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Enhancing UK Core Medical Training through simulation-based education: an evidence-based approach

A report from the joint JRCPTB/HEE Expert Group on Simulation in Core Medical Training

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Acknowledgements

The Joint Royal Colleges of Physicians Training Board (JRCPTB) improves patient care by setting and maintaining standards for the highest quality of physician training in the UK on behalf of the Royal College of Physicians of London (RCPL), the Royal College of Physicians of Edinburgh (RCPE) and the Royal College of Physicians and Surgeons of Glasgow (RCPSG). It achieves this through excellence in curriculum design and implementation, providing oversight of the recruitment and certification of trainees and by supporting the General Medical Council (GMC) in quality management.

Health Education England (HEE) is responsible for delivering a better health and healthcare workforce for England. It is the organisation responsible for the education, training and personal development of every member of staff, and recruiting for values.

This report was prepared under the oversight of the joint JRCPTB/HEE Expert Group on Simulation in Core Medical Training (CMT). A list of Group members is provided as Appendix 1. Names and titles were accurate as per the last meeting of the Group.

The Group would like to particularly thank the following for their contributions:

Principal authors:

Dr Makani Purva, Director of Simulation and Deputy Chief Medical Officer, Hull and East Yorkshire Hospitals NHS Trust (formerly Director of Medical Education, Hull and East Yorkshire Hospitals NHS Trust)

Dr Graham Fent, Specialty Registrar in Cardiology, Health Education Yorkshire and the Humber (formerly Educational Leadership in Simulation Fellow, School of Medicine, Health Education Yorkshire and the Humber)

Dr Anoop Prakash, Consultant in Respiratory Medicine, Hull and East Yorkshire Hospitals NHS Trust (formerly Educational Leadership in Simulation Fellow, School of Medicine, Health Education Yorkshire and the Humber)

Principal editor:

Dr Miriam Armstrong, Senior Policy Adviser, JRCPTB

Survey of UK CMT Training Programme Directors (TPDs):

Professor Jean Ker, NHS Education for Scotland (NES) National Clinical Lead for Skills and Simulation; Associate Dean of Innovation and Medical Education, Ninewells Hospital and Medical School, Dundee

Dr Nicki Colledge, Director of Education, Royal College of Physicians Edinburgh (RCPE)

Executive summary

Simulation-based education (SBE) is increasingly becoming a vital component of postgraduate medical education. Its adoption is supported by national policies and an expanding body of literature. Although pioneered in anaesthetics and surgical training in the UK, SBE is an important element of physician training that is widely recognised as a means of improving patient outcomes through enhanced learning of evidence-based standards.

The Joint Royal Colleges of Physicians Training Board (JRCPTB) and Health Education England (HEE) are committed to harnessing faculty and technology to support the development of excellence in education and to driving up the quality of Core Medical Training (CMT). CMT has been a shared priority for some time and this report reflects the importance assigned to achieving those aims, but with improvements underpinned by an evidence base.

The recommendations in this document are based on a detailed review of the literature and expert opinion on best practice. It examines those aspects of the CMT curriculum that can be appropriately and effectively taught using SBE and provides recommendations for their mandatory implementation. The findings are intended to assist Training Programme Directors (TPDs), Heads of Schools of Medicine, Foundation Schools, Deaneries, Local Offices of HEE, consultants and everyone else involved with the delivery of CMT, in understanding exactly how and where simulation can be used most effectively to improve educational outcomes and trainee experience.

The key findings are as follows:

- There is good evidence (T3)[1] that certain CMT practical procedures (central venous catheterisation, thoracentesis, abdominal paracentesis) and emergency presentations (cardiorespiratory arrest) can improve patient outcomes if taught using SBE. There is no obvious reason why additional CMT procedures should not also be taught using SBE, indeed the evidence points to it being desirable to do so

- There is reasonable evidence (T2) that non-technical and human factors skills required by CMT can be effectively taught using SBE

- The teaching of CMT essential and desirable procedures (see Appendix 2 for more details) and also non-technical skills using SBE is already widespread within the UK and CMT TPDs support this training.

The JRCPTB intends to submit a revised CMT curriculum to the General Medical Council (GMC) based on these findings, and which proposes:

That all essential and desirable practical procedures listed in the CMT curriculum should be taught by simulation as early as possible in Year One, with further simulation teaching involving human factors and scenarios training carried out in either Year One or Year Two. The latter should also include refresher training for procedural skills where necessary.

The supporting evidence for this action, plus additional recommendations, is discussed in the main report. It should be noted that all different types of SBE can be used to achieve the required learning outcomes. Examples include (but are not limited to) task training, manikin-based simulation, standardised patient approaches or virtual reality. This is subject to the availability of equipment and faculty.

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[1] The relative strength of evidence has been graded according to the system commonly used for medical educational outcomes. In this instance, T1 level evidence is where an effect is demonstrated in the simulation centre, T2 is where an effect on downstream patient care behaviours and practices is demonstrated and T3 is where an effect attributable to simulation on patient care or public health is demonstrated. More details are provided in the Methodology section.

Contents

Foreword

Recent years have seen a widespread rise in the adoption of simulation-based education (SBE) amongst postgraduate specialties, supported by an ever-expanding body of literature. Although initially pioneered in anaesthetics and surgical training in the UK, SBE is increasingly recognised as an important element of physician training. It is effective in improving patient safety and care, as well as enhancing learning, and is being more widely embedded in both undergraduate and postgraduate training programmes.

As partner organisations for this report, the Joint Royal Colleges of Physicians Training Board (JRCPTB) and Health Education England (HEE) are committed to expanding the use of SBE to contribute to excellence in the training and development of healthcare staff. Core Medical Training (CMT) has been a shared priority for both organisations for some time and this report reflects the importance assigned to driving up the quality of CMT as quickly as possible, but with the proposed improvements being underpinned by an evidence base.

Drawing on the experience of the joint JRCPTB/HEE Expert Group on Simulation in CMT, this document identifies those aspects of the CMT curriculum which can be appropriately taught using SBE and provides recommendations as to when implementation should be mandatory.

The recommendations are based on a detailed review of the literature (pertaining to the syllabus contents of the CMT curriculum) and expert opinion on best practice. They are expected to be fully implemented by Training Programme Directors (TPDs), Heads of Schools of Medicine, consultants and all educators involved in the delivery of CMT.

The recommendations will also be of relevance to those responsible for implementation of the JRCPTB's CMT quality criteria[2] (2015), one of which is dedicated to the use of SBE:

B.4 Skills laboratory and/or simulation training for all mandatory procedural skills to be provided at least once a year to supplement clinical training.

This document is intended to promote the wider adoption of SBE as early as possible within UK CMT to improve the quality of training for better patient care. It will also help those overseeing the delivery of training identify exactly how and where learning can be enhanced via the use of simulation and meet the requirements of the CMT quality criteria in the process.

Professor David Black
Medical Director, JRCPTB

Alan Ryan
Director of National Programmes, HEE

[2] For more details see: http://www.jrcptb.org.uk/quality-criteria-core-medical-training

Introduction

Overarching policy context

The value of simulation-based education (SBE) to postgraduate medical education and training has been evident for some time. The report *150 years of the Annual Report of the Chief Medical Officer: On the state of public health 2008* (Department of Health, 2009) provided the impetus for the growth of simulation in the UK and suggested that simulation should be 'more fully integrated into the health service'. A subsequent report, *A Framework for Technology Enhanced Learning* (Department of Health, 2011), set out a vision to enable commissioners across health and social care to integrate technology into education, training and continuing professional development. In 2013, Health Education England (HEE) launched the Technology Enhanced Learning (TEL) Programme[3] with the vision that healthcare in the UK should be underpinned by world-class education and training that is enhanced through innovation and the use of existing, evidence-based and emergent technologies and techniques (including simulation). These aims concur with those outlined in the Scottish White Paper Partnership for Care (NHS Education for Scotland (NES), 2007)[4] , namely that, 'Staff need to have the tools to do their job. So we are investing heavily, not only in NHS staff themselves, but also in modernising the infrastructure of NHS Scotland, and, above all, in the information systems and communications technology necessary to deliver redesigned healthcare.'

Since then, a variety of initiatives have progressed at a national and local level. To take account of these developments the Association for Simulated Practice in Healthcare (ASPiH) conducted a survey, *The National Simulation Development Project: Summary Report* (ASPiH, 2014), to scope current provision for SBE, including the assessment of capacity for teaching, within the UK. Importantly, the report concluded that:

- There is a growing body of evidence to support the use of SBE in healthcare
- SBE is used widely for training in core technical skills for craft specialties and other disciplines
- The presence of SBE in core curricula for most medical specialties and for nursing is increasing
- The UK has the highest number of advanced simulation centres in Europe
- The NHS is regarded as a global leader in the field of SBE.

Despite these promising factors, the report noted that funding, staff training and the availability of educational faculty were the key constraints to the wider adoption of SBE. In particular, that the management, sharing and co-ordination of resources between centres delivering SBE was poor in many areas. This finding is especially significant given that over 80% of advanced simulation centres reported having spare capacity.

[3] Available at: https://www.hee.nhs.uk/our-work/research-learning-innovation/technology-enhanced-learning
[4] Available at: http://www.gov.scot/Publications/2003/02/16476/18737

The role of SBE in physician training

Core Medical Training (CMT) provides the fundamental building blocks for all the physician specialties, particularly in preparing doctors for the demanding role of Medical Registrar. It is therefore vital that CMT doctors receive the necessary training to be fully equipped to competently and confidently perform this role, and SBE is one route to achieving this outcome. It is likely that the principles of SBE established during CMT will be relevant to higher medical specialty training.

A number of descriptions of SBE and its potential application exist in the literature. Key examples include:

SBE should be considered 'a technique not a technology, to replace or amplify real experiences with guided experiences' (Gaba, 2004). *Uniquely, it offers the chance for a learner to practise an activity in a safe environment without compromising patient safety* (Weller et al., 2012).

SBE can be used to deliver a wide range of curriculum requirements through case studies and role plays, 'part task trainers' (simulation of procedures) or 'full mission simulators' where a learner works through a simulated scenario, often using a high-tech manikin (Beaubien, 2004).

Simulation lends itself particularly well to procedures or emergency situations which occur infrequently, but are potentially dangerous or even life-threatening (Aggarwal et al., 2010).

The concept of 'deliberate practice', where repetitive practice of a skill in a focussed domain is associated with improved performance (Ericsson, 2004)*, is thought to be enhanced by SBE. Rather than being used to simply introduce a learner to a new skill, simulation when repeated multiple times can lead to eventual mastery of the skill (*Motola et al., 2013; Issenberg et al., 2005).

Methodology

To inform this report, the principal authors undertook a review of the literature relating to the use of simulation-based education (SBE) in teaching the current Core Medical Training (CMT) curriculum. In order to simultaneously assess current use and potential capacity of simulation in CMT across the UK, a survey of CMT Training Programme Directors (TPDs) was conducted with the University of Dundee. The findings are detailed below.

1) Literature review

A review was conducted to identify all aspects of the CMT curriculum (2009 with amendments by the Joint Royal Colleges of Physicians Training Board (JRCPTB) in 2013) where evidence for SBE exists in the literature.

Searches were conducted using the MEDLINE database and limited to English language only and articles published from 1996 to 2015. In order to identify appropriate search terms, the two-page 'Syllabus contents' section of the curriculum was used. All terms listed within 'common competencies', 'emergency presentations', 'top presentations', 'other important presentations', 'investigation competencies' and 'procedural competencies' were searched. These search terms were combined with the term 'simul*'.

Articles relating to specialties other than General Internal Medicine (GIM) or undergraduate medical students were also included, providing it was clear that there was significant teaching overlap with CMT curriculum requirements in the competency or presentation being assessed. Educational outcomes included knowledge, time skills and behaviours, process skills and behaviours, product skills and behaviours, as well as patient effect.

Two assessors with experience in SBE considered the abstracts for all of the returned citations for suitability of inclusion in the study. The level of evidence demonstrated in individual papers was graded T1 to T3.[5]

- T1 level evidence is where an effect is demonstrated in the simulation centre
- T2 is where an effect on downstream patient care behaviours and practices is demonstrated
- T3 is where an effect attributable to simulation on patient care or public health is demonstrated.

[5] Rather than using the traditional hierarchy of scientific evidence, the relative strength of studies in SBE research is conventionally graded in terms of their impact as a translational science. For this reason, even a rigorously conducted randomised control trial may only be graded as T1 evidence if the outcome measurement demonstrates improvements in care in a simulation centre rather than at the bedside.

Studies were classified as being either 'positive', 'neutral' or 'negative'. A positive study was considered to be one where the main outcome showed a statistically-significant effect in favour of simulation. A neutral study was considered to be one where the main outcome did not show any statistically-significant effect in favour of either simulation or the teaching modalities to which it was being compared. A negative study was considered to be one where the main outcome showed a statistically-significant effect in favour of alternative teaching modalities to which simulation was being compared.

Where articles were deemed appropriate for inclusion, relevant data were extracted and entered into the following table:

Skill	Study title & author	Evidence level	Outcome	Specialty

2) Survey of CMT Training Programme Directors (TPDs)

A web-based survey evaluating the current use of SBE in CMT, as well as canvassing views on the feasibility of making such training mandatory, was sent to all UK CMT TPDs in February 2015. The survey was live for two weeks, during which time one email reminder was sent mid-term. The full questionnaire is provided as Appendix 3.

A further survey of UK postgraduate Deans was conducted in summer 2016.

Results

1) Literature review

Evidence relating to elements of the Core Medical Training (CMT) curriculum

Out of the 20,564 articles identified by the original search terms, evidence of the use of simulation-based education (SBE) in teaching content relevant to General Internal Medicine (GIM) was identified in a total of 95 individual studies.

Positive evidence supporting training using SBE was found in a total of 90 individual studies applicable to 7/25 of skills listed in the 'common competencies' domain of the CMT curriculum, 4/4 in 'emergency presentations', 4/22 in 'top presentations', 2/26 in 'investigations' and 8/9 in 'procedures'. Neutral evidence was found in four individual studies relevant to 1/4 in the 'emergency presentations' domain of the CMT curriculum, 2/22 in 'top presentations' and 1/9 in 'procedures'. Evidence of negative effects of teaching using SBE was found in a single T3 study relevant to the 'communication within a consultation' skill in the 'common competencies' domain of the CMT curriculum (Curtis et al., 2013).

The vast majority of papers regarded as showing a positive outcome only did so at T1 level; namely, there was no direct effect on trainee behaviour in real life practice or on patient-related outcomes. However, many were not designed to evaluate T2 or T3 outcomes and, furthermore, there is little evidence existing at T3 level outside of SBE in the wider medical education literature.

Table 1 summarises the areas of the CMT curriculum where evidence was identified to support the use of SBE in teaching and the associated grading of evidence. More details of the key references are provided in Appendix 4. A full list of the studies identified by the review is available from the Joint Royal Colleges of Physicians Training Board (JRCPTB) website (www.jrcptb.org.uk).

Key to Table 1:

- T1 evidence — denotes an effect in a simulation centre
- T2 evidence — denotes an effect on downstream patient care behaviours and practices
- T3 evidence — denotes an effect on patient care or public health.

TABLE 1			
	Competency	**Outcome level [no. of papers]**	**Key reference**
Common competencies	Clinical examination	T2 [1]	(Fraser et al., 2011)
	Decision making and clinical reasoning	T1 [1]	(Howard et al., 1992)
	Relationships with patients and communication within a consultation	T2 [1]	(Fallowfield et al., 2002)
	Breaking bad news	T2 [1] T1 [12]	(Fallowfield et al., 2002)
	Communication with colleagues and co-operation	T1 [8]	(Blum et al., 2003)
	Teamworking and patient safety	T1 [3]	(Blum et al., 2003)
	Complaints and medical error	T1 [1]	(Sukalich et al., 2014)
Emergency presentations	Cardiorespiratory arrest	T3 [2] T2 [1] T1 [5]	(Mundell et al., 2013)
	Anaphylaxis	T1 [5]	(McCoy et al., 2011)
	Shocked patient	T1 [4]	(Lighthall et al., 2003)
	Unconscious patient	T1 [1]	(Owen et al., 2006)
Top presentations	Abdominal pain	T1 [2]	(Steadman et al., 2006)
	Breathlessness	T1 [1]	(Steadman et al., 2006)
	Chest pain	T2 [1] T1 [1]	(Fraser et al., 2011)
	Management of patients requiring palliative and end-of-life care	T1 [3]	(Harting et al., 2008)
Investigations	Blood biochemistry	T1 [1]	(Botezatu et al., 2010)
	Blood haematology	T1 [1]	(Botezatu et al., 2010)
Procedures	Intercostal drain insertion (all techniques including Seldinger)	T1 [6]	(Hutton et al., 2008)
	Lumbar puncture	T2 [2] T1 [6]	(White et al., 2012)
	DC cardioversion	T1 [3]	(Healey et al., 2010)
	Central venous catheterisation (CVC)	T3 [5] T2 [2] T1 [7]	(Barsuk et al., 2009)
	Pleural aspiration (thoracentesis)	T3 [1] T2 [1] T1 [3]	(Duncan et al., 2009)
	Abdominal paracentesis (including ascitic tap)	T3 [1] T1 [2]	(Barsuk et al., 2014)
	Knee aspiration	T1 [5]	(Jolly et al., 2007)
	Nasogastric tube insertion	T1 [1]	(Bosse et al., 2015)

Evidence relating to non-technical skills and the human factors approach

The literature review found four studies with T2 level and 25 studies with T1 level evidence for teaching 'common competencies', such as communication and teamwork, effectively with SBE.

Simulation, by role play or with standardised or simulated patients[6] , is a commonly used method of teaching communication skills due to its simplicity, relatively low cost and effectiveness.

Standardised patients can be used in scenarios such as breaking bad news, disclosing medical errors, and discussing end-of-life issues. One study looked at the use of simulated consultations to develop communications skills for neurology trainees, which involved 12 specialist registrars in neurology (Smith et al., 2002). The study concluded that trainees particularly valued being able to review recordings of their consultations with simulated patients, which enabled them to reflect upon and improve their history-taking skills and imparting of information to patients.

SBE also offers an opportunity to enhance trainees' understanding and awareness of the importance of 'human factors' in healthcare. Human factors are 'attributes that diminish the ability of humans to perform the necessary steps to succeed consistently in the complexity of real-world settings' (Weinger & Englund, 1990) and, over the past 20 years, a deeper understanding has been gained of the role they play in clinical error. Human factors teaching using SBE may include teaching on recognition of, and strategies to cope with, workplace issues, such as task prioritisation skills in times of high workload, dealing effectively with distraction and avoiding 'fixation error'.[7]

A systematic review meta-analysis (Cook et al., 2011) showed that SBE at postgraduate level consistently achieved improved educational outcomes across a wide range of clinical topics and types of SBE, when using no educational intervention as a control. Thus SBE can be effectively used to teach not only knowledge and technical skills, but also non-technical and behavioural skills, enabling doctors to provide safe and effective healthcare for patients.

2) Survey of CMT Training Programme Directors (TPDs)

A response rate of 67% was obtained (16/24 CMT TPDs). The survey revealed that, at present, use of simulation to train in procedural skills, emergency presentations and non-technical skills is already high in CMT. Furthermore, the majority of CMT TPDs consider it feasible for this training to be mandatory. A summary of results is presented in Table 2.

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[6] A 'standardised patient' is someone who has been trained to portray a patient in a medical situation in a consistent, standardised manner.

[7] 'Fixation error' describes when a practitioner becomes fixated on completing a discrete task, rather than stepping back and considering the more pressing global picture (Weinger & Gaba, 2014).

TABLE 2	
Survey questions (paraphrased for brevity)	**% positive response**
Do you use simulation to train procedures in CMT?	100
Use of simulation to train CORE/ESSENTIAL procedures:	
Advanced CPR	75
Ascitic tap	69
Lumbar puncture	88
Nasogastric tube placement	56
Pleural aspiration/intercostal drain insertion	100
Use of simulation to train DESIRABLE procedures:	
Central venous cannulation	88
DC cardioversion	63
Intercostal drain insertion (Seldinger)	81
Abdominal paracentesis	63
Knee aspiration	19
Would it be feasible to make procedures training mandatory in CMT?	88
Use of simulation to train emergency presentations other than cardiorespiratory arrest e.g. shock, loss of consciousness, anaphylaxis	69
Use of simulation to teach non-technical skills	75
Use of simulation to teach the following non-technical skills:	
Situational awareness	63
Team communications	69
Leadership	63
Decision making	56
Prioritisation	50
Challenging communication e.g. breaking bad news	56
Task management	44
Other human factors	44
Would it be feasible to make simulation teaching of non-technical skills mandatory in CMT?	75

The findings from the UK postgraduate Deans survey are presented in Table 3.

TABLE 3		
Deanery/HEE local office	**I am assured that my Core Medical Training programme has the capacity to accommodate the delivery and assessment of the recommended changes**	**I have considered whether there are funding implications around mandating the use of simulation in Core Medical Training curricula in terms of existing capability and capacity**
HENE	Yes	Yes
HENW	Yes	Yes
HEYH	Yes	Yes
HEWM	Yes	Yes
HEEM	Yes	Yes
HEEoE	Yes	Yes
HESW	-	-
HEWessex	Yes	Yes
HETV	Yes	Yes
HENCEL	Yes	Yes
HENWL	Yes	Yes
HESL	Yes	Yes
HEKSS	-	-
Defence Deanery	Yes	Yes
NES	Yes	Yes
Welsh Deanery	Yes	Yes
NI Deanery	Yes	Yes

Discussion

There is a broad evidence base supporting the use of simulation-based education (SBE) to enhance teaching of the medical curricula generally. This report investigated how simulation might specifically be applied to enhance teaching for Core Medical Training (CMT) trainees. Further consideration of the findings of the literature review and their practical implications are discussed below.

Procedural competency training

There is some T3 level evidence that SBE enhances the effectiveness of teaching procedural aspects of the CMT curriculum (central venous catheterisation, thoracentesis, abdominal paracentesis) and also emergency scenarios (cardiorespiratory arrest). There is a broad range of (mainly T1 level) evidence that suggests SBE can safely enhance the teaching of all other procedural competencies for CMT and also emergency presentations and top presentations.

Occasionally, other curricula may provide more details on particular procedures, for example, the Advanced Life Support (ALS) curriculum (Resuscitation Council, 2015) covers cardiopulmonary resuscitation and transcutaneous cardiac pacing, and, where these exist, they should also be referred to when devising training programmes to prevent duplication.

In some cases, CMT trainees may have already received training in certain procedures listed in the CMT curriculum, for example, nasogastric tube insertion, at Foundation Level. Unfortunately, this does not necessarily mean they are fully competent (Lee & Mason, 2013), and trainers need to consider where best to invest the training resources at their disposal for CMT whilst taking national guidance or local feedback on patient safety matters into account.

Non-technical and human factors skills

Aside from its clear role in enhancing the effectiveness of teaching procedural aspects of the CMT curriculum, SBE also offers an opportunity to deepen understanding and awareness of the importance of non-technical skills, such as communication and 'human factors' in healthcare delivery.

The development of good communication skills is a key requirement for becoming an effective physician. Studies have shown that improved patient-centred communication can improve patient satisfaction and biomedical outcomes (Stewart, 1995).

Human factors have been described as 'attributes that diminish the ability of humans to perform the necessary steps to succeed consistently in the complexity of real-world settings' (Weinger & Englund, 1990) and, over the past 20 years, a greater understanding has been achieved of the role they play in clinical errors.

Teaching human factors using SBE has the potential to help individuals recognise and devise coping strategies for dealing with challenging non-technical issues, such as task prioritisation in times of high workload, managing distraction and avoiding 'fixation error'. It can also improve patient safety by ensuring a teamworking approach. For example, operating theatre staff who underwent human factors training demonstrated significant improvements in non-technical skills and behaviours as well as technical skills, compared to before they received training (McCulloch et al., 2009). Emergency Department staff who underwent human factors training demonstrated significantly improved team behaviours, in addition to a significant reduction in the number of clinical errors they made, compared with staff who had not undergone this training (Morey et al., 2002).

A multi-disciplinary simulation-based teamwork and communication training event in a US Paediatric Emergency Department resulted in significant improvements in staff knowledge and a reduction in patient safety events (Patterson et al., 2013). Following the intervention, the authors noted that the department managed 1,000 days without a single patient safety event, compared with a pre-intervention baseline rate of 2–3 events per year.

Another example of a successful teamworking application involved a multi-centre US randomised controlled trial, where clinical stroke rehabilitation staff from six professional disciplines were assigned to either a six-month 'team training intervention' (involving 2.5 days of training, written exercises and a videoconference consultation) or to 'no training'. Observed functional motor outcomes in stroke rehabilitation patients treated by the intervention group were significantly improved, compared to those treated by the non-intervention group, for the following 12 months (Strasser et al., 2008).

Practical considerations for delivering SBE

The literature also highlighted some important factors associated with the effective delivery of SBE:

- Retention of skills and knowledge degrade with time, particularly with seldom-performed procedures or activities (McGaghie et al., 2010). High-fidelity SBE can be used annually to retain procedural skills (Boet et al., 2011)

- Conducting scenario-based SBE in situ can ensure a more realistic exercise than in a simulation centre, as well as allowing live drills to be conducted by real teams. Additionally, it can help with the detection and resolution of 'latent errors'[8] (Miller et al., 2008)

- Using SBE to perform paracentesis procedures at the bedside resulted in cost savings compared to performing these procedures in a radiology department (Barsuk et al., 2014).

[8] 'Latent errors' are events that are identified during in situ simulation exercises, which, if occurred in a real-life setting, may cause a degree of harm to the patient.

Recommendations

The findings of the literature review highlight the potential enhancements to patient safety and the quality of care that may be achieved through increasing use of simulation-based education (SBE) within postgraduate medical education. Whilst the survey results highlight there is already widespread use of SBE to teach the Core Medical Training (CMT) curriculum across the UK, the outcomes illustrate where those efforts might best be directed. Indeed, the extent to which SBE is currently used to teach CMT is such that, for quality management purposes, its universal implementation in CMT should now become a priority. This proposition is supported by the evidence that SBE teaching of some CMT procedures and emergency presentations improves patient outcomes. The main findings are:

- There is good evidence (T3) that certain CMT practical procedures (central venous catheterisation, thoracentesis, abdominal paracentesis) and emergency presentations (cardiorespiratory arrest) can improve patient outcomes if taught by SBE. There is no obvious reason why additional CMT procedures should not also be taught using SBE, indeed, the evidence points to it being desirable to do so

- There is reasonable evidence (T2) that non-technical and human factors skills required by CMT can be taught effectively using SBE

- The teaching of CMT essential and desirable procedures, and also non-technical skills using SBE, is already widespread within the UK and that CMT Training Programme Directors (TPDs) support this training.

Specific recommendations to mandate the use of SBE in CMT

Based on these findings, the Joint Royal Colleges of Physicians Training Board (JRCPTB) intends to submit a revised CMT curriculum to the General Medical Council (GMC) to consider mandating the following:

That all essential and desirable practical procedures listed in the CMT curriculum should be taught by simulation as early as possible in Year One, with further simulation teaching, involving human factors and scenarios training, carried out in either Year One or Year Two. The latter should also include refresher training for procedural skills, where necessary.

The evidence reviewed suggests that UK Deanery and Health Education England (HEE) Local Office Schools of Medicine should deliver the following:

a) **Procedural competency training,** using simulation aimed at achieving technical competence for all essential and desirable procedures in the CMT curriculum, as early as possible during Year One (see Appendix 2 for more details).

b) **Scenario-based immersive simulation training,** addressing the management of shock, the unconscious patient, anaphylaxis and cardiorespiratory arrest, in Year Two.

In addition, further scenarios which explore the differential diagnosis and management of abdominal pain, chest pain and breathlessness should be included in the simulation teaching. Other aspects of the curriculum that should be covered include management of patients requiring palliative and end-of-life care, communication within a consultation and breaking bad news. Teaching of human factors can also be incorporated into these scenarios.

Other recommendations

1. The Association for Simulated Practice in Healthcare (ASPiH) report, The National Simulation Development Project: Summary Report (ASPiH, 2014), highlighted funding, staff training and the availability of education faculty as key constraints to the wider adoption of SBE. Given the challenging funding environment, it is important that improvements are sought through multiprofessional collaboration where possible, including sharing equipment and costs with other departments, such as Emergency Medicine, Paediatrics and Anaesthetics, who are already active and regular users of simulation equipment and facilities. Indeed, the ASPiH report (2014) revealed that over 80% of advanced simulation centres had spare capacity, which should prompt discussion, perhaps at a regional level, as to how to make best use of the facilities available. In addition, existing programmes should be considered as to how they might assist the wider provision of SBE training. Such programmes may incorporate scenario-based simulation, procedural skills training and communication skills, and may therefore be considered to deliver these curriculum requirements.

2. Patient safety can be improved by conducting scenario-based SBE in situ. This provides a more realistic environment than a simulation centre, allows live drills to be conducted with real teams and, additionally, can help in the detection and resolution of 'latent errors' (Miller et al., 2008).

3. Where alternative curricula already teach aspects of the CMT curriculum through simulation (for example, ALS and Foundation Level), they should be taken into account when training programmes are devised, to prevent duplication.

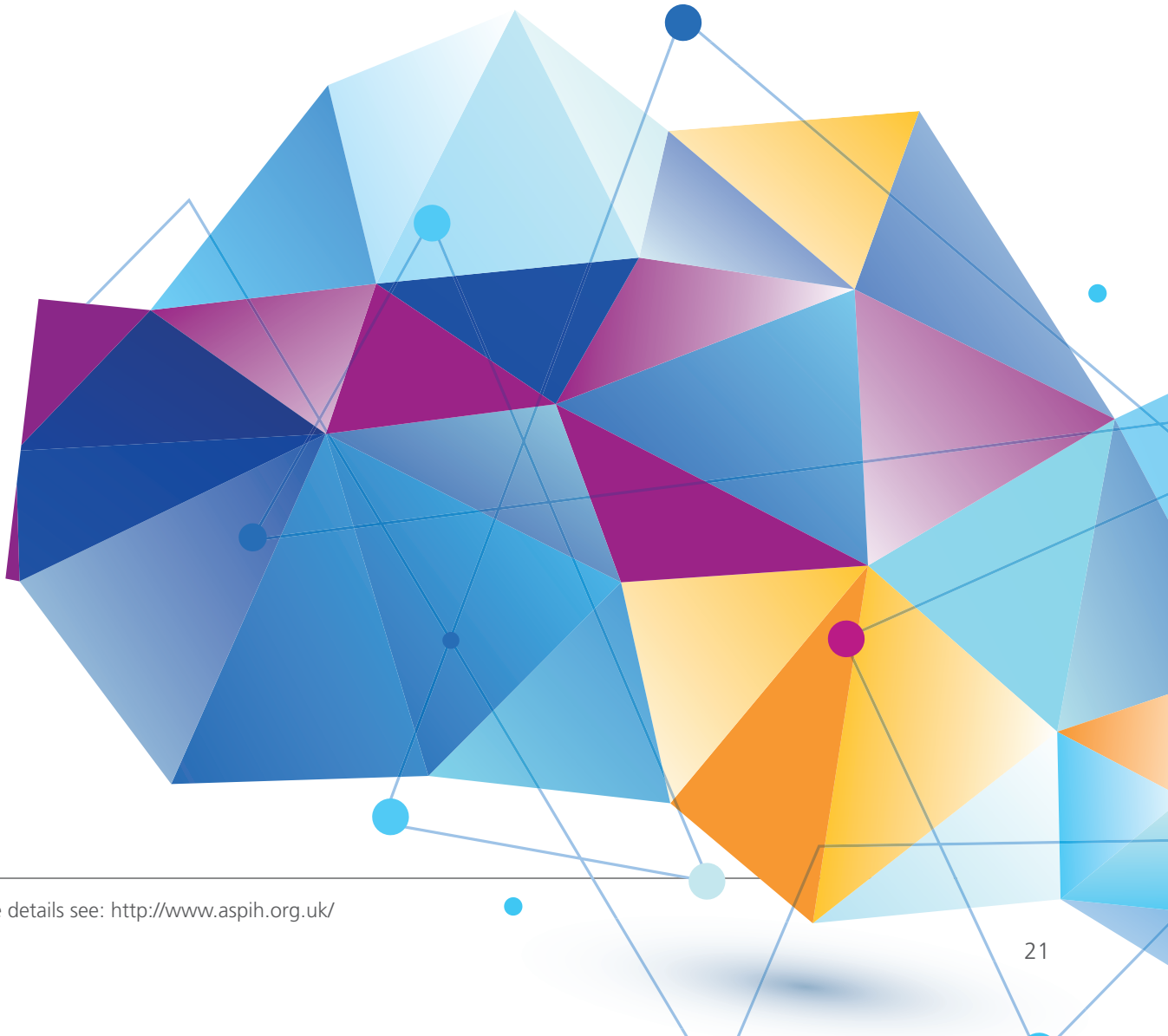
Update: ASPiH has been engaged by HEE to further develop its simulation standards in 2016/17 with the objective of having national standards, backed by a full consultation process across all stakeholders. The draft standards were presented at the ASPiH 2016 Conference in November 2016.

Simulation-based education (SBE) can improve the quality and impact of training provided to doctors now and in the future

Conclusion

Simulation-based education (SBE) can improve the quality and impact of training provided to doctors now and in the future. For teaching to deliver maximum benefit, it should be closely aligned to the relevant educational curriculum, informed by the evidence base and adhere to the highest quality standards.

This document provides more evidence and detail on how this vision can now be achieved for Core Medical Training (CMT). The development of accompanying standards[9] for the delivery of SBE for CMT heralds the next step in creating a clear framework for SBE to be provided systematically within all postgraduate medical curricula. It is hoped that further strides will quickly be made to advance this aspiration, thus providing regular opportunities for SBE throughout doctors' careers. The evidence indicates that this is an effective route for ensuring skills and knowledge are kept up to date, whilst delivering tangible improvements in patient outcomes.



[9] For more details see: http://www.aspih.org.uk/

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Appendix 1 — Membership of the joint JRCPTB/HEE Expert Group on Simulation in Core Medical Training

Group membership is primarily from the medical and educational fields, representing all levels of the medical education system from trainees to Deanery/Health Education England (HEE) local office level across the UK. Names and titles were accurate as per the last meeting of the Group.

Members of the Small Working Group on Simulation in Core Medical Training:

Professor David Black (Chair), Medical Director, Joint Royal Colleges of Physicians Training Board (JRCPTB)

Dr Miriam Armstrong, Senior Policy Adviser, JRCPTB

Dr Ian Barrison, Associate Dean — Postgraduate Medicine, University of Hertfordshire

Catherine Boyd, Lay Member, JRCPTB and Royal College of Physicians of Edinburgh (RCPE); Lay Adviser, Health Education North West

Dr Nicki Colledge, Director of Education, RCPE

Dr Graham Fent, Educational Leadership in Simulation Fellow, School of Medicine, Health Education Yorkshire and the Humber

Professor Jean Ker, NHS Education for Scotland (NES) National Clinical Lead for Skills and Simulation; Associate Dean of Innovation and Medical Education, Ninewells Hospital and Medical School, Dundee

Dr Anoop Prakash, Educational Leadership in Simulation Fellow, School of Medicine, Health Education Yorkshire and the Humber

Dr Makani Purva, Director of Medical Education, Hull and East Yorkshire Hospitals NHS Trust

Emma Scales, Programme Lead for TEL, HEE

Winnie Wade, Director of Education, Royal College of Physicians of London (RCPL)

Additional members of the Expert Group on Simulation in Core Medical Training:

Professor Bill Burr, Medical Director, JRCPTB (Chair until 1 August 2014)

Fiona Carmody, TEL Programme Administrator, HEE

Dr Indranil Chakravorty, Consultant in Acute and Respiratory Medicine, St George's Hospital, London

Dr Andrew Douds, CMT Simulation Lead, Health Education East of England

Dr Pramod Luthra, Associate Postgraduate Dean, Health Education North West

Dr Shairana Naleem, Consultant Acute Physician and CMT Simulation Lead, King's College Hospital and Health Education South East London

Dr Hina Pattani, CMT Lead, Health Education South East London

Dr Mohammed Peerally, Academic Clinical Fellow, University Hospitals of Leicester NHS Trust

Dr Paul Rylance, Director, NHS Teaching Academy, Royal Wolverhampton NHS Trust

Dr Nadia Short, Training Programme Director and Simulation Lead, Health Education South East

Dr Mukesh Thakur, General Internal Medicine Training Programme Director, Health Education Yorkshire and the Humber

Dr Michael Trimble, Deputy Director, Ill Medical Patients' Acute Care and Treatment (IMPACT) Programme; Head of School of Medicine, Northern Ireland Medical and Dental Training Agency

Dr Emma Vaux, Chair, JRCPTB CMT Advisory Committee; Consultant Nephrologist and Programme Director of Quality Improvement, Royal Berkshire NHS Foundation Trust

Appendix 2 — Procedural competencies for CMT (2009 curriculum — amendments approved 28 August 2013)[10]

As a minimum, the specialty registrar (StR) must be able to outline the indications for these procedures, recognise the importance of valid consent, aseptic technique, safe use of analgesia and local anaesthetics, minimisation of patient discomfort and when to request help. It is good medical practice to obtain training in procedural skills in a clinical skills lab before performing these procedures clinically.

The procedural competencies for the Core Medical Training (CMT) framework are divided into three sections:

Essential CMT procedures (part A, clinical independence essential)

CMT StRs must be able to undertake the following procedures before completion of CMT:

- Advanced cardiopulmonary resuscitation (including external pacing)
- Ascitic tap
- Lumbar puncture
- Nasogastric tube placement and checking
- Pleural aspiration or intercostal drain insertion for pneumothorax.

Essential CMT procedures (part B, clinical independence desirable)*

CMT StRs must have some experience* of these procedures before completion of CMT:

- Central venous cannulation (by neck or femoral) with ultrasound (U/S) guidance where appropriate
- DC cardioversion
- Intercostal drain insertion using Seldinger technique with U/S guidance (excepting pneumothorax).

* Trainees considering progression into an acute medical specialty are expected to develop clinical independence in these procedures, where possible. If not able to gain clinical independence, then one or more of the following are acceptable: skills lab competent with certification, course competent with certification, some clinical experience with Directly Observed Procedural Skills (DOPS) indicating, at a minimum, 'able to perform the procedure under direct supervision/assistance'.

[10] Available at: http://www.jrcptb.org.uk/sites/default/files/FINAL%202009%20CMT%20Curriculum%20%28AMENDMENTS%20Aug%202013%29_0.pdf

Desirable CMT procedures

CMT StRs should try to gain at least some experience**, and independent competency if possible, in the following procedures. However, it is recognised that it may be difficult to gain experience in these procedures because of reduced opportunities due to changed clinical practice and patient safety issues. The ability to undertake these procedures will be dependent on the training opportunities within a particular programme.

- Abdominal paracentesis
- Knee aspiration.

**If not able to gain clinical independence, then one or more of the following are acceptable: skills lab competent with certification, course competent with certification, some clinical experience with DOPS indicating, at a minimum, 'able to perform the procedure under direct supervision/assistance'.

Foundation procedural competencies

The CMT StR is expected to be competent, and maintain competency, in the following practical procedures in the Foundation curriculum during CMT:

- Arterial blood gas sampling
- Cannula insertion, including large bore
- Electrocardiogram
- Peak flow measurement
- Urethral catheterisation
- Venepuncture

Appendix 3 — UK CMT Training Programme Director (TPD) web-based survey

JRCPTB

Joint Royal Colleges of Physicians Training Board

Survey of UK Core Medical Training (CMT) Training Programme Directors (TPDs)

1. About you

Region/Deanery

No. of CMT trainees

What is your education job title?

2. Is simulation used for CMT training in procedures in your region/Deanery?

- Yes
- No

3. Do you use simulation to train the following core essential procedures?

Please tick all that apply

- Advanced cardiopulmonary resuscitation (including external pacing)
- Ascitic tap
- Lumbar puncture
- Nasogastric tube placement and checking
- Pleural aspiration or intercostal drain insertion for pneumothorax

4. Do you use simulation to train the following desirable practical procedures?

Please tick all that apply

- Central venous cannulation
- DC cardioversion
- Intercostal drain insertion using Seldinger technique
- Abdominal paracentesis
- Knee aspiration

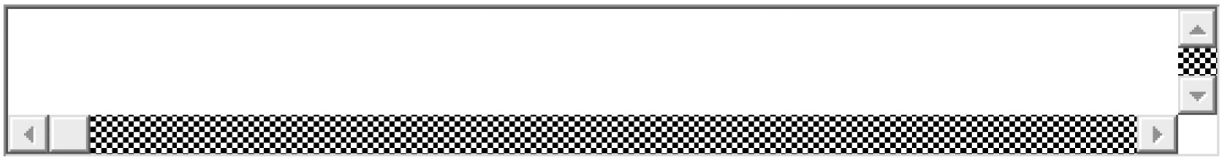
5. What percentage of your trainees attend SBE training in practical procedures?

- 0–20%
- 21–40%
- 41–60%
- 61–80%
- 81–100%

6. Would it be feasible to make procedures training mandatory?

- Yes
- No

If no, what would be the barriers?



7. Do you use simulation to train CMT trainees in emergency presentations other than cardiorespiratory arrest, such as shocked patient, unconscious patient or anaphylaxis?

- Yes
- No

8. Do you use simulation for non-technical skills (NTS) training?

- Yes
- No

9. For which NTS do you use simulation to train CMT trainees in your region?

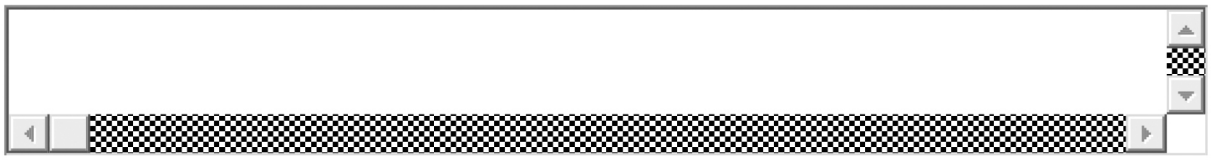
Please tick all that apply

- Situational awareness
- Team communication
- Leadership
- Decision making
- Prioritisation
- Challenging communication (e.g. breaking bad news using an interpreter)
- Task management
- Human factors

10. Would it be feasible to make this mandatory?

- Yes
- No

If no, what would be the barriers?



Appendix 4 — Details from key references identified from the literature search

Skill	Study title & author	Evidence level	Outcome	Specialty
Common competencies				
Clinical examination	Simulation training improves diagnostic performance on a real patient with similar clinical findings (Fraser et al., 2011)	T2	Students able to diagnose murmurs in real-life chest pain patients following SBE	Undergraduate
Decision making and clinical reasoning	Anesthesia crisis resource management training: teaching anesthesiologists to handle critical incidents (Howard et al., 1992)	T1	Improvement in knowledge regarding management of emergency presentations following SBE	Anaesthetics
Relationships with patients and communication within a consultation & Breaking bad news	Efficacy of a Cancer Research UK communication skills training model for oncologists: a randomised controlled trial	T2	Oncology doctors randomised to SBE course demonstrated better communication skills across wide range of oncology issues in real patients	Oncology
Communication with colleagues and co-operation & Teamworking and patient safety	Crisis resource management training for an anaesthesia faculty: a new approach to continuing education (Blum et al., 2003)	T1	Self-reported improvements in communication, teamwork and crisis resource management skills following SBE	Anaesthetics
Complaints and medical error	Teaching medical error disclosure to residents using patient-centred simulation training (Sukalich et al., 2014)	T1	Improvement in disclosure of medical error following SBE	General Internal Medicine (GIM)
Emergency presentations				
Cardio-respiratory arrest	Simulation technology for resuscitation training: a systematic review and meta-analysis (Mundell et al., 2013)	T3	Improved patient outcomes from resuscitation following SBE	Mixed

Anaphylaxis	Prospective randomized crossover study of simulation vs. didactics for teaching medical students the assessment and management of critically ill patients (McCoy et al., 2011)	T1	Improved treatment of anaphylaxis following SBE	Undergraduate
Shocked patient	Use of a fully simulated intensive care unit environment for critical event management training for internal medicine residents (Lighthall et al., 2003)	T1	Self-reported improvements in ability to manage patients with shock following SBE	GIM
Unconscious patient	Comparison of three simulation-based training methods for management of medical emergencies (Owen et al., 2006)	T1	Improved treatment of unconscious patient with full mission simulation	GIM
Top presentations				
Abdominal pain & Breathlessness	Simulation-based training is superior to problem-based learning for the acquisition of critical assessment and management skills (Steadman et al., 2006)	T1	Improved critical assessment and management skills with SBE vs problem-based learning	Undergraduate
Chest pain	Simulation training improves diagnostic performance on a real patient with similar clinical findings (Fraser et al., 2011)	T2	Students able to diagnose murmurs in real-life chest pain patients following SBE	Undergraduate
Management of patients requiring palliative and end-of-life care	Computer-based simulation as a teaching tool for residents treating patients with cancer-related pain crises (Harting et al., 2008)	T1	Improvements in management of pain following use of computer simulation program	GIM
Investigations				
Blood biochemistry & Blood haematology	Virtual patient simulation: knowledge gain or knowledge loss? (Botezatu et al., 2010)	T1	Improved knowledge retention with virtual patient simulation	Undergraduate
Procedures				
Intercostal drain insertion (all techniques including Seldinger)	Using simulation models to teach junior doctors how to insert chest tubes: a brief and effective teaching module (Hutton et al., 2008)	T1	Improvement in insertion of intercostal drain following SBE course	GIM

Lumbar puncture (LP)	Transfer of simulated lumbar puncture training to the clinical setting (White et al., 2012)	T2	Trainees performed LP competently in real patients following training using task trainer	Paediatrics
DC cardioversion (DCCV)	A low-fidelity simulation curriculum addresses needs identified by faculty and improves the comfort level of senior internal medicine resident physicians with inhospital resuscitation (Healey et al., 2010)	T1	Improvement in self-reported ability in performing DCCV following SBE course	GIM
Central venous catheterisation (CVC)	Simulation-based mastery learning reduces complications during central venous catheter insertion in a medical intensive care unit (Barsuk et al., 2009)	T3	Fewer catheter-related bloodstream infections in ICU patients following SBE	GIM/Emergency Medicine
Pleural aspiration (thoracentesis)	Reducing iatrogenic risk in thoracentesis: establishing best practice via experiential training in a zero-risk environment (Duncan et al., 2009)	T3	SBE in ultrasound-guided thoracentesis resulted in lower rates of pneumothorax	GIM
Abdominal paracentesis (including ascitic tap)	Cost savings of performing paracentesis procedures at the bedside after simulation-based education (Barsuk et al., 2014)	T3	Reduced cost and reduced need for platelet or fresh frozen plasma (FFP) transfusion when paracentesis performed after SBE vs standard methods	Mixed
Knee aspiration	Influence of an interactive joint model injection workshop on physicians' musculoskeletal procedural skills (Jolly et al., 2007)	T1	Self-reported improvement in joint aspiration following SBE course	GIM
Nasogastric (NG) tube insertion	The benefit of repetitive skills training and frequency of expert feedback in the early acquisition of procedural skills (Bosse et al., 2015)	T1	Improved performance in NG tube placement with deliberate practice/ SBE	Undergraduate