Protocol

A Systematic Review of
the Effectiveness of the Use of Virtual Patients
for Medical Students

Best Evidence Medical Education (BEME)
Systematic Review

Lead Reviewer

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Peninsula College of Medicine and Dentistry
John Bull Building, Tamar Science Park
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Consultant ENT Surgeon, Plymouth Hospitals NHS Trust
Professor of Otolaryngology, Alexandria University

Members of the Review Group

Dr. Nick Cooper
Associate Professor
Programme Lead for Clinical Education, Peninsula College of Medicine and Dentistry
General Practitioner, Catherine House Surgery, Totnes

Dr. Thomas Gale
Lead for Clinical Skills and Honorary Associate Professor
Peninsula College of Medicine and Dentistry
Consultant Anaesthetist, Plymouth Hospitals NHS Trust

Prof. Adrian Copplestone
Associate Dean and Honorary Professor of Haematology
Peninsula College of Medicine and Dentistry
Consultant Haematologist, Plymouth Hospitals NHS Trust

Mr. Desmond Nunez
Head (Designate) Division of Otolaryngology, Faculty of Medicine, University of British Columbia
Honorary Reader in Otolaryngology, Faculty of Medicine, University of Bristol
**Associate Researchers**

Mrs Gemma Sandberg MA(Hons) DipLIS.
Information Specialist/Trials search coordinator
Cochrane Collaboration

Mr. Aris Poulios, MRCS
ENT Fellow
Plymouth Hospitals NHS Trust
I. Background

Virtual Patients (VP) are computer-based patient simulations used to educate and test medical knowledge and skills.(1) VP are commonly used to teach clinical interviewing skills, bioethics, basic patient communication, history taking, and clinical decision-making skills.(2)

There are numerous arguments for including VP in the medical curriculum. As rates of chronic disease in the developed world continue to rise, but outpatient care and shorter hospital admissions become the norm, exemplar cases are less readily available to medical trainees; VP augment clinical observation and enhance the breadth and consistency of the educational experience. (3) Wendling et al demonstrated that Virtual Humans perform at least as well as Standardised Patients (SP) and provide a unique opportunity for training and assessment within the realm of SP encounters.(4)

Botezatu et al conducted focus-group interviews to explore the opinions of medical students on the educational use of VP. Five main themes were found to be associated with successful VP use in medical curriculum: Learning, Teaching, Assessment, Authenticity and Implementation. Medical students perceived VP as important learning and assessment tools, fostering clinical reasoning, in preparation for the future clinical practice as young doctors. (5)

Although VP have been used widely to teach medical students, there is a paucity of literature on formal methods for assessing what students have learned. Round et al, distinguished between linear and branched models, choice and consequence driven designs. They reviewed the use of assessments in VP in the context of assessment theory and concluded that assessments involving VP can become valuable components in high stakes medical exams, particularly in later years of courses. However they stated that this requires application of established assessment principles to VP design. (6)
Cook et al carried out a systematic review and meta-analysis of computerized VP in health professions education. They concluded that Virtual patients are associated with large positive effects compared with no intervention. They found that effects in comparison with non-computer instruction were on average small. They suggested that further research clarifying how to effectively implement virtual patients was needed. (7)

Saleh stated in a review of the literature on VP that they have a number of disadvantages including being expensive and resource intensive, difficult to integrate into medical curricula, difficult to edit and author, limited by technology, limited by lack of diversity (race, culture, and discipline), and poor at evaluating complex cognitive skills such as empathy, negotiation, and conveying bad news. (1)

Medical Schools and educators responsible for the design of undergraduate medical curricula will benefit from a review highlighting the different applications of VP and their effectiveness. A scoping search identified 3 reviews on the subject of virtual patients. Two reviews had methodological limitations related to the search strategy, studies included and absence of a meta-analysis. (1, 8) The third review was a systematic review with meta-analysis and included studies of VP from 1991-2009. (7) However, the MedBiquitous Virtual Patient interoperability standard introduced in 2009 has since facilitated the sharing of VP cases and collaboration, resulting in a standardized point of reference for VP design and a tighter definition of what a VP is. (9)

II. Review topic/question(s), objectives & key words

The current review focuses on the use of virtual patients as an educational intervention for medical students. The main research questions include:

- What are the applications of virtual patients for medical students?
- What are the instructional designs used
- How do virtual patients compare to other instructional methods e.g. non-computerised standardised patients?
- Does the use of virtual patients improve learning outcomes for medical students?
- What aspects of virtual patients are associated with effective learning?
- Is the use of virtual patients cost-effective?

The applications of virtual patients in assessment will be the focus of a separate review.

**Key Words**

Computer-based instruction, clinical simulation, e-learning, instructional methods, medical students, simulation, virtual learning, virtual patients, virtual simulation, undergraduate medical education.

**III. Search Sources and Strategies**

**Scoping search**

A scoping search using a multi-level search strategy was carried out. Literature searches of Medline, Embase, CINHAL, ERIC and PsychINFO were conducted using the following terms; “clinical simulation”, “e-learning”, “medical education”, “medical students”, “virtual patients”, “virtual learning” and ”virtual simulation”. This identified a number of key references on the subject for the purpose of writing the protocol.

**Search Strategy for the Review (10)**

1. Search terms.

The search terms employed in the scoping search will be used in the review.

2. Core Bibliographic Data Bases

Medline, Embase, CINHAL, ERIC, BEI, PsychINFO, Research and Development Resource Base (RDRB) and Topics in Medical Education (TIMELIT), Google Scholar

3. Hand searching of medical education journals

4. Contacting experts in the field

5. Proceedings of conferences

6. ‘Grey’ literature searches

**IV. Study Selection Criteria**

**Population**
Undergraduate Medical students at any stage of their studies

**Activity/Intervention**

The activity to be studied is the use of virtual patients as a learning tool/educational intervention. Virtual patients. This is defined as any computer program that simulates real-life clinical conditions in which medical students assume the role of a doctor /medical student /other healthcare professional and provides the medical students with opportunities to obtain a history, conduct a physical exam, make diagnostic and take a management decision.

**Inclusion Criteria**

- All studies describing the use of virtual patients as an educational intervention for undergraduate medical students.
- Studies published in any language

**Exclusion criteria**

- Studies involving postgraduate medical trainees
- Studies involving other health care professionals
- Computer-base programs without active interaction with the learner
- BEME rating scale of strength less than 3 (Table 1)

**Table 1. BEME rating scale of strength of studies(11)**

<table>
<thead>
<tr>
<th>BEME Strength of Evidence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No clear conclusion can be drawn</td>
</tr>
<tr>
<td>2</td>
<td>Results ambiguous, may be a trend</td>
</tr>
<tr>
<td>3</td>
<td>Conclusions can probably be based on the results</td>
</tr>
<tr>
<td>4</td>
<td>Results are clear and very likely to be true</td>
</tr>
<tr>
<td>5</td>
<td>Results are unequivocal</td>
</tr>
</tbody>
</table>

**Type of Studies**

- Randomised controlled trials
- Non-randomised controlled trials
- Case controlled studies
Cohort studies
- Descriptive studies

Comparisons
- Virtual patients versus no intervention
- Virtual patients versus alternate type(s) of virtual patients
- Virtual patients versus other instructional strategies

Outcome Measures
The review will summarise all outcome measure or evaluations in the included studies. (8) This is to include:

I. Qualitative Outcomes
   Examples include:
   - Overall satisfaction with the use of virtual patients
   - Change in attitudes and knowledge
   - Change in clinical reasoning, clinical and communication skills and behaviour

II. Quantitative Outcomes
   Examples include:
   - Effect on assessment scores

V. Procedure for Data Extraction
- Reviewers will work independently to scan the retrieved titles and abstracts and code studies as “included” or “excluded” according to the inclusion and exclusion criteria.
- The lead reviewer will arbitrate if differences arise after retrieving the full text article and discussion with the group
- Full text articles of included studies will be retrieved.
- A data extraction form based on the BEME coding sheet(Appendix I) will be developed, piloted and adapted where appropriate. The information on the data extraction form will include information related to year of study for the medical students, design of the study, duration and type of intervention, discipline(s), the details of the instructional
design of the virtual patients used e.g. narrative VP versus problem solving design, the presence or absence of number of cases, duration of learning, the amount of interactivity provided by the intervention.

- The included studies will be stratified according to quality based on the information in the data extraction forms.

**VI. Synthesis of Extracted Evidence**

1. Quantitative Studies

Outcomes of quantitative studies will be collated separately. The mean and standard deviation or odds ratio will be converted to a standardised mean difference. The standardized mean difference (SMD) will be used to analyse included trials presenting continuous data. This method expresses the size of the intervention effect in terms of the pooled standard deviation (SD), and therefore accounts for any differences in measurement scale. It assumes that the differences in SD are not due to differences in the variability among study populations or the reliability of outcome measures.

2. Qualitative Studies

The reviewers will synthesize qualitative studies by identifying key themes independently

**VII. Project Timetable**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
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<tbody>
<tr>
<td>Formation of review team</td>
<td>October 2011</td>
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<tr>
<td>Scoping Search and protocol</td>
<td>November 2011</td>
</tr>
<tr>
<td>Review search</td>
<td>December- February 2012</td>
</tr>
<tr>
<td>Identification of studies to be included</td>
<td>March- April 2012</td>
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<tr>
<td>Retrieval of full-text articles</td>
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<tr>
<td>Contacting experts in the field</td>
<td></td>
</tr>
<tr>
<td>Data extraction</td>
<td>May –June 2012</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>July –August 2012</td>
</tr>
</tbody>
</table>
VIII Brief CV for each review team member

Hisham S KHALIL

Personal Details
Name: Hisham Saleh Khalil
Date of Birth: 28 September 1964
Sex: Male
Address Peninsula Medical School
Locality Office, John Bull Building
Tamar Science Park, Plymouth PL6 8BU
Tel: 01752 437396 (work), 07803925790 (mobile)

Current Posts
- Director of Clinical Studies, Honorary Associate Professor, Peninsula Medical School,
- Consultant ENT Surgeon Derriford Hospital, Plymouth,
- Professor of Otolaryngology, Faculty of Medicine, University of Alexandria

Qualifications
- MB.Ch.B (Distinction with Honors), 1987
- Masters of Surgery(MS), 1991
- FRCS Ireland , 1993
- FRCS(Glasg), 1994
- Doctorate Degree in Medicine (MD), 1996
- FRCS(ORL-HNS),2002
- Fellow of the Higher Education Academy (FHEA), 2007
- Diploma of Medical Education(Dip.Med.Ed), 2008
- Masters in Clinical Education(Dissertation stage, in Progress)

Experience in Primary Research
1. Theses:
2. 50 peer-reviewed full articles (4 in press)
3. 21 peer-reviewed abstracts in journals and conference proceedings
4. Supervised an MS Thesis and currently supervising an MD thesis

Experience in Secondary Research
1. Member of the ENT Group in the Cochrane collaboration
2. Published 2 protocols and 1 systematic review in the Cochrane Library and a further systematic review submitted for publication
3. Published 2 further reviews in peer review journals
4. Published 1 book, co-editor of 1 book and contributor to 2 other books.

Recent Publications


- Khalil HS, Eweiss AZ, Clifton N., Radiological findings in patients undergoing revision endoscopic sinus surgery: a retrospective case series study. BMC Ear Nose Throat Disord. 2011 7;11:4


- Eweiss AZ, Ibrahim AA, Khalil HS. The safe gate to the posterior paranasal sinuses: reassessing the role of the superior turbinate. Eur Arch Otorhinolaryngol. 2011 Nov 16. [Epub ahead of print]-

Experience in Medical Education

1. Overall responsibility for the Clinical Undergraduate curriculum in the Peninsula Medical School
2. Chaired the Curriculum and learning Group in the PMS and currently the chair of the Medical Programmes management Committee
3. Chair of the PMS curriculum steering group responsible for development of the new curriculum
4. Undergraduate teaching experience for Medical and Dental Students in Alexandria, Bristol and the Peninsula Medical School
5. Postgraduate Courses
   - PCMD Practical ENT for General Practitioners(Convener)
   - Sinus Anatomy and dissection Course, Bristol(Convener from 2012)
   - PCMD Clinical Allergy course(Faculty)
   - Clinical Education Course(Faculty)
6. Academic Lead for Specialist Training in Otolaryngology, Peninsula Deanery
Nick COOPER

Date of Birth: 13 August 1952
Address
Peninsula College of Medicine and Dentistry
John Bull Building Plymouth School
Tamar Science Park (University of Exeter
Devon PL6 8BU
Mobile: 07817 866265
Email : nick.cooper@pcmd.ac.uk

CAREER HISTORY
Principal General Practice, Catherine House Surgery, Totnes 1982 to date
Clinical Senior Lecturer, Peninsula College of Medicine and Dentistry, Graduate School 2008 to 2011
Associate Professor, Peninsula College of Medicine and Dentistry, Graduate School 2008 to 2011
Programme Lead Clinical Education, Peninsula College of Medicine and Dentistry Academic Lead Peninsula Foundation School 2008 to date
Programme Lead Generic Professional Skills Programme 2006 to date
Programme Lead Health and Social Care Education, Peninsula Postgraduate Health Institute 2004-8
Director of Postgraduate Education, Peninsula Medical School 2001-3

EDUCATION
FAcadMEd Fellow of Academy of Medical Educators 2009
FRCPCH Fellow Royal College of Paediatrics and Child Health 2007
FRCP Fellow Royal College of Physicians (London)
FHEA Fellow Higher Education Academy 2002
MMeD Medical Education, University of Dundee 1998
MRCPCH 1997
DFFP 1993
MRCP (Paediatrics) 1979
MB BS 1970-1976
London Hospital Medical College
BSc Anatomy 1970-1973
University of London (2.1)
Experience in undergraduate, postgraduate and continuing medical education in primary care and child health, as well as in higher education through undergraduate medical education, postgraduate masters programmes and
CPD. A peer reviewer for Medical Education, Medical Teacher and British Journal of General Practice and have been on the editorial board of MIMS magazine and Child Abuse Review, and secretary of The Society of Medical Writers. An assessor for The Academy of Medical Educators and External Examiner for the Masters Programme in Medical Education at The University of Dundee.

RESEARCH

Primary Care: Catherine House Surgery Medical Research Council (MRC) – General Practice Research Funded Practice, Member of PCRN (Peninsula Primary Care Research Network), Member of ‘Vision’ Research Practices

Peninsula College of Medicine and Dentistry: Medical Education Research:
- development of clinical reasoning process
- evidence of how teachers develop
- quality assurance of postgraduate programmes through quality enhancement.
- mind mapping
- child health in primary care

RECENT PUBLICATIONS

Browne J, Cooper N & Bligh J (2011) Become recognised for your teaching. Education for Primary Care 22: 124-6

MANAGEMENT

Harvard Macy Scholar 2010 Developing high quality outcomes
Various management roles in undergraduate and postgraduate education, including
Member of Plymouth Locality Curriculum Management Group, Graduate Programmes Committee and Peninsula Medical School Appeals Committee, Torbay Postgraduate Education Committee
Thomas C GALE

Name: Thomas Charles Edward GALE

Address: Porthkerry House
Chapel Road
Yealmpton
Devon
PL8 2LZ

E-mail: thomas.gale@pms.ac.uk

Date of Birth: 7 October 1968

Age: 43

Nationality: British

G.M.C. Registration No: 4095851

Present employment

March 2005 – date
Consultant Anaesthetist
Department of Anaesthesia
Plymouth Hospitals NHS trust
Derriford Road, Plymouth PL6 8DH
Tel: 01752 439205

April 2011 – date
Associate Professor & Lead for Clinical Skills
Peninsula College of Medicine and Dentistry (PCMD)
John Bull Building, Plymouth PL6 8DU

Qualifications

July 1992 Bachelor of Medical Science (Upper Second Class
Honours) July 1994 Bachelor of
Medicine, Bachelor of Surgery
March 1999 Australian Medical Council Examination
July 2002 Fellowship of the Royal College of Anaesthetists
Dec 2004 Fellowship of Australian and New Zealand College of
Anaesthetists
June 2005 Postgraduate Certificate in Clinical Education
(Peninsula Medical School)

Educational and management experience

PCMD Lead for Clinical Skills (April 2010 – date)
- Leading delivery and assessment of clinical skills curriculum at the Peninsula
College of Medicine and Dentistry.
- Co-supervisor of 1 PhD student and 2 masters students carrying out research
into innovations in clinical skills training.

**PCMD Masters in Clinical Education (in progress; 2009 – date)**

- Completed 120 credits to achieve the Postgraduate Diploma stage of the Masters programme.
- Completed a systematic review on the use of simulation for assessment in anaesthesia.
- Completed a proposal on the evaluation of in-situ simulation training for theatre teams which I have since instigated as a clinical project at Derriford Hospital.
- Completed data collection for my main master’s dissertation on a comparison of different critical incident algorithms for use in novice anaesthetists.

**Project Lead, Acute Specialties Selection Pilot (2008 – date)**

**Chair of Peninsula Simulation Network (2008 – date)**

**Publications**

8 peer-reviewed full articles, 1 review article, 21 Abstracts, 2 correspondences. And 4 book chapters

**Recent Articles**

Crossingham G, Sice P, Roberts M, Lam H, **Gale T.** Development of workplace-based assessments of non-technical skills in anaesthesia. *Anaesthesia (accepted November 2011)*


Anderson I, Sice P, **Gale T.** Setting up a simulation facility from scratch; the Peninsula Simulation Suite. *Royal College of Anaesthetists Bulletin* 2010; 67: 40-42

**Recent Abstracts**


Holmes K, Alderson L, Bratanow S, **Gale T.** The WHO checklist; not just a tick-box exercise. *Anaesthesia* 2010; 65: 1246-5

**Book Reviews 2**

**John Adrian COPPLESTONE**

**Appointments**

Consultant Haematologist.
Plymouth Hospitals NHS Trust

Associate Dean (Plymouth Locality)
Peninsula College of Medicine & Dentistry

Honorary Professor of Haematology
PCMD, Plymouth University

**Work Address:**

Derriford Combined Laboratory, level 7
Derriford Hospital,
Derriford Rd,
Plymouth. PL6 8DH.

**Telephone:**

01752-792398 (work)
01752 774248 (home)

**Mobile:**

0776688 5326

**Qualifications:**

F.R.C.Path October 1995
F.H.E.A. March 2007 (previously ILTM)
F.Acad.M.Ed. November 2010

**Research Areas:**

Chronic lymphoproliferative disease
Thrombocytopenia
Blood Transfusion
Medical Education
Health Services Research – VTE prophylaxis

**Publications**

Chapters 6 abstracts 94
Papers refereed 79 Papers non-refereed 8
Other 14 e.g. The Chief Medical Officer’s National Blood Transfusion Committee Annual Reports

**Other research activity**

Trial Steering Committee Chair 2 (PRISM, SWIM)
Principal Investigator 4 trials (3 RCTs)
Journal Reviewer 5
Desmond A NUNEZ

Current Post:
Head (Designate) Division of Otolaryngology, Faculty of Medicine, University of British Columbia
Honorary Reader in Otolaryngology, Faculty of Medicine, University of Bristol

Contact Address:
Division of Otolaryngology, Vancouver General Hospital, Gordon & Leslie Diamond Health Care Center, 4th Floor, 2775 Laurel St. Vancouver, British Columbia V5Z 1M9
Tel: (+1)6048754664 Fax: (+1)6048755018  Email: d.a.nunez@bristol.ac.uk

1. Research Writing
Primary

MD Dissertation
The prevalence of human papilloma viruses in laryngeal squamous cell carcinoma a polymerase chain reaction investigation.  Supervisor: I Lauder, Professor of Pathology, 1997

Peer Reviewed Journal Publications (n=48, the most recent 3 are cited)

Peer Reviewed Conferences and Proceedings abstracts publishedvid (n=24, the most recent 3 are cited)

Secondary
Textbook Chapters

Peer Reviewed Journal Publications (n=12, the most recent 3 are cited)
Toll EC, Nunez DA. Acute Otitis Media, Diagnosis and Treatment - A review. J Laryngol Otol. In press June 2011


Peer Reviewed Conference and Proceedings abstracts published (n=5, the most recent 3 are cited)


IX. Conflict of interest statement

The members of the review group do not have any perceived conflicts of interest.

X. Plans for updating the review

The review group intends to review the literature and update the review every 2 years.

XI. Changes to protocol

Any changes to protocol will be communicated to BEME before they are implemented.

XII. References