Virtual Patients in Health Professions Education: A Systematic Review

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Background

Safer and more efficient means of facilitating clinically-relevant knowledge and skills are needed to accommodate the increasing complexity of medical decision-making. The computer-based virtual patient, "a specific type of computer program that simulates real-life clinical scenarios; learners emulate the roles of health care providers to obtain a history, conduct a physical exam, and make diagnostic and therapeutic decisions,"[1] has been proposed as one contribution to the solution.[2-4]

Importance of topic

Virtual patients are increasingly common in health professions education.[5] Educators will benefit from a better understanding of the potential roles of virtual patients, the instructional designs and outcomes commonly used, and which features are associated with higher outcomes. A review and synthesis of existing evidence could inform decisions on how to effectively use virtual patients. We are not aware of previous systematic reviews addressing these issues.

Methods

We seek to answer the questions: what design features are commonly used in virtual patients, what outcomes are commonly evaluated, and what features are associated with higher outcomes? We will adhere to standards of quality for reporting systematic reviews (QUOROM and MOOSE),[6, 7] including duplicate coding at all phases.

We will conduct a comprehensive search of MEDLINE, EMBASE, CINAHL, ERIC, and PsychINFO using terms including virtual patient, computer simulation, clinical simulation, and medical education. We will also identify relevant studies from investigators' files and from reference lists of included articles. We will include studies published in any language that have investigated use of virtual patients to teach health professions learners at any stage in training or practice. Working independently and in duplicate we will review all titles and abstracts for inclusion. In the event of disagreement or insufficient information we will review the full text of potential articles, in duplicate.

We will conduct full text review in duplicate. We will catalog all original research reports including descriptive studies. We will abstract in full all comparative studies (those with a pre/post-intervention assessment or comparison arm). Abstracted information will include study design, participant demographics, details of intervention(s), outcomes, and main quantitative and qualitative results.

We will group studies according to the research question(s) or hypothesis(es) using inductively-identified themes (conceptual frameworks). Within each theme we will pool quantitative results using random effects meta-analysis.

Importance of review

This review will benefit medical education in multiple ways. First, the catalog of studies (descriptive and comparative) will provide educators a reference to virtual patient designs employed for various clinical topics, and for comparative studies will identify effective virtual patient formats. Second, the quantitative syntheses will provide best estimate answers for each research question. Third, we hope to distill theoretical and conceptual insights[8] to inform future virtual patients. Fourth, the research themes identified will provide a starting point for further research.

Feasibility

Our preliminary search identified approximately 350 potentially eligible articles, of which we expect approximately 50 will be eligible for full review. The principal investigator has experience conducting systematic reviews including a recently-published meta-analysis of Internet-based instruction,[9] and anticipates the review can be completed within twelve months.

References *(note that references do not count in word limit)*
1. Effective Use of Educational Technology in Medical Education: Summary Report of the 2006 AAMC Colloquium on Educational Technology. Washington, DC: Association of American Medical Colleges, 2007.
2. McGee JB, Neill J, Goldman L, Casey E. Using multimedia virtual patients to enhance the clinical curriculum for medical students. Stud Health Technol Inform. 1998; 52 Pt 2:732-5.
3. Ziv A, Wolpe PR, Small SD, Glick S. Simulation-based medical education: an ethical imperative. Acad Med. 2003; 78:783-8.
4. Ellaway R, Poulton T, Fors U, McGee JB, Albright S. Building a virtual patient commons. Med Teach. 2008; 30:170-4.
5. Huang G, Reynolds R, Candler C. Virtual patient simulation at US and Canadian medical schools. Acad Med. 2007; 82:446-51.
6. Moher D, Cook DJ, Eastwood S, Olkin I, Rennie D, Stroup DF. Improving the quality of reports of meta-analyses of randomised controlled trials: the QUOROM statement. Quality of Reporting of Meta-analyses. Lancet. 1999; 354:1896-900.
7. Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of Observational Studies in Epidemiology: A Proposal for Reporting. JAMA. 2000; 283:2008-12.
8. Bradley P, Postlethwaite K. Simulation in clinical learning. Med Educ. 2003; 37(s1):1-5.
9. Cook DA, Levinson AJ, Garside S, Dupras DM, Erwin PJ, Montori VM. Internet-Based Learning in the Health Professions: A Meta-Analysis. JAMA. 2008; 300:1181-96.

Note to applicants:
The fact that this model document describes a systematic review / meta-analysis does not imply that SDRME Invited Reviews need to be systematic reviews. In fact, a large proportion of the sponsored reviews have been non-systematic. What is important, however, is that the review methods are clearly described, rigorous, feasible, and appropriate to answer the question of interest.

Tools to measure the learning environment in medical education: A systematic review of validity evidence

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Background

The learning environment (LE) encompasses the physical, social, and psychological context in which trainees are immersed and is thought to play a significant role in professional[1] and moral[2] development. While most agree supportive LEs are essential for effective medical education, it has been challenging to determine how exactly to assess LE quality.

Importance of topic

The LCME states that medical schools "should regularly evaluate the LE."[3] Yet in the absence of a standard LE metric, schools have struggled to determine how to comply with this standard. The ACGME recently implemented a clinical LE review program to address the LE during residency training. Thus, it is an apt time to review the literature for tools used to assess the LE, and more importantly, to determine the strength of validity evidence for the interpretation of scores from those tools.

Methods

This review aims to summarize results from studies that have measured the LE and address the following research questions: (1)What tools have been developed to measure the LE in medical education? (2) What types of constructs do the tools assess? (3) What is the strength of validity evidence[4] (content, response process, internal structure, relationship to other variables, consequence) for the interpretation of scores from those tools?

We will use ERIC, PsychINFO, and MEDLINE to conduct a search for all articles using the terms _learning, educational, physical, social, and psychological paired with environment_. For all extracted articles we will review the references lists for additional relevant articles and if

needed, add related search terms. Studies will be limited to those that have assessed the LE by medical students and residents (US and internationally) published in English. Two of the authors will independently identify inclusion based on the abstract and an article will be included if at least one of the authors identified it as such. While the exact data to be extracted has yet to be determined, articles will certainly be coded for respondent type, LE tool name, and themes/constructs of tool or items measured. We will evaluate study quality based on the MERSQI[5] criteria for design, sample, and validity, adding response process, internal structure, and consequences validity evidence.

Importance of review
To date, there has been not been a systematic review of tools used to assess the LE. Since this review will explore validity evidence for the interpretation of scores, it will inform medical educators of the strengths and limitations of existing LE tools. Thus, the field will be able to make evidence-based decisions on the right tool(s) to assess the LE or determine if a new tool needs to be developed by researchers.

Feasibility
The PI has protected time for research so she will be able to devote 15% FTE towards this project. The other authors have all committed to spend 2.5% so the collected team will have 20% FTE devoted to this review. Additionally, we have a clinical librarian liaison available to help with literature searches. As such, we believe the entire review can be completed in 24 months.

References

1. Cooke M, Irby DM, O'Brien BC. *Educating Physicians: A Call for Reform of Medical School and Residency*. 2010: Stanford, CA; Jossey-Bass. p 6-26.

2. Hafferty, FW. Beyond curriculum reform: confronting medicine's hidden curriculum. Acad Med. 1998; 73(4):403-7.

3. Liaison Committee on Medical Education. Accreditation Standards. (www.lcme.org/functionslist.htm). Accessed August 2, 2012.

4. American Educational Research Association. (1999). Standards for educational and psychological testing. Washington, DC: American Psychological Association. pp 25-36.

5. Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between funding and quality of published medical education research. JAMA. 2007; 298:1002-9.

Jorie M. Colbert-Getz, PhD

Education and Training

Year	Degree	Institution	Discipline
2003	Bachelors of Science	Illinois State University	Psychology
2005	Masters of Science	Illinois State University	Psychology
2008	Doctor of Philosophy	University of Utah	Educational Psychology

Personal Experience

Date	Position/Institution
2006 – 2009	Research Associate, Academic Affairs Utah System of Higher Education
2009 – Present	Director, Office of Assessment and Evaluation Johns Hopkins University School of Medicine
2012-Present	Adjunct Professor, Department of Education Johns Hopkins University
2012-Present	Assistant Professor, Bayview Internal Medicine (*pending*) Johns Hopkins University School of Medicine

Teaching Experience

Date	Course/Institution	Role(s)
2004	*Statistics for the Social Sciences* Illinois State University	Instructor of Record
2007	*Health Statistics* University of Utah	Instructor of Record
2012	*Ensuring Learning through Assessment and Feedback* Johns Hopkins University	Co-Developer and Co-Instructor

Selected Peer Reviewed Publications

1. Aboumatar H, Thompson D, Wu A, Dawson P, **Colbert* JM**, Marsteller J. Development and evaluation of a three day patient safety curriculum to advance knowledge, self-efficacy, and system thinking among medical students, BMJ Quality & Safety. 2012; 21(5): 416-422.

2. Dudas RA, **Colbert J M**, Goldstein S, Barone MA. Validity of faculty and resident global assessment of medical students' clinical knowledge during their pediatric clerkship. Acad Peds. *2012; 12:* 138-141*.*

3. Neufeld K, Alvanzo A, King VL, Feldman L, Hsu J, Rastergar DA, **Colbert JM**. & MacKinnon D. A collaborative approach to teaching medical students how to screen, intervene and treat substance use disorders. Sub Abuse, in press.

4. **Colbert-Getz, JM**, Fleishman C, Jung J, Shilkofski N. The Impact of gender and anxiety on self-assessment and actual performance of a high-stakes clinical skills examination, Acad Med, in press.

5. Shochet R, **Colbert-Getz JM**, Levine R, Wright S. Gauging events that impact students' perceptions of the medical school learning environment. Acad Med, in press.

Selected Workshops/Seminars

Date(s)	Course Title, Location, and Role
2009	*Returning rigor to clerkship grading: Designing a standard setting workshop at your institution*
	Association of American Medical Colleges Annual Meeting, Boston, MA
	Co-Presenter
2012	*Program and course evaluation for medical education*
	Medical Education Partnership Initiative Grant
	Makerere University, Kampala, Uganda
	Developer and Co-Presenter

Selected Peer review presentations- Talks and Posters

Dudas R, **Colbert JM,** Goldstein S, Barone MA. (2010, May). Faculty and resident assessment of medical students' clinical knowledge during the pediatric clerkship. Pediatric Academic Society Annual Meeting, Vancouver, BC, Canada.

Thomas PA, **Colbert JM.** (2010, May). Self-awareness of cultural competency in internal medicine residents. Society of General Internal Medicine, Phoenix, AZ.

Chou B, **Colbert JM**, Hueppchen N. (2011, March). The impact of obstetrics and gynecology clerkship change on student performance, teaching, and student/teacher satisfaction. APGO and Council of Resident Education in Obstetrics and Gynecology Annual Meeting, Orlando, FL.

Colbert JM, Shochet RB, Levine RB, Wright SM. (2011, August). Events that influence medical students' perceptions of the learning environment. An International Association for Medical Education Annual Conference, Vienna, Austria.

Chen CCG, Green IC, Chou B, Lawson SM, Firoozmand A, **Colbert-Getz JM**, Satin, AS. (2012, March). Warm-up with laparoscopic simulator improves resident laparoscopic performance in the operating room: A randomized trial. APGO and Council of Resident Education in Obstetrics and Gynecology Annual Meeting, Orlando, FL.

Sheth S, Chou B, **Colbert-Getz JM**, Heuppchen N. (2012, March). Feedback passports: A tool for an improved journey through the obstetrics & gynecology clerkship. APGO and Council of Resident Education in Obstetrics and Gynecology Annual Meeting, Orlando, FL.

Experience conducting a review/synthesis

The principle investigator had completed course work, including a research report on meta-analysis (*Predicting Graduate School Success: An Investigation of Criterion-Related Validity for GRE General Scores, GRE Subject Scores, and UGPA).* She has also taught undergraduate and graduate students on validity evidence in addition to delivering faculty development workshops on the topic.

Robert Shochet, MD

Education and Training

Year	Degree	Institution	Discipline
1979	Bachelor of Arts	Brandeis University	Biology
1983	Doctor of Medicine	University of Maryland	Medicine
1983-86	n/a-Residency	St. Vincent Hospital	Internal Medicine
1986-87	n/a-Fellowship	Mass. General Hospital	Consultation Psychiatry

Personal Experience

Date	Position/Institution
1988- 1990	Private practice, Internal Medicine- Baltimore, MD
	Educator, part-time- Communication Skills Training for Med. Residents
	University of Maryland School of Medicine
1990 – 1993	Faculty Physician, Internal Medicine Residency Program
	Greater Baltimore Medicine Center, Baltimore, MD
1993- 1998	Associate Director, Johns Hopkins University/Sinai Hospital
	Residency Training Program in Internal Medicine
1993- 2005	Faculty Physician and Director of Psychosocial Medicine Training
	JHU/Sinai Residency Training Program in Internal Medicine
1994- 2002	Chairman, Continuing Medical Education Committee, Sinai Hospital
2005- present	Director, Colleges Advisory Program for Medical Students
	Assistant Professor of Medicine
	Johns Hopkins University School of Medicine

Teaching Experience

Date	Course/Institution	Role(s)
1988-90	Communication Skills in Healthcare	Teacher for
	University of Maryland School of Medicine	Medical Residents
1993-2005	Psychosocial/Behavior Medicine	Director, Teacher
	JHU/Sinai Residency Training Program in Internal Medicine	
2005-	*Clinical Foundations of Medicine*	Director, Developer and
	Johns Hopkins University School of Medicine	Co-Instructor
2005-2010	Communication Skills for Physicians	Trainer, Consultant
	Train the Trainer Initiative, Mayo Clinic, Jacksonville, FL	

Selected Peer Reviewed Publications

1. Ashar B, Levine R, Magaziner J, **Shochet R**, Wright S. An association between paying physician teachers for their efforts and an improved educational experience for learners. J Gen Intern Med. 2007; 22 (10): 1393-7.

2. Stewart RW, Barker AR, **Shochet RB**, Wright SM. The new and improved learning community at Johns Hopkins University School of Medicine resembles that at Hogwarts School of Witchcraft and Wizardry. Med Teach. 2007 (4): 353-7.
3. Levine R, Cayea D, **Shochet RB**, Wright SW. The mid-clerkship crisis: Lessons in advising a medical student with career indecision. Acad Med 2010; 85: 654-659*.*
4. Murinson B, Klick B, Haythornthwaite J, **Shochet RB**, Levine RB, Wright SM. Formative experiences of emerging physicians: gauging the impact of events that occur in medical school. Acad Med.2010*;* 85(8):1331-7.
5. **Shochet, RB,** Cayea D, Levine R, Wright, SW. Using medical student case presentations to help faculty learn to be better advisors- editorial. Acad Med 2010; 85: 578-579*.*
6. Bicket M, Misra S, Wright SW, **Shochet RB.** Medical student engagement and leadership within a new learning community. BMC Medical Education 2010; 10:20 (26 February 2010).
7. Levine RB, **Shochet RB**, Cayea D, Ashar BH, Stewart RW, Wright SM. Measuring medical students' sense of community and satisfaction with a structured advising program. Int J Med Ed. 2011; 2: 125-32.
8. **Shochet RB.** Learning Communities: A New Twist to Medical Education. Maryland Medicine 2012; 13(1): 13-14.
9. **Shochet RB,** Colbert-Getz J, Levine RB, Wright SM. Gauging events that impact students' perceptions of the medical school learning environment. Acad Med 2012. *Accepted for publication, 7/23/2012.*

Selected Workshops/Seminars

Dates   Course Title, Location, and Role
2001-03   Course Director and Host, American Academy on Communication in Heathcare
                Annual Research and Teaching Forum- Baltimore- March, 2002 and October, 2003.

2007, 2010   Course Director and Host, Annual Conference, Learning Communities Institute
                Johns Hopkins University School of Medicine- November, 2007 & 2010, Baltimore MD.

Selected Peer review presentations- Talks and Posters

Misra S, Bicket M, Wright S, and **Shochet, R**. Medical Student Engagement and Leadership with a new Learning Community: Perspectives from Student Leaders. Poster, *Society General Internal Medicine Annual Meetings, Miami Beach FL, 5/2009.*

Nichols D, **Shochet R,** Drake T. Transforming Medical Education for the 21st Century: The Johns Hopkins University School of Medicine Initiative. Nichols D, **Shochet R,** Drake T. AAMC Group on Business Affairs and Institutional Planning Meeting, Philadelphia, PA, 4/27/2011.

R Shochet, J Colbert, R Levine, S Wright. Events that influence medical students' perceptions of the learning environment, Oral Abstract Presentation, American Academy on Communication in Healthcare Annual Research Meeting, Northwestern University School of Medicine, Chicago, IL. 10/17/2011.

R Shochet, S Wright. Learning Communities: A Way to Support Humanism in Medical School?
Gold Humanism Honor Society Biennial Conference, Dallas, TX, 10/2010.

Experience conducting a review/synthesis
The second author recently completed a year-long research award to study the medical school LE at the Johns Hopkins University School of Medicine, where he reviewed the body of literature on LE so is familiar with the types of articles that we need to review.

Scott M. Wright, MD

Education and Training

Year	Degree	Institution	Discipline
1988	DEC	Vanier College	Health Sciences
1992	MD	McGill University	Medicine
1995	n/a- Residency	Montreal General Hospital	Medicine
1997	n/a-Fellowship	Johns Hopkins University	Medicine

Personal Experience

Date	Position/Institution
1997 - 2002	Assistant Professor of Medicine, JHUSOM
1999 - 2002	Associate Editor, *Journal of General Internal Medicine*
2002 - 2008	Associate Professor of Medicine, JHUSOM.
2008 - Present	Professor of Medicine, JHUSOM.
2009 - Present	Director, Miller-Coulson Academy of Clinical Excellence, JHUSOM.
2011 - Present	Chief, Division of General internal Medicine, JHBMC.

Teaching Experience

Date	Course/Institution	Role(s)
1997-2005	Teaching Skills Workshop, Faculty Development Program (FDP)	Core Faculty
1998-present	Evidence-Based Medicine	Course Director
1998-2005	Mentor for Facilitators-in-Training Teaching Skills Workshop, FDP	Core Faculty

Selected Peer Reviewed Publications

1. Beasley BW, Wright SM, Cofrancesco J, Babbott SF, Thomas PA, Bass EB. Promotion criteria for clinician-educators in the United States and Canada: a survey of promotion committee chairpersons. *JAMA*. 1997; 278: 723-8.
2. Wright SM, Kern DE, Kolodner KB, Howard DM, Brancati FL. Attributes of excellent attending-physician role models. *N Eng J Med*. 1998; 339: 1986-93.
3. Yao DC, Wright SM. National Survey of Internal Medicine Residency Program Directors Regarding Problem Residents. *JAMA.* 2000; 284: 1099-1104.
4. Wright SM, Beasley BW. Motivating factors for academic physicians within Departments of medicine. *Mayo Clinic Proceedings*. 2004; 79: 1145-1150.
5. Reed D, Kern DE, Levine R, Wright SM. Costs and funding for medical education research. *Journal of the American Medical Association*. 2005; 294:1052-57*.*
6. Wright SM, Levine RB, Beasley B, Haidet P, Gress TW, Caccamese S, Brady D, Marwaha A, Kern DE. Personal growth and its correlates during residency training. *Medical Education*. 2006; 40: 737-745.
7. Reed D, Cook D, Beckman T, Levine R, Kern D, Wright SM. Association between funding and quality of published medical education research. *JAMA.*2007; 298:1002-1009.
8. Kravet S, Shore A, Miller R, Green G, Wright SM. Healthcare utilization and the proportion of primary care physicians. *American J of Medicine.* 2007; 121: 142-148.
9. Christmas C, Kravet S, Durso C, Wright SM. Defining clinical excellence in academic medicine: A qualitative study of the master clinicians. *Mayo Clinic Proceedings.* 2008; 83: 989-994.

10. Durso C, Christmas C, Kravet S, Wright SM. Implications of academic medicine's failure to recognize clinical excellence. *Clin Med and Research.* 2009; 7: 127-133*.*
11. Wright SM, Christmas C, Burkhart K, Kravet S, Durso C. Creating an Academy of Clinical Excellence at Johns Hopkins Bayview Medical Center: A 3-Year Experience. Acad Med. 2010; 85:1833-9.
12. Page K, Castillo-Page L, Wright SM. The challenging task of diversifying the faculty in academic medicine. Accepted for publication in an upcoming issue of *Acad Med.*
13. Kravet S, Christmas C, Durso C, Parson G, Burkhart K, Wright SM,. The intersection between clinical excellence and role modeling in medicine. Accepted for publication in an upcoming issue of *J Grad Med Ed.*
14. Stewart R, Wolfe L, Flynn G, Carrese J, Wright SM. Success in Grateful Patient Philanthropy: Insights from Experienced Physicians. Accepted for publication in an upcoming issue of *Am J Med.*
15. Wright SM, Gozu A, Burkhart K, Bhogal H, Hirsch G. Clinicians' perceptions about how they are valued by the academic medical center. Accepted for publication in an upcoming issue of *Am J Med.*

Selected Workshops/Seminars

Dates	Course Title, Location
October 2003	"Guiding residents along the path toward personal growth." Workshop at the Association of Program Directors in Internal Medicine annual national meeting in Washington, DC.
May 2004	"The facilitation of personal growth in medical learners." Workshop at the Society of General Internal Medicine's Annual National Meeting in Chicago, IL.
May 2004	"Making it count twice: How to get curricular work published." Workshop at the Society of General Internal Medicine's Annual National Meeting in Chicago, IL.
May 2005	"Leadership Skills for Internists." Workshop at the Society of General Internal Medicine's Annual National Meeting in New Orleans, LA.
November 2007	"Conducting Research within a Learning Community" Workshop for the American Association of Medical College's (AAMC) Learning Community Group, Baltimore, MD.
April 2008	"Enhancing career development one pair at a time: How to start and sustain a mentoring program at your institution", Workshop at the Society of General Internal Medicine's Annual National Meeting in Pittsburgh, PA.

Experience conducting a review/synthesis
The third author has published review articles, and written book chapters that have reviewed clinical content. He was a primary mentor to the investigator who has developed the MERSQI (Dr. Reed) and he been asked to serve as a peer-reviewer for many reviews that have used this tool. Because his career has focused on medical education research, his general insights on the subject matter and the review should help the team in process and outcome.

How do we measure how we think?
A scoping review on the measurement of clinical reasoning

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Background:

Failures in reasoning have been linked to medical error, with significant impacts on patient safety.[1-3] This has emphasized the importance of effective clinical reasoning as a component of professional competence.[4] As with other competencies,[5-6] the development of competence in clinical reasoning must be supported by teaching, assessment, and if needed, remediation. However, the definition and observable characteristics of effective clinical reasoning processes have been underspecified, making clear communication particularly difficult.

Importance of topic:

A review of the current medical education literature for measures of clinical reasoning could facilitate decision-making regarding assessment, teaching and remediation of clinical reasoning. The objective of this study is to broadly review this literature to identify the breadth of ways in which clinical reasoning has been operationalized in the context of both assessment and research.

Methods:

Considering the breadth of ways clinical reasoning may be measured within medical education, we propose the application of a scoping review methodology. This methodology involves the use of rigorous methods to select, collect and summarize existing literature in broad thematic areas and allows for iterative and reflective interaction with findings[7]. *Identifying studies.* A research librarian will assist in developing search strategies for the main scholarly databases using MeSH terms and keywords relating to: clinical reasoning, diagnostic reasoning (including medical error), medical education, and measurement (sample in Table 1). *Study selection.* Original articles reporting a measure of clinical reasoning in medical education will be included. Research syntheses of existing evidence, reviews, commentaries and editorials will be excluded, but will be reviewed and hand-searched for relevant references. Two team members will review titles and abstracts for inclusion criteria, and the full text will be reviewed in cases of disagreement. *Data charting*. A data charting form will be developed, focusing on the following units of analysis: conceptual framework and quantifications of clinical reasoning (measures of observed outcome (e.g. diagnostic accuracy), measures of performance on an assessment (e.g. score on a key features test), or process-based assessments (e.g. measures of reflective process)). *Collating and reporting results*. Descriptive analysis will highlight the nature and distribution of studies (e.g. number of studies, study design, year of

publication, study population, methodology and area of practice (clinically (e.g. pediatrics) and level of practice (e.g., PGME)). We will conduct a thematic analysis to map the scope of measurements of clinical reasoning using the main units of analysis listed above.

Importance of review to the practice of medical education

Clinical reasoning represents a multitude of processes key to the diagnosis and management of patients. As competency-based education moves closer to implementation, strong assessment strategies are needed. We hope that this review could function as a framework to summarize current work in the measurement of clinical reasoning and to propose 'gaps' in current practices.

Feasibility

All authors have conducted research in clinical reasoning and are, therefore, familiar with the construct under review. KE is editor-in-chief of Medical Education, enabling a strong sense of the medical education literature. AT has conducted several scoping reviews and will provide strong methodological expertise.

References:

1. Kohn LT, Corrigan JM, Donaldson M. eds. To err is human: building a safer health system. Institute of Medicine; 1999.
2. Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. Acad Med 2003; 78(8): 775-780.
3. Graber ML, Franklin N, Gordon R. Diagnostic error in internal medicine. Arch Intern Med 2005; 165(13); 1493-1499.
4. Epstein RM, Hundert EM. Defining and assessing professional competence. JAMA 2002; 287(2): 226-235.
5. Leung W-C. Competency based medical training: review. BMJ 2002; 325(7366): 693-696.
6. Frank JR, Snell L, Ten Cate O, Holmboe ES, Carraccio C, Swing SR, et al. Competency-based medical education: theory to practice. Med Teach 2010; 32: 638-645.
7. Arskey H & O'Malley L. Scoping studies: towards a methodological framework. Int J of Soc Res Meth 2005; 8: 19-32.

Table 1: Pilot search strategy for assessment of clinical reasoning in UGME (databases include: Ovid Medline, CINAHL, Ovid Psychinfo, ERIC, Scopus, and Google Scholar; studies in both French and English will be included).

Concept	MeSH headings	Keywords
Clinical Reasoning	clinical competence, choice behaviour, differential diagnosis, problem solving, decision making	clinical reasoning, (diagnos*adj10(uncertainty or reasoning)), cogni*adj3 error*, diagnos*adj3 error
UGME	Educational Medical Undergraduate, Educational Medical, Students Medical	medical student, (undergraduat* adj3 medic*)
Measurement	Educational measurement	evaluat*, assess*, rating*, rate*, measure*, accuracy, response time, RT, plan, map, test*

Note: *Studies must include one search dimension from each concept to be included in the review. Concept 2 will be adapted and defined as appropriate.*

Practical application of motivation theory to health professions education: a scoping review and examples for practice

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Background

Motivation theories that apply to education are jointly referred to as "achievement motivation" theories[1] (AM). AM theories and research examine how instructional design influences motivation[2]. This research has primarily been conducted in K-12/general post-secondary education[3-6] however, recent research has involved health sciences education (HSE) learners[7-12]. AM includes multiple theories such as intrinsic motivation[13], self-efficacy[14], attributions[15], achievement goals[16,17], and expectancy-value[18], among others. AM explores why some students approach learning eagerly and are undaunted by setbacks, while other students make minimal effort or are discouraged by challenge.

Understanding how instructional practices foster AM is crucial to improving learning. For example, self-efficacy and goal orientation are predictive of the use of adaptive cognitive learning strategies[19-21] and attributions affect student learning through their impact on self-determination and self-worth[22]. The focus of this project is to leverage AM theory for instructional design to enhance motivation in HSE learners.

Importance of this review to medical education

HSE professionals are beginning to recognize the essential role that motivation plays in learning[7, 11,12]. Despite the recognition that motivation influences deeper learning[21,22] and effectiveness of innovations[8], many HSE professionals are unaware of how to influence motivation. This is understandable: motivation theory literature encompasses hundreds of articles every year. Expecting overtaxed HSE instructors to become familiar with this literature is unreasonable. The proposed project will produce a resource that surveys AM literature and offers examples of applying theory to practice. No such review has been published in HSE.

Methods and Rationale

This will be a scoping review (a review approach which maps key concepts and summarizes key findings and recommendations in complex bodies of literature)[23] investigating current AM theories and the resultant instructional design recommendations. Searches will be conducted within social cognition, psychology, educational psychology, and HSE literatures to synthesize theoretical concepts and findings relevant to motivation and instructional design. Development of the searches will be carried out in collaboration with a subject expert research librarian. Further assistance will be sought through consultations with HSE, instructional design, and educational psychology experts. Databases to be searched include the following (listed alphabetically): Academic Search Premier, Dissertation abstracts, ERIC, MEDLINE, PsychINFO, and Web of Science.

Impact of review on the practice of HSE.

As no reviews such as the one proposed here exist for HSE, providing a resource to HSE instructional designers to assist them in developing material and approaches to enhance motivation and engagement will benefit learners and instructors. Given the deeper learning associated with enhanced motivation [24,25], patients are likely to eventually benefit, too, from the proposed resource.

Finally, a coherent summary of AM theories and examples of application to HSE may inspire educators to become involved in motivation research. Increasing knowledge of motivation among HSE learners can add to theory, as these learners have been relatively absent from this body of research.

Feasibility

My dissertation examined AM[25]. I have a familiarity with this literature which will allow me to efficiently search and summarize the major concepts. My work in HSE will be leveraged to develop clear examples from AM literature to design HSE instruction to enhance motivation.

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Example budget justification for SDRME invited review

Option 1
Budget justification: Among other expenses, this project will require online data extraction software for two investigators for one year ($780 per person = $1560), translation fees ($225 per article x anticipated 10 articles = $2250), and 30 hours of research assistant support (@ $35/hour = $1050), for a total of $4860. Any amount in excess of the award will be covered through local discretional funds. All investigator time will be donated without charge.

Option 2
Budget justification

Online data extraction software	2 1-year licenses @ $780/license	$1560
Translation fees	Anticipated 10 articles @ $225/article	$2250
Research assistant	30 hours @ $35/hour	$1050
TOTAL		**$4860**

Any amount in excess of the award will be covered through local discretional funds. All investigator time will be donated without charge.

Note: This statement would usually appear on page 2 of the proposal, and <u>does</u> count toward the 2-page limit. It is entirely reasonable to request funds for investigator time.