Institution: University of Aberdeen

Unit of Assessment: 4 - Psychology, Psychiatry and Neuroscience

Title of case study: Making surgery safer: non-technical skills of anaesthetists, surgeons and scrub nurses

1. Summary of the impact

Non-technical aspects of clinicians' performance, including cognitive errors and lack of teamwork, are a common cause of adverse events for patients. A series of studies at the University of Aberdeen identified the non-technical skills of operating theatre staff, and developed behavioural rating systems for their evaluation. The resulting skills frameworks for anaesthetists (ANTS), surgeons (NOTSS) and scrub practitioners (SPLINTS) have been adopted and implemented by these professional groups, across the UK and elsewhere in the world.

The resulting impact has been on healthcare professional standards, guidelines and training. Practitioners have used these research findings and tools in the conduct of their work.

2. Underpinning research

Adverse events for patients – where they are in some way damaged during or as a result of healthcare – are clearly situations which hospitals seek to minimise and eradicate. Failures in clinicians' non-technical skills (such as situation awareness, decision making, leadership and teamwork) resulting in human errors are a common cause of such events. Recent concern in the UK and the USA about unacceptable rates of surgical 'never events' demonstrates that the operating theatre remains a particularly susceptible domain for this type of problem.

As has been demonstrated in high-risk industries such as aviation, once the required skills to minimise human error have been identified, they can be improved through structured training and competence assessment programmes. Formative or summative assessments of such skills can be made by observing behaviours of individual practitioners at work (in simulation or situ). Prior to the University of Aberdeen work, no skill frameworks or assessment tools for this purpose were available for healthcare professionals – this research was designed to address that deficit.

Professor Rhona Flin, Chair of Applied Psychology at the University of Aberdeen since 1996, was the Principal Investigator for three project teams based at the University's School of Psychology, identifying non-technical skills of operating theatre staff and designing behavioural rating systems for their evaluation. The research method that underpins this impact case was based on her earlier work with European airline pilots, followed by a set of multidisciplinary research studies, using task analyses, conducted at the University of Aberdeen (1999 - 2012). These projects developed three skills frameworks with behaviour rating tools – Anaesthetists' Non-Technical Skills System (ANTS) [3.1, 3.2], Non-Technical Skills for Surgeons (NOTSS) [3.3, 3.4, 3.5], and Scrub Practitioners' List of Intra-operative Non-Technical Skills (SPLINTS) [3.6].

The research involved close collaboration with consultant anaesthetists, surgeons and scrub nurses from hospitals across Glasgow, Aberdeen, Dundee, Inverness and Edinburgh. For each project, an industrial psychologist was employed as the Research Fellow: Dr Georgina Fletcher on the ANTS project (1999-2003), Dr Steven Yule on the NOTSS project (2004-2008), and Dr Lucy Mitchell on the SPLINTS project (2008-2012).

In each project, the aim was to identify the key non-technical skills for an individual practitioner while he or she was working within a clinical team during the intra-operative phase of anaesthesia and surgery. The research methods used to identify the skill set included literature reviews [3.3], questionnaire surveys [3.2], observations of staff conducting anaesthesia or surgery, critical incident interviews with subject matter experts (consultant anaesthetists, surgeons and senior scrub nurses), and accident analyses. Refinement of the resulting data into structured skill frameworks with behavioural markers were produced from interviews and focus groups with subject matter experts, conducted in six hospitals across Scotland [3.4]. The skill sets and associated behavioural rating systems were then tested by producing videotaped re-enactments of anaesthetic and surgical procedures which were shown to panels of practitioners who used the

prototype rating tools to score observations of practitioners' cognitive and teamwork skills. Psychometric properties were found to be sufficiently robust [3.1, 3.5, 3.6] to justify usability testing before releasing the tools.

3. References to the research

[3.1] Fletcher, G, Flin, R, McGeorge, P, Glavin, R, Maran, N, & Patey, R. (2003). Anaesthetists' Non-Technical Skills (ANTS): Evaluation of a behavioural marker system. *British Journal of Anaesthesia,* 90 (5), 580 - 588. *Reports the evaluation study for the ANTS tool. Cited 221 times, by clinicians using the tool or research studies e.g. in clinical simulators, or by clinicians using the same method to develop similar tools for other specialties.*

[3.2] Flin, R, Fletcher, G, McGeorge, P, Sutherland, A & Patey, R. (2003) Anaesthetists' attitudes to teamwork and safety. *Anaesthesia,* 58, 233-242. *This survey was part of the initial task analysis for ANTS. Cited 62 times.*

[3.3] Yule, S, Flin, R, Maran, N & Paterson-Brown, S. (2006). Non-technical skills for surgeons in the operating room: A review of the literature. *Surgery,* 139, 140-149. *The initial examination of the role of non-technical skills in surgical performance. Cited 156 times.*

[3.4] Yule, S, Flin, R, Paterson-Brown, S, & Maran, N. (2006). Development of a rating system for surgeons' non-technical skills. *Medical Education,* 40, 1089-1044. *The development process for the first tool to rate individual surgeons' non-technical skills (NOTSS). Cited 96 times*.

[3.5] Yule, S, Flin, R, Maran, N, Rowley, D R, Youngson, G & Paterson-Brown, S. (2008). Surgeons' non-technical skills in the operating room: Reliability testing of the NOTSS behaviour rating system. *World Journal of Surgery, 32*, 548-556. *The evaluation study for the surgical behaviour rating tool. Cited 70 times.*

[3.6] Mitchell, L, Flin, R, Mitchell, J, Coutts, K. & Youngson, G. (2012). Evaluation of the Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system. *International Journal of Nursing Studies, 49,* 201-211. *Reports the evaluation of the newest tool, for scrub practitioners.*

Key Research Grants

- Amalberti et al 1998-2000, €750,000, EC DGVII 'JARTEL' project (Flin (AU) partner of NLR, DLR, IMASSA, British Airways, Alitalia, DERA, SOFREAVIA). This was an aviation psychology research project (Framework 4) evaluating a non-technical skills framework and rating system (NOTECHS) for European airline pilots.
- Flin, Glavin, Maran. Anaesthetists' Non-Clinical Skills. Scottish Council for Postgraduate Medical and Dental Education. £156,090. 1999-2003.
- Flin, Paterson-Brown, Rowley & Maran. Surgeons' Non-Technical Skills. Royal College of Surgeons Edinburgh / NHS Education Scotland (NES). £124,000. 2003-2006.
- Flin, Yule & Paterson- Brown. Non-Technical Skills for Surgeons. Royal College of Surgeons Edinburgh. £46,000. 2006-2007.
- Flin & Mitchell. Non-Technical Skills for Scrub Nurses. NES. £84,000 2007-2009
- Flin**,** Davies, Davey et al. Scottish Patient Safety Research Network. Scottish Funding Council/Universities of Aberdeen, Dundee and St Andrews. *Strategic Research Development Grant*. £1.5M. 2007-2012. One work package, based at the University of Aberdeen, was devoted to non-technical skills research.

4. Details of the impact

This research has provided new training and assessment tools designed to raise awareness of human factors in patient safety and to enhance the non-technical skills of clinical practitioners working in the operating theatre. These tools have been adopted by surgical and anaesthetic professional bodies in the UK and beyond, influencing medical education, clinical guidelines and

professional standards and training.

Since 2008, the Royal College of Surgeons Edinburgh (RCSEd) [5.1] has delivered (with input from University of Aberdeen psychologists), a programme of courses on surgeons' non-technical skills using the NOTSS system. These are: Training the trainers online training programme (NOTSS in a box); NOTSS Masterclass since 2009 (high-level skills course with international delegate list, 110 trained to date); International NOTSS workshops (e.g. Melbourne, Philadelphia, Budapest, Ottawa, Lisbon, Tokyo ,Kuwait – approx. 120 trained to date; workshops for Macau and Hong Kong later in 2013); with an e-learning module for surgical trainees. Safer Operative Surgery (SOS) courses held across NHS institutions since 2007 were delivered by the NOTSS faculty of the University of Aberdeen and RCSEd. (120 delegates). These also use the ANTS and SPLINTS tools. [5.1]

The Intercollegiate Surgical Curriculum Project (ISCP) [5.2] decided to adopt the NOTSS system for assessment of all surgeons in training in the UK in 2012. In the USA, SCORE (Surgical Council on Resident Education) decided (June 2013) to incorporate NOTSS in their curriculum for the next academic year as a method of teaching and assessing senior residents. This means that practically every surgical resident in the US will spend December 2013 on two NOTSS modules (cognitive skills, social skills). The American College of Surgeons included a whole day training workshop on NOTSS at the 2013 congress (Washington, October), led by a Harvard surgeon [5.3]. The Royal College of Surgeons England training course 'Patient Safety in Theatre Teams', which began in 2012, uses the ANTS, NOTSS and SPLINTS tools as core elements of the course. [5.4]

The Royal Australasian College of Surgeons, adopted the NOTSS system in 2008 as part of their competence framework for surgeons (Professional Standards Document). This is included in their updated 2011 /12 version and they have developed a Faculty of surgeons who are running NOTSS training courses, with 12 courses scheduled for 2012/13. To date 20 faculty have been trained to teach this course, with 340 attending. The Australian and New Zealand College of Anaesthetists is developing a similar 'professionalism guide' and is intending to use ANTS as part of it (Dr Graham, ANZCA, personal communication June 2013).

The Royal College of Anaesthetists in London began using ANTS in its Certificate of Competence in training (CCT) in 2007, also in later editions. [5.5] In 2011, it issued advice that ANTS could be used as part of a retraining package for staff returning to work after maternity leave. The May 2011 council meeting of the Royal College of Anaesthetists referenced the research by discussing the merits of attaching the correct importance to anaesthetic non-technical skills in arranging Specialty Trainee year 3 appointments (ST3). [5.5] ANTS is used to build a new method of assessment in the selection of anaesthetic trainees in South West England. [5.5]

The ANTS framework was incorporated into the UK National Advanced and Immediate Life Support Courses validated by the Resuscitation Council (UK) in 2011. [5.6] These courses are taught to every medical graduate in the UK and many other senior clinicians (e.g. nursing, dentists). The European Board and Section of Anaesthesiology under the European Union of Medical Specialists (Union Européanne des Médicins Spécialistes) specified ANTS as a 'part of the core competencies for postgraduate training in anaesthesiology in 2011. [5.8]
Training in the use of the tools has been devised for surgeons (see above), anaesthetists and scrub practitioners, with workshops run since 2008 in the USA, Australia, New Zealand, Japan, Malaysia, Denmark, Austria, Canada, Hungary and Spain. The tools have received international recognition and the frameworks are now being adopted in other countries (NOTSS translated into Japanese and Danish; ANTS into Korean, Japanese, German, Danish, SPLINTS into Japanese). The ANTS tool was made freely available from the start, and the NOTSS and SPLINTS tools are available on request via the tool website. Since October 2012, over 80 requests from scrub practitioners for SPLINTS have been received from China, Denmark [5.9], Australia, Canada, Sweden, New Zealand, India, Korea, USA, Latvia, Germany, Italy, Switzerland [5.10], Hong Kong, Iran, Malaysia and Thailand, as well as the UK.

A book of collected papers from the first specialist meeting to discuss the measurement of non-technical skills in the operating theatre, (attended by psychologists, surgeons, nurses and

anaesthetists) was Highly Commended in the surgery category of the British Medical Association Book of the Year 2010. This knowledge transfer event was established by the Aberdeen research team as an annual event, and the Karolinska Institute in Stockholm hosted it in 2013.

The development method and design framework have been adopted by other clinical specialities, such as emergency physicians (Flowerdew, *Annals of Emergency Medicine*, 2012), who have used it to develop similar tools for their professions.

Therefore the impact, as defined by REF, was in professional practice, standards, assessment methods and training; decisions by professional bodies have been influenced by this research into non-technical skills and professionals and practitioners have used the research findings in conducting their work.

5. Sources to corroborate the impact

[5.1] The Royal College of Surgeons in Edinburgh is using the NOTSS system, including on their Safer Operative Surgery Courses. http://www.rcsed.ac.uk/education/patient-safety-and-notss.aspx http://www.rcsed.ac.uk/education/patient-safety-and-notss/safer-operative-surgery-(sos).aspx

[5.2] Intercollegiate Surgical Curriculum Project link to 'NOTSS-in-a-box' www.iscp.ac.uk/dashboard (password required, screen shot available) and testimonial from Patient Safety Board member/Past Vice-President of the Royal College of Surgeons of Edinburgh.

[5.3] American College of Surgeons - workshop on NOTSS http://tinyurl.com/NOTSS-ACS-2013 and Testimonial from Programme Director of General Surgery Residency of a Boston Hospital, Harvard Medical School.

[5.4] Royal College of Surgeons England - www.rcseng.ac.uk/courses/course-search/patient-safety-in-theatre-teams. This course uses the NOTSS, ANTS and SPLINTS tools as part of training (Prof Baxendale, course tutor personal communication January 2013).

[5.5] Royal College of Anaesthetists - e.g. *CCT in Anaesthetics 2010* Ed 2 version 1.4 chapter 5/ appendix 7; RCA *Teaching and Training in the Workplace.* 2011, p10. www.rcoa.ac.uk Accessed 26.8.13; Gale et al (2010), BJA, 105.

[5.6] Resuscitation Council (UK) Advanced Life Support Manual 6th Edition & Resuscitation Council (UK) *Immediate Life Support Manual 3rd Edition – 2011* available for purchase from http://www.resus.org.uk/pages/public.htm. "'To improve the situation the Anaesthetists Non-Technical Skills (ANTS) system was developed. The principles used to promote good non-technical skills in the ILS course are based on the principles of ANTS" (page 1).

[5.7] Royal Australasian College of Surgeons (2008, 2012) *Surgical Competence and Performance: A Guide by the Royal Australasian College of Surgeons*. Department of Professional Standards. Melbourne: RACS. NOTSS training courses: http://www.surgeons.org/for-health-professionals/register-courses-events/professional-development/non-technical-skills-for-surgeons/

[5.8] European Union of Medical Specialists http://www.eba-uems.eu/resources/PDFS/ANAESTHESIOLOGY-PGT-guidelines.pdf (This document shows the use of ANTS in postgraduate training.)

[5.9] Translation and adaptation of NOTSS for use with surgeons in Denmark (NOTSSDk). Spanager L, et al (2012). Customization of a tool to assess Danish surgeons´ non-technical skills in the operating room. *Danish Medical Journal* 59, 1, A4526.

[5.10] Study by Swiss anaesthetists using the ANTS tool**.** Riem N, et al (2012) Do technical skills correlate with non-technical skills in crisis resource management. *B. J. Anaesthesia,* 109, 5, 723-8.