

## Development of the NOTSS (Non-Technical Skills for Surgeons) behaviour rating system

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Non-technical skills are defined as “Behavioural aspects of performance in the operating theatre which underpin medical expertise, use of equipment and drugs”. They are the cognitive and interpersonal skills which underpin clinical and technical skills and are requirements for a competent surgeon<sup>1</sup>. The NOTSS system was developed and tested under funding from the Royal College of Surgeons of Edinburgh and NHS Education for Scotland, from 2003-2007. The project was run by the University of Aberdeen, with a steering group of surgeons, psychologists and an anaesthetist. The research drew on previous work in Scotland on surgical competence, professionalism, and the skills surgeons required to operate safely<sup>1,2</sup> and followed on from a similar project which developed a behaviour rating system for anaesthetists – the ANTS (Anaesthetists' Non-Technical Skills) system<sup>3</sup>. The aim of the NOTSS project was to develop and test an educational system for assessment and training based on observed skills in the intraoperative phase of surgery. The system was developed from the bottom up with subject matter experts (consultant surgeons), instead of adapting existing frameworks used in other industries. We thought it was important to understand the unique aspects of non-technical skills in surgery, and not to assume that the non-technical skills identified for pilots, nuclear power controllers or anaesthetists would be exactly mirrored in surgeons. The NOTSS system is in surgical language for suitably trained surgeons to observe, rate and feedback on non-technical skills in a structured manner. A model of systems design (adapted from Gordon, 1993<sup>4</sup>, see figure 1) was used to guide the design of the system. The three phases in the model relate to the three objectives set by the NOTSS steering group in 2003: to identify the relevant non-technical skills required by surgeons, to develop a system to allow surgeons to rate these skills, and to test the system for reliability and usability.

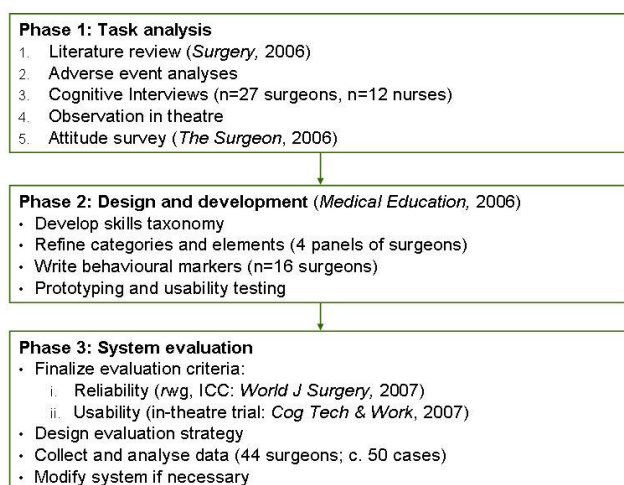


Figure 1. Model of NOTSS system development, showing where the research has been published

In Phase 1 we used task analysis to identify the relevant skills. Methods used included field notes of observation sessions in the operating theatre, analysis of surgical mortality reports, a literature review<sup>5</sup>, attitude survey of operating theatre personnel<sup>6</sup>, and cognitive interviews with subject matter experts<sup>7</sup>. This generated a list of 150 non-technical skills. In phase 2, four independent groups of consultant surgeons used an iterative process to develop a skills taxonomy<sup>7</sup> from these skills which formed the basis of the system. The NOTSS system follows the same hierarchical structure of categories, elements, and behaviours as behaviour rating systems in other professions such as the ANTS (anaesthetists) and NOTECHS<sup>8</sup>, which is used to assess pilots' non-technical skills by several European airlines. Exemplar good and poor behaviours were written by a further n=16 consultant surgeons to complete the prototype system. The NOTSS skills taxonomy (see table 1) was revised after psychometric evaluation of the prototype system in phase 3, where n=44 surgeons rated standardized video scenarios of surgeons' behaviours in the operating theatre<sup>9</sup>. The skills taxonomy comprises two cognitive skills (Situation Awareness and Decision Making<sup>10</sup>) and two interpersonal skills (Communication & Teamwork and Leadership), broken down into constituent elements.

**Table 1. NOTSS skills taxonomy v1.2**

<b>Category</b>	<b>Element</b>
Situation Awareness	Gathering information Understanding information Projecting and anticipating future state
Decision Making	Considering options Selecting and communicating option Implementing and reviewing decisions
Communication and Teamwork	Exchanging information Establishing a shared understanding Co-ordinating team
Leadership	Setting and maintaining standards Supporting others Coping with pressure

A user handbook was then written which included advice for using NOTSS, definitions and behavioural examples of the NOTSS categories and elements, and a set of rating forms for users. An initial usability trial in which the system was used to observe skills and debrief trainees after 43 operations revealed that observing and rating non-technical skills was feasible for surgeons and that the system was viewed as a positive adjunct to available methods for assessing trainees<sup>11</sup>. A controlled trial of the system is currently underway at three hospitals in Scotland, and the system is also being used by other groups in Australasia, Europe and North America. Further information is available from Royal College of Surgeons of Edinburgh Patient Safety Board: [www.patientsafetyboard.org](http://www.patientsafetyboard.org) or from the University of Aberdeen NOTSS website: [www.abdn.ac.uk/iprc/notss](http://www.abdn.ac.uk/iprc/notss) where you will also be able to request a handbook.

**References**

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