

# LES COMPÉTENCES NON TECHNIQUES DES PRATICIENS EN SERVICE INTERNE : LE SYSTÈME SPLINTS

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## RÉSUMÉ :

Cet article présente l'ensemble des compétences non techniques, et l'outil d'évaluation du comportement, pour les praticiens/les infirmiers et les infirmières en service interne (p. ex. : les infirmières/les infirmiers en soins périopératoires; les techniciens en salle d'opération) connu sous le nom de Scrub Practitioners' List of Intraoperative Non-Technical Skills (Liste de compétences non techniques peropératoires pour les praticiens en service interne) ou le système SPLINTS. Le système SPLINTS a été élaboré au Centre de recherche en

psychologie industrielle de l'Université d'Aberdeen, en Écosse, par une équipe de recherche se composant de psychologues, d'infirmières en service interne et d'un chirurgien. Les détails du système ont été présentés par Rhona Flin lors de la Conférence nationale et internationale de l'AII SOC avec l'IFPN, à Ottawa, en avril 2013. Le présent article expose les grandes lignes du projet de recherche et la méthode utilisée pour développer le système SPLINTS en plus de suggérer la raison pour laquelle il pourrait être un outil de formation et d'évaluation précieux pour les praticiens en service interne au Canada.

Le système SPLINTS pour les praticiens en service interne a été financé par HHS Education Scotland et par une subvention pour le développement stratégique de la recherche du Conseil écossais de financement, décernée au Réseau de recherche écossais pour la sécurité du patient. Vous trouverez tous les détails concernant le système et les publications s'y rapportant à [www.abdn.ac.uk/iprc/splints](http://www.abdn.ac.uk/iprc/splints).

# NON-TECHNICAL SKILLS OF THE SCRUB PRACTITIONER: THE SPLINTS SYSTEM

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## ABSTRACT:

This article describes the non-technical skill set, and behavioural rating tool, for scrub practitioners/nurses (e.g. perioperative registered nurses; operating room technicians) known as the Scrub Practitioners' List of Intraoperative Non-Technical Skills or the SPLINTS system. The SPLINTS system was developed at the Industrial Psychology Research Centre of the University of Aberdeen, Scotland, by a research team comprising psychologists, scrub nurses, and a surgeon. Details of the system were presented, by Rhona Flin, at the ORNAC National and International Conference with IFPN, in Ottawa, in April of 2013. This article outlines the background of the research project and the method used to develop the SPLINTS system and suggests why it might be a valuable training and assessment tool for scrub practitioners in Canada.

## THE BACKGROUND:

Adverse events (AE) are iatrogenic (unintended) injuries or complications that are caused by the delivery of the patient's care rather than the underlying medical condition. The first study of adverse events in Canadian hospitals,<sup>1</sup> published in 2004, indicated that 7.5% of hospital patients suffered an adverse event and that for 51.4% of the AEs the service most responsible for the delivery of care

was surgery. A later systematic review reported that 41% of all adverse events occurred in the operating theatre.<sup>2</sup> A subset of AEs is called surgical 'never events' and they include such incidents as sponges and instruments being retained within patients<sup>3</sup> or wrong-site operations. It is estimated that, in the USA, there are over 4000 malpractice claims for surgical 'never events' each year.<sup>4</sup> A new report on surgical never events<sup>5</sup> identifies human factors as part of the cause. This can include failures of attention, lack of assertiveness, inadequate leadership, and poor communication among team members. These factors relate to what are now called non-technical skills. Non-technical skills are the cognitive and social skills that complement the technical skills in order to lead to safe and efficient task performance.<sup>6</sup> The term comes from European aviation skill categories and is also widely used in many higher risk occupations to describe generic non-technical skill categories such as the communication, teamwork, leadership, situational awareness and decision-making that are critical for safety.

The importance of non-technical skills training has long been recognised in the aviation industry but it is a relatively new area of research for healthcare. Airlines have, since the 1980s, incorporated non-technical skills training into their team training in the form of Crew Resource Management (CRM) programmes.<sup>7</sup> This step was the

result of the airline industry recognising, after retrospective incident analysis, that accidents or 'near-misses' usually occurred as a result of a combination of factors, rather than one isolated issue, and that one of the contributing factors was often human error or another human factor. The aviation industry, rather than blaming individuals, accepted that human error is inevitable and, to minimize risk, it now provides training in non-technical skills through CRM courses. Air Canada introduced CRM training for pilots in the 1990s.<sup>8</sup>

This CRM (non-technical skills) training involves teaching team members to understand that humans are fallible and that thinking and teamwork skills can sometimes be compromised – particularly in high pressure situations. An incident may result from an individual lacking a critical piece of information or becoming fixated on a peripheral issue rather than keeping an overall perspective of the full task at hand. CRM training is designed to minimize these instances by encouraging a positive culture that permits members of the team to communicate openly and by teaching the skills for effective teamwork including, for example, the ability to recognize that another team member is concentrating and know when they should, or should not, be interrupted. In recent years this type of CRM training has been introduced for operating theatre teams in Canada and in other country's healthcare systems.<sup>9</sup>

The SPLINTS system was developed at the Industrial Psychology Research Centre of the University of Aberdeen, Scotland, by a research team comprising psychologists, scrub nurses, and a surgeon.

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The main difference between providing training for non-technical skills in aviation as opposed to healthcare is that, in aviation, annual pilot licensing is only granted after passing both technical and non-technical skills examinations. In nursing/ medicine, there is not, as yet, any requirement for non-technical skills assessment in order to practice. These non-technical skills are not, in fact, explicitly taught in medical/nursing degree courses in Canada or the United Kingdom although this is beginning to change.<sup>10</sup> Non-technical skills would seem to be critical for staff in the operating theatre as this is where multi-disciplinary teams of different training backgrounds, with various levels of expertise, work together toward the same goal – safe surgery for the patient. Researchers in a number of countries are now recognizing this and have begun working with clinicians to develop assessment and training methods that could lead to improving patient safety.<sup>11</sup>

Behavioural rating systems have now been developed in order to rate an individual's non-technical (CRM) skills performance. A research team of psychologists and clinicians based at the University of Aberdeen has developed non-technical skills rating systems for anaesthetists (ANTS, [www.abdn.ac.uk/iprc/ants](http://www.abdn.ac.uk/iprc/ants)), anaesthetic assistants (ANTS-AP, [www.abdn.ac.uk/iprc/antsap](http://www.abdn.ac.uk/iprc/antsap)) and surgeons (NOTSS, [www.abdn.ac.uk/iprc/notss](http://www.abdn.ac.uk/iprc/notss)) and these systems are now being used by clinicians, to rate and train colleagues within their respective disciplines, in several countries.

The skill sets, or 'taxonomies', in the behavioural rating system, typically include a list of the most essential non-technical skills for the role that is being assessed and also provide behavioural markers in the form of examples of good and poor performance. The examples are provide guidance to the person who is going to be using the system to observe task performance, make ratings, and provide feedback. A numeric rating scale, and space for debriefing comments, are usually provided on the score form for recording the behavioural rating.

#### SPLINTS FOR THE SCRUB NURSE:

In 2007 the NHS Education for Scotland (NES) funded research into developing a similar rating system for the scrub practitioner and this funding resulted in the SPLINTS system project. A multi-disciplinary team of perioperative practitioners, psychologists, and a consultant surgeon began by reviewing the medical and psychological literature on scrub practitioner non-technical skills. Very little empirical research was found and this confirmed that this was a new topic of study as related to the scrub practitioner.<sup>12</sup> The review determined that, of the 424 papers originally identified, only 37 reported data collected in the operating theatre and only 13 of those papers had data pertaining to the non-technical skills of scrub practitioners. The non-technical skills of the scrub practitioner, as outlined in the literature, focused on communication, teamwork, and situation awareness (knowing what is going on around you).<sup>13, 14</sup> Although perceptual and anticipatory skills are critical for the scrub practitioner only one paper in the review had explicitly studied this. An Australian study referred to scrub practitioners possessing 'judicial wisdom' to assess the behaviour and actions of the theatre team by drawing on their personal expertise, combined with their technical knowledge of procedures, without the need to interrupt the surgeon.<sup>15</sup> There were 10 papers on communication in the review including a Canadian study on the development of a communication checklist to promote better team communication between disciplines.<sup>16</sup> Disruptions caused by information exchange about future patients, or other communications irrelevant to the patient currently undergoing surgery, were also discussed as a distraction for the nurses in theatre.<sup>17</sup>

The literature review provided no evidence of a behavioural rating system in use for scrub practitioners in any healthcare systems. In order to further investigate and identify the essential non-technical skills, specific to the role of scrub practitioner, semi-structured interviews were conducted with experienced scrub practitioners (n=25) from three Scottish hospitals. Consultant surgeons (n=9) from

four Scottish hospitals were also interviewed to gain a surgical perspective regarding which scrub practitioner behaviours make the surgical task easier or more difficult.<sup>18</sup> Interviewing ‘subject matter experts’ (SME) is a recognised method of task analysis and is used to identify the social (inter-personal) and cognitive (thinking) processes a worker uses to achieve task goals.<sup>19</sup> Sometimes it is difficult for experts to verbalise what they do in their jobs, as they believe that they perform automatically, so interview techniques have been developed to enable this tacit knowledge to emerge.

Further evidence was obtained, from these interviews, to support the

importance of situation awareness for scrub practitioners. Listening, watching, understanding and anticipating were all described as being critical skills required for the scrub practitioner to be able to effectively assist the surgeon. Teamwork was also mentioned and interviewees described the importance of the skills of sharing, clarifying, and coordinating with other members of the scrub and the wider theatre team. Being organised and preparing for a case, when there was time available, and setting an example to others by maintaining high standards were also stated as important to the scrub practitioners. Coping with stress, particularly when a procedure does not go according to the original plan, was

another critical skill that was mentioned. There were fewer mentions of the skills of leadership and decision-making although guiding a less experienced surgeon and making decisions surrounding which instruments to hand to the surgeon did emerge in the interviews.

Behavioural rating systems should be concise and focus on only the most critical skills so that they are not overly complex or time-consuming for the user. The SPLINTS system was prepared for use by scrub practitioners in theatre so, in order to generate a list of essential non-technical skills for the scrub practitioner, the data extracted from the literature review was combined with the

**Table 1: SPLINTS v 1.0 skill categories, elements and behavioural examples for good (✓) and poor (✗) performance**

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

data from the interview studies. Four panels of experienced scrub practitioners (Participant total, n=16) then discussed and refined the skill list to produce the prototype SPLINTS taxonomy.<sup>20</sup> This prototype contained three skill categories, each with three underlying elements, and the panels also provided examples of good and poor behaviours to assist users of the SPLINTS system in make judgements regarding a scrub practitioner's performance (see Table 1).

A handbook was also produced to help scrub practitioners use the system in practice and to assess non-technical performance in the operating theatre. Along with the skill categories, the underlying elements, and the behavioural examples, a rating scale was also created for the SPLINTS system to enable the user to make specific ratings of performance: 1 = poor; 2 = marginal; 3 = acceptable; 4 = good; NR = not required (for occasions where that skill was not necessary). There is also a section on the rating form, to allow the user to record notes for each behavioural element so that the trainer/assessor can, at the conclusion of the surgical procedure, provide performance scores as well as structured feedback to the scrub practitioner.

The next study in the SPLINTS project was conducted to test the reliability and sensitivity of the SPLINTS system.<sup>21</sup> This was important to ascertain whether the prototype system contained all the essential skills and elements necessary for safe and effective scrub practitioner performance and to test whether the SPLINTS system could be used reliably to rate the behaviour of scrub practitioners. This study recruited, on a volunteer basis, experienced (mean=17 years; SD=8.22; range 2-35 years) scrub practitioners (n=34) who each attended a session consisting of a 4-hour training and testing workshop covering background regarding human factors and non-technical skills in high-risk industries. The training also included instruction in and practice using the SPLINTS system to rate the performance of a scrub practitioner. This training used a 12 minute film of a simulated scenario, showing an operating theatre situation,

which was paused at various intervals to allow for discussion among participants. The researchers then tested the SPLINTS system by asking the participants to individually rate (without discussion) the performance of the scrub practitioner in the simulated scenarios (n=7). Each scenario showed a scrub practitioner dealing with a different, and realistic, intraoperative situation. Situations included, for example, discovering that a swab/sponge is missing from a count or organising equipment when a laparoscopic case has to be converted to an open procedure. The scenarios were designed to show the full range of behaviours that were to be scored using the four-point SPLINTS rating system.

Acceptable inter-rater agreement (rwg>.7) (22) was achieved between the raters. This was, given the short training time the participants received (4 hours), encouraging. Participants fell within one scale point of expert ratings in >90% of skill categories, and elements, and were able to use SPLINTS to rate performance with a reasonable level of accuracy. There was also good internal consistency in the system with absolute mean difference  $M < 0.2$  of a scale point for all three categories. Evaluation questionnaires were completed by participants and indicated that they felt the SPLINTS system contained all the essential skills and was a usable tool in the operating theatre. The project then underwent a final test of the usability of the SPLINTS system, in the real theatre setting, at four Scottish teaching hospitals. Volunteer scrub practitioners, in the roles of mentor, were asked to use the SPLINTS system to structure feedback for junior (less than 2 years' experience) scrub practitioners' performance on cases (n=20) over a four week period. Not all the participants managed, due to other work pressures, to

complete their observations and ratings. Questionnaires that were completed (n=8 mentors and 8 juniors) provided a preliminary indication that SPLINTS was usable in the operating theatre. This now needs to be tested more systematically by the practitioners who are trying out SPLINTS as a tool for training and assessing scrub practitioners' non-technical skills.

Details of this project and related papers can be found at [www.abdn.ac.uk/iprc/splints](http://www.abdn.ac.uk/iprc/splints). A new tool, A-ANTS, is now also being developed for the assessment of anaesthetic practitioners, such as nurses and Operating Department Practitioners (ODP), who assist the anaesthetist.<sup>23, 24</sup>

## CONCLUSION:

What the SPLINTS system aims to do is to provide a structured framework, and common terminology, for discussing non-technical skills that all good scrub practitioners possess and use on a daily basis. The experienced scrub practitioners, who were involved in the project, have all indicated that the SPLINTS system will provide them with a training resource for an aspect of scrub practitioner performance by identifying skill sets that are sometimes difficult to teach. It should also be noted that SPLINTS can be used to rate scrub practitioners of all experience levels, not just junior members of staff, and it can also be used for self-assessment. By developing the SPLINTS system, the Aberdeen project group has now produced a system that helps provide a common language for discussing non-technical issues that may emerge during the course of the busy working day in the multi-disciplinary operating theatre. The SPLINTS tool could be adapted for use by other healthcare facilities, including those

The SPLINTS system for scrub practitioners was funded by HHS Education Scotland and a Strategic Research Development Grant from the Scottish Funding Council, awarded to the Scottish Patient Safety Research Network.

Full details of the system, and supporting publications, can be found at [www.abdn.ac.uk/iprc/splints](http://www.abdn.ac.uk/iprc/splints).

in Canada, with testing to ensure that it is applicable to the behaviours typically found in those operating theatre environments.

ORNAC Standards pertaining to this article can be found in the Operating Room Nurses Association of Canada (ORNAC) (April 2013) Standards, Guidelines, and Position Statements for Perioperative Registered Nursing Practice (11th edition). Section I, Part A - ORNAC Scope of practice for Perioperative Registered Nurses statement 4, pg 19, Section I, Part A, pg(s) 28-31 and Section I Part B RNS 3.4.1 - 3.4.9 pages 40-41.

## REFERENCES:

- Baker R, Norton P. et al. The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. *Canadian Medical Association Journal* 2004; 170: 1678-1686.
- Devries, EN. et al. The incidence and nature of in-hospital adverse events: a systematic review. *Quality and Safety in Health Care* 2008; 19: 216-223.
- Gawande, AA. et al. Risk factors for retained instruments and sponges after surgery. *New England Journal of Medicine* 2003; 348: 229-235.
- Mehtsun, W. et al. Surgical never events in the United States. *Surgery* 2013; 153: 465- 472.
- NHS England Patient Safety Domain Standardise, Educate Harmonise. Commissioning the Conditions for Safer Surgery. Report of the NHS England Never Events Task force 2014; London: NHS England.
- Flin R, O'Connor P, Crichton M. Safety at the Sharp End. A Guide to Non-Technical Skills. Aldershot: Ashgate 2008.
- Kanki B, Helmreich R, Anca J. (Eds.) *Crew Resource Management*. San Diego, CA: Academic Press 2010.
- Dowd, N. Integrating CRM into an airlines culture: The Air Canada process. In B. Kanki, R. Helmreich & J. Anca (eds.) *Crew Resource Management* (2nd ed). 2010 San Diego, Academic Press.
- Gillespie B, Chaboyer W, Murray P. Enhancing communication in surgery through team training interventions: A systematic literature review. *AORN Journal* 2010; 92: 642-657.
- Flin R, Patey R. Editorial: Training in non-technical skills to improve patient safety. *British Medical Journal*. 2009; 339: 985-986.
- Flin R, Mitchell L. (Eds.) *Safer Surgery: Analysing Behaviour in the Operating Theatre*. Farnham: Ashgate. 2009.
- Mitchell L, Flin, R. Non-technical skills of the operating theatre scrub nurse: literature review. *Journal of Advanced Nursing*. 2008; 63: 15-24.
- Endsley, M. Toward a theory of situation awareness in dynamic systems. *Human Factors*. 1995; 37: 32-64.
- Royal College of Physicians and Surgeons of Canada. Situational awareness and patient safety. 2011; [www.royalcollege.ca/portal/page/portal/rc/common/documents/canmeds/resources/publications/situational\\_awareness\\_patient\\_safety\\_preview\\_e.pdf](http://www.royalcollege.ca/portal/page/portal/rc/common/documents/canmeds/resources/publications/situational_awareness_patient_safety_preview_e.pdf).
- Riley RG, Manias E. Governance in operating room nursing: Nurses' knowledge of individual surgeons. *Social Science and Medicine*. 2006; 62: 1541-1551.
- Lingard, L. et al. Getting teams to talk: Development and pilot implementation of a checklist to promote interprofessional communication in the OR. *Quality and Safety in Healthcare*. 2005; 14: 340-346.
- Sevdalis N, Healey AN, Vincent CA. Distracting communications in the operating theatre. *Journal of Evaluation in Clinical Practice*. 2007; 13: 390-394.
- Mitchell, L. et al. Thinking ahead of the surgeon: an interview study to identify scrub nurses' non-technical skills. *International Journal of Nursing Studies*. 2011; 48: 818-828.
- Stanton, NA. et al. *Human Factors Methods: A practical guide for engineering and design*. Aldershot: Ashgate 2005.
- Mitchell L. et al. Developing the Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system. *Journal of Evaluation in Clinical Practice*. 2013; 19: 317-323.
- Mitchell, L. et al. Evaluation of the Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system. *International Journal of Nursing Studies*. 2012; 49: 201-211.
- James LR, Demaree RG, Wolf G. Estimating within-group inter-rater reliability with and without response bias. *Journal of Applied Psychology*. 1984; 69: 85-98.
- Rutherford, J., Flin R & Mitchell, L. (2012) Anaesthetic assistants' non-technical skills. A literature review. *British Journal of Anaesthesia*, 109, 27-31.
- Rutherford, J., Flin, R. Mitchell, L. (2012) Attitudes to teamwork and safety in anaesthetic assistants. *British Journal of Anaesthesia*, 109, 21-26.