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Non-technical skills for anaesthetists, surgeons and scrub practitioners (ANTS, NOTSS and SPLINTS)

Rhona Flin, PhD

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Introduction

The term 'non-technical skills' (also called Crew Resource Management skills) came from the European aviation regulator in the 1990s, in relation to individual airline pilots' skills. This concept is now used to underpin training and workplace-based assessment in a number of safety-critical occupations,[1-3] including healthcare. Non-technical skills can be defined as 'the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance'.[4]

The following non-technical skills are typically required in clinical settings:

- situational awareness
- decision making/problem solving
- leadership
- teamwork
- communication
- managing stress and fatigue.

The precise set of non-technical skills for a given occupation needs to be customised for the clinical tasks, workplace conditions and the organisational/professional culture. A more detailed description of the psychological background to the main non-technical skill categories can be found in Flin et al (2008).[4]

Non-technical skills are protective against human fallibilities and consequent adverse events. They are not new or mysterious behaviours. In fact, they represent what the safest and most efficient workers do on a consistent basis and the rest of us do 'on a good day'. They help to reduce errors, increase the capture of errors and can aid an effective response when an operational problem occurs. For instance, deficiencies in non-technical skills (not thinking ahead, not following procedures, not speaking up when concerned about risks) can increase the chance of human error, which in turn can increase the chance of injury for a patient (eg wrong site surgery) or staff member (eg needle stick). Good non-technical skills (eg high vigilance, effective communication, leaders listening to team members' concerns) can reduce the likelihood of error and so decrease the chance of a patient or clinician being involved in an adverse event.

In contrast to the focus on non-technical skills in industries such as aviation, little attention had traditionally been paid to the behavioural components of safe clinical practice. Anaesthesiologists were among the first to adapt the aviation Crew Resource Management approach for training non-technical skills.[5] By 2000, fostered by the growth of the clinical simulation community, it was recognised that for training and evaluation, there was a need for methods of measuring individual non-technical skills, such as decision-making or teamwork. (See Sevdalis 2013 HF/BMJ for a description of tools for rating the non-technical skills of whole teams.[6])

In this article, a brief overview is given of three non-technical skills frameworks developed for training and evaluating the performance of clinical practitioners. These are: Anaesthetists' non-technical skills (ANTS); Non-technical skills for surgeons (NOTSS); and Scrub practitioners' intraoperative non-technical skills (SPINTS).

Anaesthetists' non-technical skills (ANTS)

To identify the non-technical skills for a given job or task, various forms of task analysis can be used.[7] Interviews and surveys of experienced practitioners, incident investigations, as well as observations of work during routine tasks or emergencies, can reveal which workplace behaviours (non-technical skills) are associated with safe practice and the avoidance of adverse events.

A team of anaesthetists and psychologists designed the Anaesthetists' Non-Technical Skills (ANTS) System using methods of task analysis. The skill set for ANTS was derived from data on anaesthetists' behaviour gathered from a literature review, observations, interviews, surveys and incident analysis.[8-10] The rating tool was formulated to meet a set of design criteria, such as suitability for practical use in the operating theatre or a simulation setting.

The ANTS skills framework (Figure 1) has four categories: Situation awareness, Decision making, Task management, and Team working. Component elements and examples of good and poor behaviour are included for each element. Managing stress and coping with fatigue are not explicit categories, as they can be difficult to detect unless extreme; moreover, they influence other behaviours which can be rated. Leadership is incorporated into the Team working category, as there are times when the anaesthetist may lead the theatre team.

Figure 1: The Anaesthetists' Non-Technical Skills (ANTS) System
(adapted from ANTS Handbook, University of Aberdeen, www.abdn.ac.uk/iprc/ANTS)

Categories	Elements
Task Management	– Planning and preparing – Prioritising – Providing and maintaining standards – Identifying and utilising resources
Team Working	– Co-ordinating activities with team members – Exchanging information – Using authority and assertiveness – Assessing capabilities – Supporting others
Situation Awareness	– Gathering information – Recognising and understanding – Anticipating
Decision Making	– Identifying options – Balancing risks and selecting options – Re-evaluating

E.g. Behavioural markers for good practice

- Confirms roles and responsibilities of team members
- Discusses case with surgeons or colleagues
- Considers requirements of others before acting
- Co-operates with others to achieve goals

E.g. Behavioural markers for poor practice

- Does not co-ordinate with surgeon(s) and other groups
- Relies too much on familiarity of team for getting things done – makes assumptions, takes things for granted
- Intervenes without informing/ involving others
- Does not involve team in tasks

Figure 2: ANTS System Rating Options
(adapted from ANTS Handbook, University of Aberdeen, www.abdn.ac.uk/iprc/ANTS)

Rating Label	Description
4 - Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
3 - Acceptable	Performance was of a satisfactory standard but could be improved
2 – Marginal	Performance indicated cause for concern, considerable improvement is needed
1 – Poor	Performance endangered or potentially endangered patient safety, serious remediation is required
Not observed	Skill could not be observed in this scenario

In addition to the ANTS skills framework, a behaviour rating scale was devised which is printed on a single page for ease of use. It has a set of four point rating scales (see Figure 2) for rating observed behaviours in relation to the elements and categories, with space to write brief comments. It should be noted that the descriptors for the points on the rating scale are not just performance levels; they emphasise their relevance for patient safety. The ANTS ratings are made where anaesthesia is being delivered, normally in the operating department (or in simulator facilities). The tool is designed to be used by experienced anaesthetists to rate the non-technical skills of another anaesthetist who has achieved basic technical competence.

An evaluation of the ANTS behaviour rating method was undertaken with 50 consultant anaesthetists,[11] followed by a usability study.[12] A handbook was produced to help anaesthetists use the system in practice, to assess non-technical performance *in situ*. On the rating form, the space provided to record notes for each behavioural element helps the trainer/assessor to give structured feedback, as well as the performance scores, at the conclusion of the procedure. The system was released by the University of Aberdeen in 2004 and made available free of charge via the ANTS website to anaesthetists for non-commercial use. ANTS has now been translated into a number of languages and is being used in both simulation and in-theatre settings.[13] For a copy of the rating tool, detailed reports and papers, see online at www.abdn.ac.uk/iprc/ants/

Non-technical skills for surgeons (NOTSS)

The tool for surgeons' non-technical skills in the intra-operative setting (NOTSS) was developed using very similar methods of task analysis to identify key behaviours and system design to produce a rating form and guidance booklet.[14-18] The basic framework is shown in Figure 3.

Figure 3: NOTSS skills taxonomy v1.2
(adapted from NOTSS Handbook, available from University of Aberdeen www.abdn.ac.uk/iprc/NOTSS)

Category	Element
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 activities
Leadership	– Setting and maintaining standards – Supporting others – Coping with pressure

The NOTSS handbook is available online at www.abdn.ac.uk/iprc/notss/

The NOTSS system has been translated into other languages (eg Japanese) and has been widely adopted by surgeons. In some countries (eg Australia) it has now been incorporated into the professional standards for surgeons. In the UK, e-learning packages are being developed to assist trainee surgeons in learning the required non-technical skills (Royal College of Surgeons, Edinburgh: see online at www.rcsed.ac.uk).

Scrub practitioners' intraoperative non-technical skills (SPINTS)

There was no behavioural rating system for scrub practitioners, so, to identify their essential non-technical skills, task analysis methods similar to those employed in the development of ANTS and NOTTS were used.[19,20] Evidence derived from interviews indicated the particular importance of situation awareness for scrub practitioners, since listening, watching, understanding and anticipating are key behaviours for effectively assisting the surgeon. Teamwork is important, including skills of sharing, clarifying and coordinating with the scrub and theatre team. Being organised and preparing for a case, and setting an example to others by maintaining high standards, are required skills for safe scrub practitioners. Panels of experienced scrub practitioners discussed and refined the skills list to produce the prototype SPLINTS taxonomy.[21] This contains three skill categories, each of which comprises three underlying elements and examples of good and poor behaviours, helping users of the SPLINTS system to make judgements on a scrub practitioner's performance (see Figure 4).

Figure 4: SPLINTS v 1.0 skill categories, elements and behavioural examples for good (√) and poor (×) performance (adapted from SPLINTS Handbook, University of Aberdeen, www.abdn.ac.uk/iprc/SPLINTS)

Category	Element	Behavioural examples
Situation awareness	Gathering information	√ watches surgical procedure × fixates on one task
	Recognising and understanding information	√ reacts to conversational cues exchanged between other team members × does not change own activity level when appropriate
	Anticipating	√ times requests appropriately × asks for items late
Communication and teamwork	Acting assertively	√ gives clear instructions/ requests to team members × fails or is slow to communicate requirements
	Exchanging information	√ uses non-verbal signals where appropriate × fails to articulate problems in a timely manner
	Co-ordinating with others	√ deals appropriately with interruptions from others × ignores requests of others
Task management	Planning and preparing	√ organises equipment × opens sterile equipment/ supplies indiscriminately
	Providing and maintaining standards	√ protects sterile field and instrumentation × fails to check equipment settings/ relies on others to do so
	Coping with pressure	√ does not rise to others' emotional outbursts × raises voice unnecessarily

The reliability and psychometric properties of the SPLINTS system were tested, and results indicated that it contained all the essential skills. Practitioners felt that it was a usable tool in the operating theatre.[22] The SPLINTS system aims to provide a structured framework and common terminology for discussing the non-technical skills which all good scrub practitioners possess and use on a day-to-day basis. Experienced scrub practitioners who have been involved with the project have indicated that SPLINTS will provide them with a training resource for an aspect of scrub practitioner performance that is sometimes difficult to teach.

SPLINTS is available, with related papers, online at www.abdn.ac.uk/iprc/splints/

Future developments

The ANTS, NOTSS and SPLINTS tools offer a training and evaluation framework for key members of a surgical team, providing a common language not only for training but also for discussing the non-technical issues that can influence the safety of patients. A non-technical skills approach has been recommended for the undergraduate training stage of the clinical professions.[23] Similar non-technical skills frameworks and behaviour rating tools are now being developed, at Aberdeen University and in other research centres, for a range of clinical roles, including anaesthetic nurses,[24,25] paramedics[26] and emergency physicians.[27]

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