



THE ROYAL COLLEGE
OF SURGEONS OF
EDINBURGH

The Non-Technical Skills for Surgeons (NOTSS)

System Handbook v2.0

*Structuring observation, feedback and rating of
surgeons' behaviours in the operating theatre*



**Decision
Making**

**Communication
& Teamwork**

Leadership

**Situation
Awareness**

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Surgical competence relies on appropriate clinical knowledge, good technical ability and a high standard of non-technical skills (NTS). Until recently these NTS were poorly understood and therefore difficult to both teach and assess. However, as we will demonstrate in this handbook, these skills have been now been identified and play a major role in underpinning technical proficiency. In order to optimise surgical performance and extract the most benefit from tuition and learning, it is important that clinicians, both in training and career grades, make the most of their clinical experience. Feedback on strengths and weakness and self-reflection are more likely to be effective when there is a terminology or vocabulary that permits analysis of performance. The NOTSS tool described in this handbook addresses the area of non-technical skills for surgeons. It provides both a framework and common terminology that allows surgeons to communicate effectively with each other in this area of practice, helping

trainees (and others) develop their abilities in the workplace. This revised handbook (v2.0) has been updated from v1.2, as a result of our overall better understanding of how these non-technical skills can be delivered in the operative environment and taking into account changes that have been introduced since then, including the pre-list team brief, the surgical safety checklist and the post-list de-brief (see pages 14 - 17).

What this handbook contains

This handbook provides a practical guide to the NOTSS system. Part 1: Information for users provides general guidance on the use of behavioural markers. Part 2: The NOTSS system details the complete NOTSS programme, including the skills taxonomy, behavioural markers, rating scale, and rating form. Further information and downloadable NOTSS materials can be found on the NOTSS section of the RCSEd website: <https://www.rcsed.ac.uk/notss>

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What are non-technical skills?

Non-technical skills are cognitive (e.g. decision making) and social (e.g. teamwork). Analyses of adverse events in surgery have revealed that the underlying causes commonly originate from behavioural or non-technical aspects of performance (e.g. communication failures) rather than a lack of technical expertise alone. Therefore, technical skills appear necessary but not sufficient to ensure safety and quality in the operating theatre. Paying attention to non-technical skills such as team working, leadership, situation awareness, decision-making, and communication will increase the likelihood of maintaining high levels of performance over time.

The formal training of surgeons predominantly focuses on developing knowledge, clinical expertise and technical skills. Surgeons have always had non-technical skills, but aspects of performance such as decision-making, leadership, and team working have been developed in an informal and tacit manner rather than being explicitly addressed in training. The NOTSS system allows for explicit identification, rating and feedback to be given on non-technical skills.

What is a behavioural marker system?

Behavioural marker systems are already used to structure training and evaluation of non-technical skills in anaesthesia, civil aviation, and nuclear power in order to improve safety and efficiency. These marker systems are rating scales based on skills taxonomies and are used to identify 'observable, non-technical behaviours that contribute to superior or substandard performance'. They tend to comprise two parts: a skills taxonomy with a set of good and poor behavioural markers allied to each skill and a rating system. Behavioural marker systems are context-specific and are developed in the domain in which they are to be used. For example, the NOTSS system was based on cognitive task analysis with consultant surgeons, supported by other data, including adverse event reports, observations of surgeons' behaviour in theatre, attitudes of theatre personnel to error and safety and consideration of existing literature. After a prototype system was developed, it was subjected to experimental and practical evaluation.

The NOTSS system can be used to structure observations, ratings and feedback in theatre, as well as identify surgeons' training needs and form the basis for non-technical skills training.

What is the NOTSS System

The Non-Technical Skills for Surgeons (NOTSS) system is a behavioural rating system developed by a multi-disciplinary group comprising psychologists, surgeons, and anaesthetists in Scotland. NOTSS describes the main observable non-technical skills associated with good surgical practice and when used in conjunction with medical knowledge and clinical skills, NOTSS can be used to observe and rate surgeons' behaviour in theatre in a structured manner and allow a clear and transparent assessment of training needs to be made. The system is suitable for use in the operating theatre or operating theatre simulator but is not recommended for formal summative assessment at the present time.

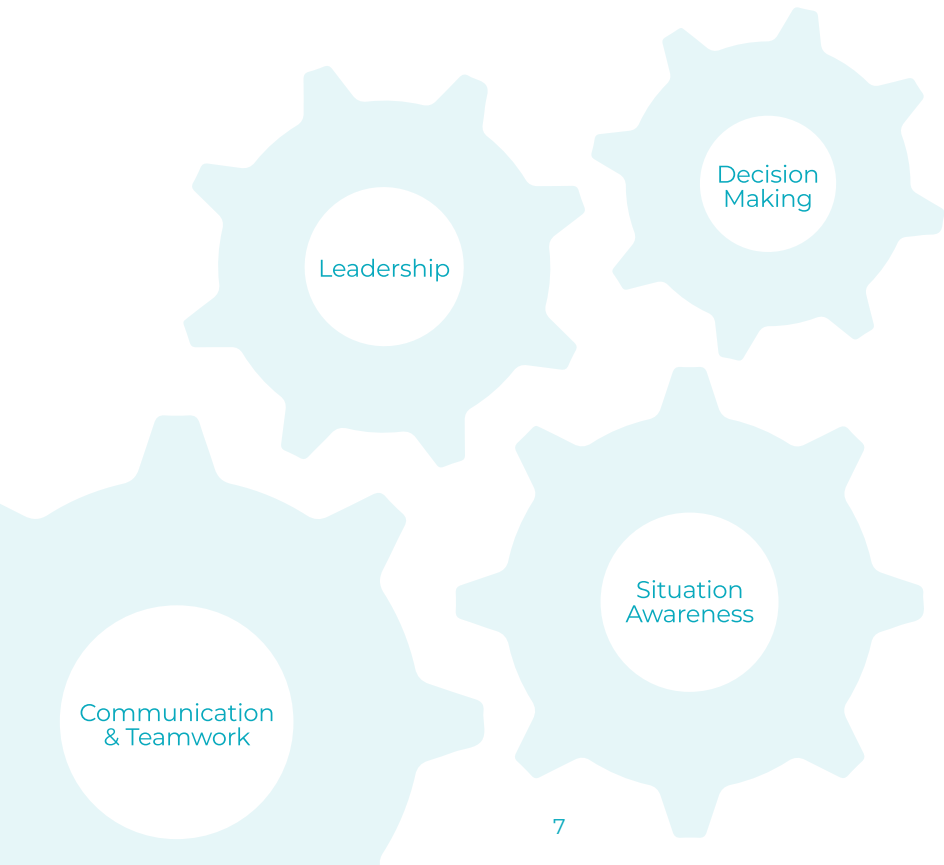
The system was developed according to a number of design criteria and comprises only behaviours that are directly observable or can be inferred through communication. The system has been developed to have wide-ranging coverage of non-technical skills in as few categories and elements as possible and covers behaviours in the intra-operative (gloves on, scrubbed up) phase of surgery. Surgeons developed the skills taxonomy, generated behavioural markers and ensured that

the system was in surgeons' language and free of jargon. These exemplar behaviours, generated by consultant surgeons, are not intended to be a comprehensive list.

The NOTSS system comprises a three-level hierarchy comprising categories (at the highest level), elements and behaviours. Four skill categories and 12 elements make up the taxonomy (see table 1). Each category and element are defined and examples of good and poor behaviours are provided for each element.

Table 1

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



Using the NOTSS System

The NOTSS system is intended to be used as a debriefing tool for consultant surgeons who are involved in training to rate trainees' non-technical performance and give feedback in a structured manner immediately after the case. Initial piloting of this method suggests that the debrief takes under five minutes to complete.

General recommendations

It may take some time for users to become familiar with the language and structure of the NOTSS system. Training and practice should help facilitate this process.

As with other in-theatre training, teaching and assessment should not interfere with clinical care; if circumstances in theatre dictate, using the NOTSS tool for teaching should be temporarily suspended.

Formative assessment and feedback on non-technical skills should occur routinely in both clinical and simulator environments and so should not be perceived as threatening.

Trainer Selection and Training

Training is required to learn to rate behaviours using the NOTSS system effectively. This should include:

- Background knowledge on human performance, error management and non-technical skills, so that constructive, directive feedback can be given to trainees
- Principles of using psychometric tools for rating performance
- The contents of the NOTSS system and how they relate to everyday activities
- Practice in observing non-technical skills and rating behaviours with the NOTSS system

If the NOTSS System is to be used for formative assessment, trainers should undergo further training to ensure that they understand the background to the system and can provide reliable judgements.

Regular updates may be required to take into account recent developments and better understanding of the overall place of non-technical skills in operative performance.

It is recommended that a small group of consultant surgeons are selected in each department to become NOTSS trainers/assessors.

Trainee Selection and Training

Trainees should also receive training on human performance and error management to support development of their non-technical skills. This is now beginning at medical school and needs to continue throughout postgraduate training

Trainees should receive their own copy of the NOTSS system booklet for reference. (See website www.rcsed.ac.uk/notss)

The NOTSS system should be used appropriately for the level of experience of the trainee:

- With junior trainees, the focus of training is on developing basic surgical expertise; the NOTSS system can be used for general discussion of non-technical skills and their importance to clinical practice
- For more senior trainees, the NOTSS system can be used to rate skills and provide feedback during increasingly challenging cases
- Towards completion of training it can also be used to help senior trainees learn how to observe and assess non-technical skills in others.

Consultant surgeons should explain to trainees why it is important to provide feedback on, and assessment of, non-technical skills during training, highlighting that the NOTSS system has been designed to aid the development of professional skills. There is now an increasing role for using the NOTSS tool to assess trainees during their surgical training and many training programmes now include such evaluations.

Suggested Functions

- To assess and review trainees' non-technical skills on a periodic basis to identify strengths and weaknesses and support skills development:
 - Use in a case or list where the trainee can operate as lead with consultant observing and providing assistance as requested/required
- To guide general discussion of NOTSS and their role in case management:
 - Consultant and trainee work together more as a team with case/list issues being discussed from a non-technical perspective e.g. role of situation awareness – what is it for, how is it to be developed and maintained, how can it be lost or why good team working is so important
 - This more informal use is appropriate with new users, junior trainees when numerical ratings are premature and senior trainees in more complex cases
- As a framework for self-reflection both by consultants and trainees after an operating list.

Practical Tips

- Use the NOTSS system in a variety of different cases as appropriate for the list type, health of patient, trainee level and consultant load
- New users are recommended to work at the element level, as ratings can be more directly related to observed behaviours
- Consultants and trainees should have a feedback and discussion session after the case.
 - Use element level observations/ratings to give specific feedback on skills
 - Use category level to describe more general performance
- Use whole NOTSS system during training and assessment but focus on areas relating to weakness or of particular importance for the type of case
- Make notes of specific circumstances of the case and trainees experience, tasks, etc. (e.g. if very complex case, trainee new to grade, been on-call all night etc)

Evaluation Studies

- Reliability
- Usability
- Assessment
- Supporting technical skill
- Improving patient safety

Yule et al (2008a)
Yule et al (2008b)
Crossley et al (2011)
Brunkhorst et al (2015)
Dias et al (2018)

Key References & Recommended Reading

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See also the NOTSS section of the RCSEd website for other relevant publications and learning resources: <https://www.rcsed.ac.uk/notss>

Part 2: The NOTSS System

Situation Awareness

Developing and maintaining a dynamic awareness of the situation in theatre based on assembling data from the environment (patient, team, time, displays, equipment); understanding what it means, and thinking ahead about what may happen next.

Gathering Information

Seeking information in the operating theatre from the operative findings, theatre environment, equipment, and people.

Good Behaviours:

Carries out pre-operative checks of patient notes, including investigations and consent

Ensures that all relevant /investigations (e.g. imaging) have been reviewed and are available

Liaises with anaesthetist regarding anaesthetic plan for patient

Optimises operating conditions before starting e.g. moves table, lights, AV equipment

Identifies anatomy/ pathology clearly

Monitors ongoing blood loss

Asks anaesthetist for update

Poor Behaviours:

Arrives in theatre late or has to be repeatedly called

Does not ask for results until the last minute or not at all

Does not consider the views of operating room staff

Fails to listen to anaesthetist

Fails to review information collected by team

Asks for information to be read from patient notes during procedure because has not been read before operation started

does not attend team brief

is not present for the 'surgical pause' (WHO checklist timeout), does not engage in 'sign out'

Understanding Information

Interpreting the information gathered from the environment, comparing it with existing knowledge to identify the match or mismatch between the situation and the expected state, and update ones mental model.

Good Behaviours:

Acts according to information gathered from previous investigation and operative findings

Looks at CT scan and points out relevant area

Reflects and discusses significance of information

Poor Behaviours:

Overlooks or ignores important results

Misses clear sign (e.g. on CT scan)

Asks questions which demonstrate lack of understanding

Discards results that don't 'fit the picture'

Projecting and Anticipating Future State

Predicting what may happen (to the patient) in the near future as a result of possible actions, interventions or non-intervention.

Good Behaviours:

Plans operating list taking into account potential delays due to surgical or anaesthetic challenges

Verbalises what equipment may be required later in operation

Shows evidence of having a contingency plan ('plan B') (e.g. by asking scrub nurse for potentially required equipment to be available in theatre)

Cites contemporary literature on anticipated clinical event

Poor Behaviours:

Overconfident manoeuvres with no regard for what may go wrong

Does not discuss potential problems

Gets into predictable blood loss, then tells anaesthetist

Waits for a predicted problem to arise before responding

Operates beyond level of experience

Decision Making

Skills for diagnosing the situation and reaching a judgement in order to choose an appropriate course of action.

Considering Options

Generating alternative possibilities or courses of action to solve a problem. Assessing the hazards and weighing up the threats and benefits of potential options.

Good Behaviours:

Recognises and articulates problems

Initiates balanced discussion of options, pros and cons with relevant team members

Asks for opinion of other colleagues

Discusses published guidelines

Poor Behaviours:

No discussion of options

Does not solicit views of other team members

Ignores published guidelines

Continues with original plan in the face of ongoing problems

No contingency planning

Selecting and Communicating Option

Choosing a solution to a problem and letting all relevant personnel know the chosen option.

Good Behaviours:

Reaches a decision and clearly communicates it

Makes provision for and communicates 'plan B'

Poor Behaviours:

Fails to inform team of surgical plan

Is aggressive/ unresponsive if plan questioned

Shuts down discussion on other treatment options

Only does what she/he thinks is best or abandons operation

Selects inappropriate manoeuvre that leads to complication

Implementing and Reviewing Decisions

Undertakes the chosen course of action and continually reviewing its suitability in light of changes in the patient's condition. Showing flexibility and changing plans if required to cope with changing circumstances to ensure that goals are met.

Good Behaviours:

Implements decision

Updates team on progress

Reconsiders plan in light of changes in patient condition or when problem occurs

Realises 'plan A' is not working and changes to 'plan B'

Calls for assistance if required

Poor Behaviours:

Fails to implement decisions

Makes same error repeatedly

Does not review the impact of actions

Continues with 'plan A' in face of predictably poor outcome or when there is evidence of a better alternative

Becomes hasty or rushed due to perceived time constraints

Part 2: The NOTSS System

Communication and Teamwork

Skills for working in a team context to ensure that the team has an acceptable shared picture of the situation and can complete tasks effectively.

Exchanging Information

Giving and receiving knowledge and information in a timely manner to aid establishment of a shared understanding among team members.

Good Behaviours:

- Talks about the progress of the operation
- Listens to concerns of team members
- Communicates that operation is not going to plan

Poor Behaviours:

- Fails to communicate concerns with others
- Attempts to resolve problems alone
- Does not listen to team members
- Needs help from assistant but does not make it clear what assistant is expected to do

Establishing a Shared Understanding

Ensuring that the team not only has necessary and relevant information to carry out the operation, but that they understand it and that an acceptable shared 'big picture' of the case is held by team members.

Good Behaviours:

- Provides briefing and clarifies objectives and goals before commencing operation
- Ensures team understand the operative plan before starting
- Encourages input from all members of the team
- Ensures relevant members of team are happy with decisions
- Is comfortable discussing the operative plan if challenged
- Checks that assistant knows what they are expected to do
- Debriefs relevant team members after operation, discussing what went well and problems that occurred

Poor Behaviours:

- Does not articulate operative plan to team
- Does not make time for collective discussion and review of progress
- Fails to discuss the case beforehand with unfamiliar team members
- Makes no attempt to discuss problems and successes at end of operation
- Fails to keep anaesthetist informed about procedure (e.g. to expect bleeding)

Co-ordinating Team Activities

Working together with the scrub nurse and anaesthetist to carry out cognitive and physical activities in a simultaneous, collaborative manner.

Good Behaviours:

- Checks that other team members are ready to start operation
- Stops operating when asked to by anaesthetist or scrub nurse
- Ensures that team works efficiently by organising activities in a timely manner

Poor Behaviours:

- Does not ask anaesthetist if it is OK to start operation.
- Proceeds with operation without ensuring that equipment is ready
- Does not undertake post-list de-brief

Leadership

Leading the team and providing direction, demonstrating high standards of clinical practice and care, and being considerate about the needs of individual team members.

Setting and Maintaining Standards

Supporting safety and quality by adhering to acceptable principles of surgery, following codes of good clinical practice, and following theatre protocols.

Good Behaviours:

Introduces self to new members of theatre team

Clearly follows theatre protocol

Requires all team members to observe standards (e.g. sterile field)

Poor Behaviours:

Fails to observe standards (e.g. continues even though equipment may be contaminated or inadequate)

Breaks theatre protocol

Shows disrespect to the patient

Supporting Others

Providing physical, cognitive, and emotional help to team members. Judging different team members' abilities and tailoring ones' style of leadership accordingly.

Good Behaviours:

Modifies behaviour according to trainee needs

Provides constructive criticism to team members

Ensures delegation of tasks is appropriate

Establishes rapport with team members

Gives credit for tasks performed well

Poor Behaviours:

Does not provide recognition for tasks performed well

Fails to recognise needs of others

Engages in 'tunnel vision' approach to technical aspects of operation

Shows hostility to other team members

Coping with Pressure

Retaining a calm demeanour when under pressure and emphasising to the team that one is under control of a high-pressure situation. Adopting a suitably forceful manner if appropriate without undermining the role of other team members.

Good Behaviours:

Remains calm under pressure

Emphasises urgency of situation (i.e. by occasionally raising voice)

Takes responsibility for the patient in emergency/ crisis situation

Makes appropriate decision under pressure

Delegates tasks in order to achieve goals

Continues to lead team through emergency

Poor Behaviours:

Suppresses concern over clinical problem

'Freezes' and displays inability to make decisions under pressure

Fails to pass leadership of case when technical challenge requires full attention

Blames everyone else for errors and does not taking personal responsibility

Loses temper

The NOTTS Rating Scale

The scale below is used to rate non-technical skills based on observed behaviour. The same scale is used to rate category and element-level skills. If a skill was not required or not relevant in the particular case being observed then 'N/A' should be used. If a skill should be displayed but is lacking then '1 – poor' should be used.

Rating	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
N/A	Skill was not required or relevant in this case

Not all skill elements may be required or desirable in any given clinical encounter.

You should expect to see behaviours in order to provide ratings 2 (marginal), 3 (acceptable), or 4 (good). You should expect to see poor behaviours or the absence of required behaviours to rate 1 (poor). Rating N/A means that you did not see behaviours because they were not required or not relevant for the clinical encounter being rated.

Category	Category Rating	Element	Element Rating	Feedback on Performance and Debriefing Notes
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		

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not applicable



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