

Institution: Imperial College London
Unit of Assessment: 01 Clinical Medicine
Title of case study: Building a Safer Surgical Workforce; Driving Innovation in Simulation, Training & Educational Research
1. Summary of the impact (indicative maximum 100 words) The impact of educational research from the Rothschild Centre for Clinical Simulation and Education Research (RCSER) at Imperial College London has progressed from the development and validation of simulators and skill assessment, through to shaping guidelines for training curricula and continued professional development in the NHS and beyond. This body of multidisciplinary research brings together Imperial's contributions in simulation science, skills assessment, performance-shaping factors, educational theory and surgical practice to contribute to national and international healthcare education and policy. The work impacts upon clinical practice at regional, national and international levels, with far-reaching implications for the quality and safety of patient care.
2. Underpinning research (indicative maximum 500 words) Key Imperial College London researchers: Professor Lord Ara Darzi, Professor of Surgery (1999-present) Professor George Hanna, Professor of Surgical Sciences (2003-present) Professor Roger Kneebone, Professor of Surgical Education (2000-present) Dr Rajesh Aggarwal, Clinical Research Fellow (2006-2010), Clinical Lecturer (2010-present) Dr Fernando Bello, Reader in Surgical Graphics and Computing (2000-present) Dr Nick Sevdalis, Senior Lecturer (2004-present) Dr Sonal Arora, Clinical Lecturer (2011-present) RCSER education and simulation research programme at Imperial is framed as a technical, social and professional enterprise, crossing boundaries between academic disciplines to provide the highest quality of care. The research carried out here underpins the UK and international strategies for improved patient safety training with simulation singled out as the best means to achieve this. Specifically since the 1990s we have developed a strong evidence base to simulate and assess the 'technical' aspects of surgery, demonstrating that psychomotor skill can be rigorously measured, analysed and trained. Triggered by Professor Darzi's pioneering work, collaborative partnerships between clinicians, engineers and computer scientists have led to the development and validation of physical and computer-based approaches (including haptic technology, virtual reality systems, virtual worlds, e-learning and the "Imperial College Surgical Assessment device – ICSAD"; whose impact is still evident today in organisations around the world (1, 2). We were one of the first units to demonstrate that simulation can be used to create the 'pre-trained novice' by flattening the learning curve (2007) and pioneered the use of the simulated operating theatre (2010) and curricula design informing major educational programmes (3, 4). Safe clinical practice however requires more than just technical skill. Team working, leadership and communication are fundamental to patient care. We have pioneered innovative research bringing together the surgical and social sciences to define and understand these performance-shaping factors (2006-2013). Examples include the assessment of stress and communication within teams (2010), the scientific exploration of error-inducing conditions (2011) and growing recognition of the multimodal nature of teaching and learning (5). Recognised by the British Medical Journal (BMJ) Improving Health Award for Educational Excellence, we have led patient safety education by using our research to develop, implement and evaluate 'Lessons-Learnt' - the largest UK programme for patient safety- training over 1500 junior doctors and 300 senior doctors at a national level in the past three years (2010-2013) (6).

We have advanced the concept of high-fidelity simulation as a research tool for examining clinical care. In particular our research on sequential simulation has allowed extended pathways of care to be modelled and investigated, bringing together the experiences of patients, clinicians and managers. We have also developed Hybrid Simulation and Distributed Simulation as novel ways of making simulation more accessible and a holistic learning experience (3). This work has been integral to our widespread public and patient engagement work, attracting significant media attention and leading to innovative projects with the Science Museum, Wellcome Trust and at major national and international science festivals and conferences.

<http://news.bbc.co.uk/1/hi/health/8106128.stm>

Finally, on the request of the London Deanery, the RCSEd developed the Simulation and Technology-enhanced Learning Initiative (STeLI) to deliver world class healthcare education across London. Research has focused on Curriculum development, innovative approaches to skills training and assessment including virtual patients for e-learning (2009-2013). This initiative is the first of its kind in the UK and has trained 2100 seniors doctors and delivered over 45,000 simulation-based learning events to date.

3. References to the research (indicative maximum of six references)

- (1) Aggarwal, R., Ward, J., Balasundaram, I., Sains, P., Athanasiou, T., Darzi, A. (2007). Proving the effectiveness of virtual reality simulation for training in laparoscopic surgery. *Annals of Surgery*, 246 (5), 771-779. [DOI](#). Times cited: 118 (as at 7th November 2013 on ISI Web of Science). Journal Impact Factor: 6.32
- (2) Kassab, E., Kyaw Tun, J., Arora, S., King, D., Ahmed, K., Miskovic, D., Cope, A., Vadhvana, B., Bello, F., Sevdalis, N., Kneebone, R. (2011). "Blowing up the barriers" in surgical training: exploring and validating the concept of Distributed Simulation. *Annals of Surgery*, 254 (6), 1059-1065. [DOI](#). Times cited: 10 (as at 7th November 2013 on ISI Web of Science). Journal Impact Factor: 6.32
- (3) Miskovic, D., Ni, M., Wyles, S.M., Kennedy, R., Francis, N., Parvaiz, A., Cunningham, C., Rockall, T., Gudgeon, A., Coleman, M., Hanna, G. (2013). Is Competency Assessment at the Specialist Level Achievable? A Study for the National Training Programme in Laparoscopic Colorectal Surgery in England. *Annals of Surgery*, 257 (3), 476-482. [DOI](#). Times cited: 0 (as at 7th November 2013 on ISI Web of Science). Journal Impact Factor: 6.32
- (4) Arora, S., Ahmed, M., Paige, J., Nestel, D., Runnacles, J., Hull, L., Darzi, A., Sevdalis, N. (2012). Objective structured assessment of debriefing: bringing science to the art of debriefing in surgery. *Annals of Surgery*, 256 (6), 982-988. [DOI](#). Times cited: 4 (as at 7th November 2013 on ISI Web of Science). Journal Impact Factor: 6.32
- (5) Hull, L., Arora, S., Symons, N.R., Jalil, R., Darzi, A., Vincent, C., Sevdalis, N. (2013). Training faculty in nontechnical skill assessment: national guidelines on program requirements. *Annals of Surgery*, 258 (2), 370-375. [DOI](#). Times cited: 0 (as at 7th November 2013 on ISI Web of Science). Journal Impact Factor: 6.32
- (6) Ahmed, M., Arora, S., Baker, P., Vincent, C., Sevdalis, N. (2012). Case-based learning for patient safety: the Lessons Learnt program for UK junior doctors. *World J Surg*, 36 (5), 956-958. [DOI](#). Times cited: 2 (as at 7th November 2013 on ISI Web of Science). Journal Impact Factor: 2.22

4. Details of the impact (indicative maximum 750 words)

Impacts include: health and welfare, practitioners and services

Main beneficiaries include: NHS, medical students, clinical staff, Department of Health, London Deanery, Royal College of Surgeons, Government, WHO

As a world leader in clinical educational research, the Division of Surgery at Imperial has influenced healthcare education and training so as to build a safer workforce able to deliver the highest quality of care to every patient.

At the policy level, Professor Lord Darzi's role in NHS reform and global health has provided unique opportunities for our research to respond to and to shape contemporary thinking. The underpinning research and academics in the RCSEr contributed to recommendations in the Next Stage Review (2009), "A High Quality Work Force", highlighting that all clinical staff must have the opportunity to learn and update their skills with modern educational techniques encompassing simulation [1; page 42]. Based upon our research outputs, the Department of Health also produced a strategy for innovative approaches to healthcare education emphasising the role of simulation and other training technologies developed through our work [2, 3]. The importance of innovative approaches to clinical skills training developed by RCSEr was also highlighted in the London Deanery Strategic Business Plan 2008-2011 [2]. In addition to the substantial evidence from Imperial, a recent Cochrane review has supported simulation as a supplement to surgical training. A key achievement is the inclusion of simulation in the Intercollegiate Surgical Curriculum Programme (ISCP) with the attainment of the MRCS and FRCS now requiring completion of simulated scenarios [3; page 31].

At a local and national level, curricula have been restructured to be systems-based and vertically integrated at both under and postgraduate level. New technologies encompassing virtual environments and e-learning have been integrated into these curricula. A close collaboration with the Royal College of Surgeons, confirmed by a Memorandum of Understanding, has enabled our research to make a direct impact on the changing nature of surgical training. The development of a UK-wide team-training programme founded upon national consensus guidelines developed at RCSEr (2013) is an exemplar of our research translating into better training for better care [4].

This importance of human factors training, pioneered by RCSEr, was highlighted in the CMO's report on Safer Medical Practice [5]. Our research has directly addressed this by producing national consensus guidelines for such training [4] and using them to train over 400 multidisciplinary healthcare professionals across London (in addition to the 1800 doctors identified above in our patient safety training programme). This work has been highlighted by the Economic and Social Research Council as an exemplar case-study for high quality research and contributed to their strategic plan for the next 5 years [6]. Furthermore, the London Handbook of Debriefing has been rolled out across all simulation centres in London and the National Simulation programme in Australia, building global capacity for simulation-based training and leading to adoption of best practices [7].

Internationally, our researchers have been invited to form part of the Education and Training group of the World Health Organisation (WHO) Patient Safety where they have used their research on curricula design and knowledge of patient safety training to develop 'WHO Patient Safety Research: A guide for developing training programmes'. This is being used by international audiences to build capacity and capability in patient safety research [8].

Educational activity

Our research has led to the development and implementation of influential training programmes:

- a) *Regional*: The London Deanery Training Programme (LDTP), led by Professor Hanna, has established simulation-based training for all surgical trainees within the London region (accounting for over 50% of all the surgical trainees in England). The LDTP brings together many strands of our educational research (including objective skills assessment, Hybrid and Distributed Simulation, e-learning and simulator-based skills training).
- b) *National*: Laparoscopic Colorectal programme (LapCo) was established following the 2006 NICE Guidance (<http://www.nice.org.uk/TA105>). LapCo has trained over 200 Colorectal Consultants in England in laparoscopic colorectal surgery, providing education within a framework of objective assessment and analysis. It has also informed the introduction of revalidation by the GMC and led to an increase in laparoscopic colorectal resections from <5% in 2006 to 40% in 2012 [9]

- c) As an Accredited Educational Institute, we have worked closely with the American College of Surgeons. Our research has regularly featured in their bulletins, press releases and won an international award at their 95th clinical congress for Excellence in Research in the field of Surgical Education and conferences highlighting the influence of our research
- d) *Human Factors/Non-technical skills*. We have led the research, integration and adoption of novel educational concepts from music and sports into the healthcare sector, including mental practice and deliberate practice. For example, the robotic-assisted endovascular surgery team at St Mary's Hospital regularly undertake full patient-specific rehearsal to improve operative performance and ultimately patient outcomes. We have also run human factors training programmes (2010-2013) using our research to train over 400 multi-disciplinary healthcare professionals in teamworking to achieve the adoption of best practices in patient care [4]
- e) *Technical Skills*: RCSER has pioneered the use of motion analysis for the assessment of manual dexterity in surgery through the validated Imperial College Surgical Assessment Device – ICSAD. ICSAD has been licensed for use at several centres throughout the world (University of Toronto, University of Western Ontario, Western Pennsylvania Hospital, Delft University, University of Leuven, Glostrup University Hospital, and University of Hong Kong) and has contributed to the establishment and routine use of objective measures of technical dexterity.

5. Sources to corroborate the impact (indicative maximum of 10 references)

- [1] NHS Next Stage Review 2009: A High Quality Workforce, Department of Health, p42
http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_085841.pdf. Archived on 7th November 2013.
- [2] [London Deanery Strategic Business Plan](#) 2008-2011. Archived on 7th November 2013.
- [3] MRCS examination guide:
<http://www.med.nus.edu.sg/dgms/announcement%5Cmmed%5Csurgery%5CGuide%20to%20the%20intercollegiate%20MRCS%20examination%20-Singapore%202012.pdf>. Archived on 7th November 2013.
- [4] Hull, L., Arora, S., Symons, N.R., Jalil, R., Darzi, A., Vincent, C., Sevdalis, N. (2013). Training faculty in nontechnical skill assessment: national guidelines on program requirements. *Annals of Surgery*, 258 (2), 370-375. [DOI](#)
- [5] 150 years of the Annual Report of the Chief Medical Officer: On the state of public health 2008. Chief Medical Officer 2009.
http://webarchive.nationalarchives.gov.uk/+www.dh.gov.uk/en/publicationsandstatistics/publications/annualreports/dh_096206. Archived on 7th November 2013.
- [6] ESRC Strategic Plan 2009-2014: Delivering Impact through social science
<http://www.esrc.ac.uk/strategicplan/>. Archived on 7th November 2013.
- [7] London handbook for debriefing: http://www1.imperial.ac.uk/resources/EE125DD5-63D9-48AB-8A77-F2951610CD83/lw2222ic_debrief_book_a5.pdf. Archived on 7th November 2013.
- [8] WHO Patient Safety Research: A guide for developing training programmes. WHO Patient Safety 2012. http://www.who.int/patientsafety/research/strengthening_capacity/guide_developing-training-programmes/en/index.html. Archived on 7th November 2013.
- [9] National Training Programme for Laparoscopic Colorectal Surgery (LapCo)
<http://www.lapco.nhs.uk/>. Archived on 7th November 2013.