REVIEW

Non-technical skills and gastrointestinal endoscopy: a review of the literature

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ABSTRACT

Background Non-technical skills (NTS) have gained increasing recognition in recent years for their role in safe, effective team performance in healthcare. Gastrointestinal endoscopy is a procedure-based specialty with rapidly advancing technology, significant operational pressures and rapidly changing 'teams of experts'. However, to date there has been little focus on the effect of NTS in this field.

Objectives This review aims to examine the existing literature on NTS in gastrointestinal endoscopy and identify areas for further research.

Method A systematic search of MEDLINE, Embase, Cochrane Library, PsychINFO, CINAHL Plus and PubMed databases was performed using search terms Non-Technical Skills, Team Performance or Team Skills, and Endoscopy, Colonoscopy, OGD, Gastroscopy, Endoscopic Retrograde Cholangio-Pancreatography or Endoscopic Ultrasound.

Results Eighteen relevant publications were found. NTS are deemed an essential component of practice, but so far there is little evidence of their integration into training or competency assessment. Those studies examining the effects of NTS and team training in endoscopy are small and have variable outcome measures with limited evidence of improvement in skills or clinical outcomes. NTS assessment in endoscopy is in its early phases with a few tools in development.

Conclusions The current literature on NTS in gastrointestinal endoscopy is limited. NTS, however, are deemed an essential component of practice, with potential positive effects on team performance and clinical outcomes. A validated reliable tool would enable evaluation of training and investigation into the effects of NTS on outcomes. There is a clear need for further research in this field.

INTRODUCTION

It is estimated that 10%–15% of patients will experience some kind of adverse event during their hospital stay.¹ The causes of such events often stem not from deficiencies in clinical or technical skills but from the non-technical aspects of human and team performance.^{2,3} Non-technical skills (NTS) are defined by Flin *et al*⁴ as 'the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance'. Assessment and training of NTS in healthcare have expanded dramatically over recent years with increasing acknowledgement of their importance for safe, high-quality care. Gastrointestinal endoscopy is a procedure-based specialty with both significant operational pressures and rapidly advancing technology. The 2004 National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report 'Scoping our practice' identified deficits in the non-technical aspects of care in endoscopy units across the UK, and yet over a decade later NTS are not a standard component of training or assessment. The objective of this review is to examine the existing literature on NTS in gastrointestinal endoscopy and identify areas for further research in this field.

SEARCH METHOD

A systematic search of the literature was undertaken using MEDLINE, Embase, Cochrane Library, PsychINFO, CINAHL Plus and PubMed databases. Search terms included Non-Technical Skills, Team Performance or Team Skills, and Endoscopy, Colonoscopy, OGD, Gastroscopy, Endoscopic Retrograde

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Cholangio-Pancreatography or Endoscopic Ultrasound. Titles and abstracts were reviewed and papers not reporting team or NTS in gastrointestinal endoscopy were rejected. Where the abstract was not clear, the full text was reviewed. Bibliographies were hand searched for further relevant references.

The search revealed a total of 80 publications. Sixteen met the inclusion criteria and review of bibliographies identified a further two relevant publications. Of these 18 publications, only 8 were full-text articles,⁵⁻¹² 9 were conference abstracts¹³⁻²¹ and 1 a NCEPOD report.²²

WHY ARE NTS IMPORTANT IN ENDOSCOPY?

Endoscopy units are akin to day-case operating theatres, undertaking procedures that vary from relatively simple diagnostics to complex therapeutic interventions. The demand for endoscopy has increased dramatically over recent years.⁶ This has undoubtedly been influenced by the introduction of asymptomatic screening pathways, as well as heightened education and awareness of bowel symptoms within the general population, putting additional operational pressure on units to perform high-quality investigations, efficiently and within national targets.

As with all aspects of healthcare, safety is essential. Although severe adverse events are rare in endoscopy, they can be potentially life threatening.⁶ Increasingly complex therapeutic procedures, for example, excision of large polyps, inevitably carry higher risks of complications such as bleeding and perforation, and the skills of situation awareness, judgement, decision making and communication are all key in both prevention and management. Events such as patient misidentification are also thankfully rare and often do not lead to actual harm,⁹ but it is these 'near misses' and the accumulation of minor errors that are thought to lead to more significant errors.⁴ Medical errors carry a huge cost financially and socially.⁷ For the patient and their family, harm is manifested as physical pain, ongoing medical problems, loss of earnings, psychological problems and in the worst scenario, loss of life. For the National Health Service (NHS), there are the financial consequences of additional treatments and potential legal proceedings as well as psychological harm to staff involved. The NCEPOD report 2004 (Scoping our practice)²² investigated the deaths of patients following therapeutic endoscopy in the UK. Significant variation in care was found across different units with 20 of 21 recommendations highlighting deficiencies in the non-technical aspects of practice.⁹ ²² Studies within other areas of healthcare have shown the majority of errors are attributable to so-called human factors, such as breakdowns in communication, poor decision making and the effects of fatigue and stress.⁷ It is also evident that teams that function well have reduced adverse events and are more productive.⁷ ²³ Some early work within

endoscopy has concurred with this showing positive correlation between NTS and improved safety behaviours.¹⁹

Quality assurance is increasingly important for all medical services and is multifactorial. Screening of asymptomatic patients in the national Bowel Cancer Screening Programme (BCSP) has increased public awareness of endoscopy and its performance indicators such as adenoma detection rate.⁶ There is increasing awareness that technical competence is just one aspect of practice and our desire to measure quality must include metrics which evaluate a combination of technical and NTS, as well as patient outcomes and satisfaction, with mechanisms to promote continuous improvement.⁶ ⁹

As in many other areas of healthcare, teams in endoscopy are constantly changing. This results in 'teams of experts' rather than 'expert teams'.⁷ This kind of team working relies far more heavily on positive safety attitudes, shared understanding and efficient exchange of information, unimpeded by hierarchical or cultural factors. It is therefore paramount that these NTS are taught and developed in staff. There is a growing body of opinion that NTS are the most important aspect of medical practice and NTS competence should be integral to training in endoscopy.⁵ ⁷ ⁹ ¹³

WHAT NTS ARE RELEVANT TO ENDOSCOPY?

NTS, by their nature, are transferable across different areas of healthcare practice (as well as other high-risk industries).⁴ However, it would be useful to know which skills are more or less relevant to endoscopy teams. NTS, as described by Flin *et al*,⁴ can be divided into cognitive skills such as situation awareness and decision making, and social skills such as teamwork, leadership and communication.

Situation awareness can be defined as 'knowing what is going on around you'.⁴ It is the most common theme in the literature reviewed and an essential skill.⁶ ⁷ ⁹ ¹³ ¹⁵ ¹⁷ ¹⁸ ²¹ Preprocedure information gathering provides the team with background information about the patient, their relevant history and factors which could increase the technical difficulty of the procedure to be undertaken.⁶ This information can be gleaned from a preprocedure assessment or consultation and should be communicated to allow the whole team to have a shared understanding or mental model and plan for the case. It is essential that team members are aware of each other's abilities and experience and what their roles will involve. During a procedure, active observation and communication allow for anticipation of equipment needs, early response to problems and the avoidance of errors. In their analysis of endoscopists' reflective diaries, Hawkes and McDonald¹⁵ found issues relating to situational awareness resulted in more in-depth reflective practice thus illustrating its importance.

Table 1 Non-technical skills (NTS) training in GI endoscopy

Study	Type of training implemented	Outcome measures	Findings
Heard <i>et al. Gastroenterology Nursing</i> , 2011 ⁸	Simulation based—Crisis Resource Management 15 endoscopy nurses/technicians trained	Evaluation of course	'Enjoyable, applicable and realistic' tool for team training
Pyati. <i>Br J Anaesth</i> , 2012 ²⁰ (abstract only)	Didactic and simulation based Training package to teach sedation skills in Endoscopy. Includes teamwork, communication and leadership skills	Unclear	
Matharoo <i>et al. World Journal of Gastroenterology</i> , 2014 ⁹	Didactic and interactive. 23 participants, 1-day programme covering human factors, adverse events and NTS	Participants safety knowledge (pre and post), safety attitudes (pre and post). Global course evaluations	Safety knowledge, attitudes and awareness improved postcourse. Positive global course evaluations
Grover <i>et al. Gastrointestinal Endoscopy</i> , 2015 ¹⁰	Simulation based: structured comprehensive curriculum (SCC, didactic+virtual reality with feedback) versus self-regulated learning (SRL, virtual reality without feedback). 33 participants randomised to two programmes. No details of NTS component	Task knowledge. Performance in simulator+clinical transfer Communication Global rating Measured immediately and 4–6 weeks postcourse	SCC group outperformed SRL group in simulator and clinical setting on colonoscopy performance, communication and global rating assessments
Grover <i>et al. Gastrointestinal Endoscopy</i> , 2015 ¹⁴ (abstract only)	Simulation based. 37 participants randomised to graded simulation or high-fidelity simulation programme. No details of NTS component	Procedural knowledge. Technical skills, communication and global performance in integrated simulation immediately and 4–6 weeks postcourse. Clinical assessment 4–6 weeks postcourse	Graded simulation group better technical skills, communication and global performance. Graded simulation group superior performance in clinical setting
Hawkes <i>et al. United European Gastroenterology Journal</i> , 2015 ¹⁶ (abstract only)	Integrated simulator training 7 participants attended SPRINT programme	Procedural logs compared with 14 traditionally trained individuals. Trainee evaluation of programme (simulator, lesion recognition and NTS)	SPRINT group shorter and more consistent procedure times. Training time halved High satisfaction with programme
Grover <i>et al. Canadian Journal of Gastroenterology and Hepatology</i> , 2016 ¹³ (abstract only)	Simulation based. 20 participants randomised to training with/without NTS component	NTS (via adapted OSANTS tool), communication and global outcomes during integrated simulation immediately and 4–6 weeks postcourse. TEAMSTEPPS questionnaire (participant attitudes)	NTS group superior NTS performance, communication and global performance

Decision making and judgement are also key cognitive skills.^{9 13 15 17 18 21} They were the most common themes for learning points identified by the group of endoscopists surveyed by Hawkes and McDonald,¹⁵ particularly relating to the assessment and management of lesions found at colonoscopy. Although knowledge and technical skills are required to inform decision making, it is heavily influenced by an individual and team's response to a dynamic situation, particularly when under pressure or in emergent circumstances.

The social skills of leadership, professionalism, teamwork and communication were all common themes in the literature reviewed.^{7 9 13 15 17 21} Effective teamwork requires team members to understand and support each other in their roles. Within endoscopy, the team can be defined as the group of people working together in a procedure room, or can be expanded to the whole department. These teams may be different with each session or even change during a session. Good communication requires

exchange and receipt of information, ideally in standardised way. This is particularly important with the interchangeable 'teams of experts' that are so common in endoscopy.⁷

NTS TRAINING IN ENDOSCOPY

Other high-risk industries have long recognised the importance of team training in reducing error. NTS training has received increasing recognition in other areas of healthcare such as surgery, anaesthetics and emergency medicine, but there has been little investment in team training and development in endoscopy to date.⁵ There is, however, growing momentum for teaching NTS as well as, or alongside technical skills, particularly with the development of the national BCSP and advancing therapeutic endoscopy.^{5 9}

The literature search revealed seven publications relating to NTS training interventions (see table 1). Four of the seven were conference abstracts, and in fact three were published by the same team during a 2-year period. Of those reviewed, the majority (6/7)

used a simulation-based training intervention. Five studies incorporated both technical and NTS,^{10 13 14 16 20} one focused solely on NTS⁹ and one on Crisis Resource Management training.⁸

Course evaluation and satisfaction were measured in all studies except one (where no clear outcomes were stated²⁰). Two assessed candidate safety attitudes and safety awareness^{9 13} both precourse and postcourse. In terms of evaluating NTS behaviour, two studies assessed communication as a stand-alone skill,^{10 14} but only one undertook an assessment of NTS in practice.¹³ Clinical transfer of skills was measured by Grover *et al*^{10 14} in two of their studies, evaluating performance both during an integrated simulation and in the clinical setting. Universally outcomes following a NTS training intervention were positive; however, it should be noted that all studies contained small numbers and only three remeasured outcomes after a delayed time period (4–6 weeks postcourse).^{10 13 14}

Despite agreement on the need for NTS training, the above studies have shown that there is variable measurement of the effectiveness of training.¹³ Most studies have assessed Kirkpatrick's learning level 1 (reaction), but with little attempt to measure level 2 (knowledge) or level 3 (behaviour—application of knowledge in the work place) and no assessment of learning level 4 (results—change in outcome as a result of training).²⁴ This finding is not unique to these studies. The American Veterans Health Association study is the only programme with large numbers, that we are aware of, to show significant clinical improvement (reduction in surgical mortality) following team training.²⁵ A number of reviews of team training have identified that studies are generally poor, with few reporting on all four levels of learning, and most significantly, minimal evidence for improvements in NTS performance (level 3) or clinical outcomes (level 4).^{24 26–28} Assessment of improvement in NTS, both in simulation and in vivo, and their impact on patient outcomes therefore needs to be addressed.

NTS ASSESSMENT IN ENDOSCOPY

Behavioural rating systems to evaluate NTS performance have been well established in aviation and other high-risk industries for many years.² During the last decade, similar tools have been developed in healthcare, most notably within the fields of anaesthetics and surgery. These have varied slightly in their development and structure. The 'revised NOTECHS'²⁹ and 'Oxford NOTECHS'³⁰ tools were both adapted from the original aviation 'NOTECHS', developed to assess pilots' NTS in the cockpit. 'NOTSS' (Non-Technical Skills for Surgeons),³¹ 'ANTS' (Anaesthetists Non-Technical Skills)³² and 'SPLINTS' (Scrub Practitioners List of Non-Technical Skills)³³ were developed by a team at the University of Aberdeen using qualitative methods including cognitive task analysis. These

tools, as their names imply, each assess an individual member of the theatre team, whereas both NOTECHS tools are designed to assess the team as a whole.

The most common use for NTS assessment tools to date has been in formative assessment and the evaluation of team training programmes. With increasing focus on the importance of NTS, these tools may have a role in summative assessment and revalidation.⁵ Such tools can also be a useful *aide memoire* to facilitate self-reflection or debriefing after a critical incident or complex case.

The literature search revealed five publications, describing four tools, designed to assess NTS within gastrointestinal endoscopy.^{11 12 17 18 21} Three (publications of conference abstracts) detailed the development of tools which are yet to be tested for feasibility, validity or reliability;^{17 18 21} two of these assessed NTS alone; and one assessed NTS in combination with technical skills. Walsh *et al*^{11 12} described the development and subsequent testing of the GiECAT (Gastrointestinal Endoscopy Competency Assessment Tool) tool which includes NTS and technical skill components (see table 2). Qualitative methods were used by all, including analysis of interviews or focus groups with endoscopy staff,^{17 18 21} and Delphi methodology.¹¹ This is in keeping with tool development in other specialties.^{30–33} In addition, Haycock *et al*¹⁷ analysed video recordings of live endoscopic procedures to demonstrate the identified NTS behaviours in practice, going some way to prove content validity of their taxonomy.

Situation awareness was a category common to all tools. Decision making was included by Haycock *et al*¹⁷ and Scaffidi *et al*,²¹ with Hewett *et al*¹⁸ labelling a similar category 'situation specific heuristics & strategies' and Walsh *et al* describing related behaviours in both their global rating category and checklist.^{11 12} The NTS-specific tools also included domains to assess communication, teamwork and leadership. These themes are all common to the surgical team assessment tools previously mentioned. Three of these tools require further testing for validity, reliability and usability.^{17 18 21} The GiECAT has been shown to have good construct validity, reliability and usability, but addresses all aspects of colonoscopy competency rather than NTS alone.^{11 12} A validated, reliable tool would enable evaluation of training and investigation into the effects of NTS on outcomes.

CONCLUSIONS

The current literature on NTS in gastrointestinal endoscopy is limited; however, it is conclusive that NTS are an essential component of practice. This is likely to become even more significant with the increasing use of advanced technology and therapeutic

Table 2 Non-technical skills (NTS) assessment in GI endoscopy

Study	Skills assessed	How developed	Tool structure	How tested
Haycock <i>et al. Gut</i> , 2010 ¹⁷ (abstract only)	NTS of endoscopist	Semistructured interviews (Critical Incident Technique) to identify taxonomy. Video analysis to identify behaviours in practice	13 behavioural elements divided into four categories. Scored 1–4: ► Communication and teamwork ► Situation awareness ► Leadership ► Judgement and decision making	Tool needs to be validated
Hewett <i>et al. Gastrointestinal Endoscopy</i> , 2010 ¹⁸ (abstract only)	Technical and NT skills of endoscopist	Hierarchical task analysis and verbal protocol analysis	6 categories—3 NTS, 3 <i>technical skills</i> No information on scoring: ► Clinical knowledge and reasoning ► Scope handling ► Situation awareness ► Situation specific heuristics and strategies ► Detection of abnormalities ► NTS such as intrapersonal stress coping	Not yet tested
Walsh <i>et al. Gastrointestinal Endoscopy</i> , 2014 ¹¹ and 2015 ¹²	Technical and NT skills of endoscopist (trainee)	Literature search. Delphi methodology—panel of 55 international endoscopy experts	2 parts to tool: Global rating—7 categories ► 1 category relevant to NTS ► Score 1–5 Checklist—19 points: ► 6 points relevant to NTS ► 2-point scale: not done/done incorrectly and done correctly (or not observed)	Content validity established via Delphi process Good inter-rater and test–retest reliability Usable (Of whole tool)
Scaffidi <i>et al. Canadian Journal of Gastroenterology and Hepatology</i> , 2016 ²¹ (abstract only)	NTS—does not state if team or individual	Literature search of other relevant tools. Focus groups (1× medical, 1× nursing, 1× combined). Thematic analysis	6 dimensions of NTS Scored 1–5 (Likert type) ► Teamwork ► Communication ► Situational awareness ► Decision making ► Leadership ► Professionalism	Feasibility, validity and reliability testing required

techniques and a reliance on ‘teams of experts’ rather than ‘expert teams’.

NTS training is needed but there remain unanswered questions regarding the format and content of such training. Should it target NTS alone or in combination with technical skills and how should it be delivered? Any such training needs to be evaluated thoroughly with outcomes which assess all four of Kirkpatrick’s learning levels.²⁴

Assessment of NTS specific to endoscopy needs to be developed further, with scope for a validated, reliable instrument to measure NTS in real-time and video-recorded cases. A robust tool would have a potential role in formative and summative assessment, as well as in the evaluation of training and in debriefing teams or individuals. This could be key in proving links between NTS and patient outcomes.

There is a clear need for further research and investment into the training and assessment of NTS of teams and individuals in gastrointestinal endoscopy, and significantly the effect that improving these skills has on patient outcomes.

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