, London.

3.   Catchpole M, Albert E, Lake F, Brown T. Teaching on the run--general practice training between consultations. *Australian family physician.* 2005;34 Suppl 1:47-50.

4.   Craig S. Direct observation of clinical practice in emergency medicine education. *Academic emergency medicine : official journal of the Society for Academic Emergency Medicine.* 2011;18(1):60-67.

5.   Cunningham AS, Blatt SD, Fuller PG, Weinberger HL. The art of precepting: Socrates or Aunt Minnie? *Archives of pediatrics & adolescent medicine.* 1999;153(2):114-116.

6.   Di Francesco L, Pistoria MJ, Auerbach AD, Nardino RJ, Holmboe ES. Internal medicine training in the inpatient setting. A review of published educational interventions. *Journal of general internal medicine.* 2005;20(12):1173-1180.

7.   Easton G, Stratford-Martin J, Atherton H. An appraisal of the literature on teaching physical examination skills. *Education for primary care : an official publication of the Association of Course Organisers, National Association of GP Tutors, World Organisation of Family Doctors.* 2012;23(4):246-254.

8.   Fatmi M, Hartling L, Hillier T, Campbell S, Oswald AE. The effectiveness of team-based learning on learning outcomes in health professions education: BEME Guide No. 30. *Medical teacher.* 2013;35(12):e1608-1624.

9.   Heidenreich C, Lye P, Simpson D, Lourich M. The search for effective and efficient ambulatory teaching methods through the literature. *Pediatrics.* 2000;105(1 Pt 3):231-237.

10.   Irby DM. Teaching and learning in ambulatory care settings: a thematic review of the literature. *Academic medicine : journal of the Association of American Medical Colleges.* 1995;70(10):898-931.

11.   Janicik RW, Fletcher KE. Teaching at the bedside: a new model. *Medical teacher.* 2003;25(2):127-130.

12.   Kroenke K. Attending rounds: guidelines for teaching on the wards. *Journal of general internal medicine.* 1992;7(1):68-75.

13.   LaCombe MA. On bedside teaching. *Annals of internal medicine.* 1997;126(3):217-220.

14.   Lake FR. Teaching on the run tips: doctors as teachers. *The Medical journal of Australia.* 2004;180(8):415-416.

15.   Passi V, Johnson S, Peile E, Wright S, Hafferty F, Johnson N. Doctor role modelling in medical education: BEME Guide No. 27. *Medical teacher.* 2013;35(9):e1422-1436.

16.   Ramani S. Twelve tips to improve bedside teaching. *Medical teacher.* 2003;25(2):112-115.

17.   Reeves S, Fletcher S, Barr H, et al. A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. *Medical teacher.* 2016;38(7):656-668.

18.   Sawyer T, White M, Zaveri P, Chang T, Ades A, French H, Anderson J, Auerbach M, Johnston L, Kessler D. Learn, see, practice, prove, do, maintain: an evidence-based pedagogical framework for procedural skill training in medicine. Acad Med. 2015 Aug;90(8):1025-33.

19.   Schmidt HG, Mamede S. How to improve the teaching of clinical reasoning: a narrative review and a proposal. *Medical education.* 2015;49(10):961-973.

20.   Shankel SW, Mazzaferri EL. Teaching the resident in internal medicine. Present practices and suggestions for the future. *Jama.* 1986;256(6):725-729.

21.   Stickrath C, Aagaard E, Anderson M. MiPLAN: a learner-centered model for bedside teaching in today's academic medical centers. *Academic medicine : journal of the Association of American Medical Colleges.* 2013;88(3):322-327.

22.   Teherani A, Daroff RB, Jr. Research-based models for clinical teaching and their application to psychiatry settings. *Academic psychiatry : the journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry.* 2013;37(2):114-119.

23.   Thistlethwaite JE, Davies D, Ekeocha S, et al. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. *Medical teacher.* 2012;34(6):e421-444.

24.   Veloski J, Boex JR, Grasberger MJ, Evans A, Wolfson DB. Systematic review of the literature on assessment, feedback and physicians' clinical performance: BEME Guide No. 7. *Medical teacher.* 2006;28(2):117-128.

25.   Vickery AW, Lake FR. Teaching on the run tips 10: giving feedback. *The Medical journal of Australia.* 2005;183(5):267-268.

26.   Wolpaw TM, Wolpaw DR, Papp KK. SNAPPS: a learner-centered model for outpatient education. *Academic medicine : journal of the Association of American Medical Colleges.* 2003;78(9):893-898.

27.   Yardley S, Teunissen PW, Dornan T. Experiential learning: AMEE Guide No. 63. *Medical teacher.* 2012;34(2):e102-115.