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Endoscopic non-technical skills team training: Next step in quality assurance of endoscopy training

Matharoo MK *et al.* Endoscopy team training for patient safety

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Abstract

BACKGROUND

AIM

To investigate whether novel, non-technical skills training for Bowel Cancer Screening (BCS) endoscopy teams enhanced patient safety knowledge and attitudes.

METHODS

A novel endoscopy team training intervention for BCS teams was developed and evaluated as a pre-post intervention study. Four multi-disciplinary BCS teams constituting BCS endoscopist(s), specialist screening practitioners, endoscopy nurses and administrative staff (A) from English BCS training centres participated. No patients were involved in this study. Expert multidisciplinary faculty delivered a single day's training utilising real clinical examples. Pre and post-course evaluation comprised participants' patient safety awareness, attitudes, and knowledge. Global course evaluations were also collected.

RESULTS

Twenty-three participants attended and their patient safety knowledge improved significantly from 43%-55% ($P \leq 0.001$) following the training intervention. 12/41 (29%) of the safety attitudes items significantly improved in the areas of perceived patient safety knowledge and awareness. The remaining safety attitude items: perceived influence on patient safety, attitudes towards error management, error management actions and personal views following an error were unchanged following training. Both qualitative and quantitative global course evaluations were positive: 21/23 (91%) participants strongly agreed/agreed that they were satisfied with the course. Qualitative evaluation included mandating such training for endoscopy teams outside BCS and incorporating team training within wider endoscopy training. Limitations of the study include no measure of increased patient safety in clinical practice following training.

CONCLUSION

A novel comprehensive training package addressing patient safety, non-technical skills and adverse event analysis was successful in improving multi-disciplinary teams' knowledge and safety attitudes.

Key words: Patient safety; Bowel cancer screening; Teamwork; Endoscopy Training; Adverse events

Core tip: Medical error is common and patient safety is increasingly a priority. Teamwork and communication are often implicated and hence training to improve these aspects is gaining recognition. A novel patient safety focussed training intervention was successfully targeted to multidisciplinary endoscopy teams. By delivering a single days training to experienced endoscopy teams, there was significant improvement in patient safety knowledge and some aspects of patient safety attitudes. Global course evaluation was positive with recommendations that such training should be extended more widely in endoscopy. Patient safety focused endoscopy team training should be developed to cover diagnostic, therapeutic screening and emergency endoscopy.

Matharoo M, Haycock A, Sevdalis N, Thomas-Gibson S. Endoscopic non-technical skills team training: Next step in quality assurance of endoscopy training.

INTRODUCTION

Endoscopy training and practice standards have progressed significantly over the last decade within the United Kingdom. The main driving force for this improvement has been the quality in colonoscopy audit conducted by Bowles^[1] in anticipation of the NHS Bowel Cancer Screening (BCS) Programme. This study highlighted poor performance by independent endoscopists as measured by low adjusted caecal intubation rates, unsafe sedation practice and high perforation rates.

More broadly, patient safety is an important priority across healthcare. There is increasing evidence to show that medical error is common^[2], usually multifactorial^[3,4] and often avoidable^[5]. The National Confidential Enquiry into Patient Outcomes and Death (NCEPOD)^[6] investigated 1818 deaths within 30 d of an endoscopic procedure. Many of the recommendations from this report highlight failings in teamwork and “non-technical” skills (*i.e.* communication, coordination, leadership), affecting procedure planning, patient monitoring and safe administration of sedation, as opposed to technical skills of the endoscopist. Furthermore, the prospective audit of colonoscopy practice conducted by Bowles and colleagues in 2004^[1] showed considerable variations in training and standards of practice. Recent work looking at the frequency of patient safety incidents and never events in endoscopy shows that both minor and major errors including patient mis-identification do occur^[7], and knowledge of these errors present an opportunity to intervene and prevent recurrence. Targeted training strategies to prevent errors in endoscopy are required to address these issues in order to further enhance quality in endoscopy.

As high quality, safe, therapeutic colonoscopy is a pre-requisite for population based BCS, the United Kingdom National Endoscopy Team have made great efforts to improve training and subsequent provision of endoscopic services. This has largely been achieved through initiatives such as the “Global Rating Scale”^[8,9], a quality improvement and assessment tool, overseen by the Joint Advisory Group (JAG)^[10], the endoscopy regulatory body in the United Kingdom. Regional and national endoscopy training programmes have streamlined technical skills acquisition, and provided a standard for credentialing through the JAG. This is through the web-based “JAG Endoscopy Training System” (JETS) e-portfolio^[10]. This system provides an electronic log of each individual

endoscopist's procedural data including Key Performance Indicators (KPIs), Directly Observed Procedure Skills (DOPS), Trainee Learning Objectives (TLOs) and Trainee assessment of Trainer (TAT). The JETS e-portfolio aims to improve the effectiveness and efficiency of training, to streamline the JAG certification process and to enhance Quality Assurance of endoscopy^[11].

Traditionally, endoscopy training has largely consisted of supervised, one-to-one, hands-on clinical training on real patients following an apprenticeship model. Whilst there are merits of such experiential learning, disadvantages include prolonged procedure times and potential increased patient discomfort^[12] and risk^[13]. Intensive training courses can improve knowledge and technical skills^[14] but have not been shown to improve attitudes or safety behaviours. High fidelity simulation has developed to address some of these issues and has been shown to be beneficial in developing knowledge and technical skills in a controlled environment, prior to clinical practice, and potentially shortening the learning curve to competency^[15]. All these training developments have led to improved quality of teaching and driven up standards, as reflected in a recent national colonoscopy audit^[16].

Are current training strategies therefore sufficient? Whilst technical expertise is clearly important, it is one part of a complex skill set required to perform high quality, safe endoscopy. Assessment of learning or performance can be done within multiple domains, of which the most well known framework incorporates evaluation of knowledge, skill and attitude^[17]. Endoscopy training to date has largely focused on knowledge and technical skill, with little attention to identifying, teaching or assessing professional attitudes. Optimal decision-making, diagnostic interpretive skills, communication with the patient, effective teamwork and crisis management are all integral to performing endoscopy safely and to a high level, but are not formally included in current training regimes.

Team selection, task design and team training are important factors in creating successful teams^[18], yet gastroenterology teams are often temporary, changeable and loosely formed with little specified team training. Communication, decision making, leadership and situation awareness are key non-technical skills and are central to high quality safe teams^[19]. Team training is well developed in other high-risk industries such

as aviation^[20] and is developing in anaesthetics^[21] and surgery^[22]. It is important to tailor training strategies to the teams and their specified tasks and to evaluate such training in detail to enable improvements. This can be achieved by Kirkpatrick's training intervention evaluation framework^[23]. This is the most well established framework to assess efficacy of training interventions, and specifies separate evaluations of participants' global perceptions of the training, their knowledge and attitudes both pre and post-training. Depending on the complexity of training, participants' skills and organisational outcomes (*e.g.*, adverse events) should also be assessed, where feasible.

Initial studies analysing endoscopic non-technical skills^[24] and patient safety incidents^[7] in endoscopy highlight that patient safety could be enhanced by addressing such issues. There is also an emerging view amongst BCS endoscopists that experts regard endoscopic non-technical skills training as the "most significant component of their practice"^[25]. This study set out to determine if training in non-technical skills and patient safety is feasible, relevant and desirable.

MATERIALS AND METHODS

Ethical considerations

This course was designed with the combined knowledge and expertise of the Wolfson Endoscopy Unit at St. Marks Hospital and the Centre for Patient Safety and Service Quality at Imperial College. Faculty consisted of two consultant gastroenterologists accredited for Bowel Cancer screening (AH, STG) and a psychologist with expertise in team performance and patient safety (NS). Ethical approval was granted by NRES Committee London (08/H0719/54).

Recruitment of participants

Bowel cancer screening accreditation units across England were informed about the training intervention to be delivered in London (United Kingdom) *via* email flyer and invited to attend with a full Bowel Cancer screening team. Four teams were selected based on confirmation of attendance of a complete screening team.

Participants were senior teams, with the screening endoscopists performing a minimum of 1000 screening procedures at baseline and at least 150 screening procedures

annually thereafter. Specialist screening practitioners and endoscopy nurses were senior nurses at the higher end of the scale. Specialist screening practitioners had 0-5 years ($n = 4$), 5-10 years ($n = 2$) and > 10 years ($n = 1$) of experience in specialist post. Endoscopy nurses were also experienced with 0-5 years ($n = 2$) 5-10 years ($n = 3$) and > 10 years ($n = 3$) years of experience as dedicated endoscopy nurses. Endoscopy administrative staff included a senior endoscopy unit manager.

Course content

A full day's training with didactic and interactive teaching methods was developed by experts and modelled on relevant patient safety training interventions in other specialties^[26,27]. Real BCS clinical examples were utilised to illustrate the importance of human factors, adverse events and non-technical skills for endoscopy patient safety. Teaching methods employed included didactic lectures, interactive discussion, small group exercises and video analysis of real endoscopy scenarios.

Assessment and evaluation

This course was evaluated in depth following Kirkpatrick's training intervention evaluation framework^[23] under the following areas.

Participants' knowledge of safety: Knowledge was assessed pre and post course using 20 Multiple Choice Questions (MCQ). The MCQs were completed at the beginning of the training day and immediately after the training was completed. These were written by the faculty and selected from a sample of 30 questions that were piloted and validated prior to the course with a sample of medical students ($n = 5$), Endoscopy nurses ($n = 5$), Specialist Screening Practitioners ($n = 4$) and BCS endoscopists ($n = 2$). The most discriminatory questions were selected.

Participants' attitudes to safety: Patient safety attitudes relevant to BCS were assessed at the beginning of the training day and immediately after the training was completed using a modified version of a validated questionnaire^[28,29]. Safety attitudes were quantified on a 5 point scale (1: strongly disagree, 5: strongly agree) for each category.

Participants' global course evaluations: A detailed course satisfaction evaluation focussing on content, training material and faculty was captured using a 5-point Likert scale and free text comments boxes.

Participants' knowledge of and attitudes towards safety were the main course learning outcomes to be compared pre- and post-training. Participants' descriptive evaluations (obtained post-training) were recorded as per standard good training practice.

Training material

A course leaflet and a course manual were issued to all delegates. These included the course aims, evaluation materials, presentation slides and relevant literature including the Endoscopic Non-Technical Skills rating tool^[30] (these are available upon request via the corresponding author).

Statistical analysis

Descriptive analyses were completed including the delegates' age, gender and professional background. Patient safety knowledge and attitudes were measured pre- and post-training. The paired t-test was used to determine differences in the percentage (%) of correct MCQ responses. Safety attitudes were assessed on a 5-point ordinal scale (1: strongly disagree, 5: strongly agree). The pre- and post-course responses were analysed using Wilcoxon tests. Free text comments were analysed qualitatively and emerging themes in participants' comments were tabulated^[31,32].

RESULTS

Four English BCS training centres performing large volume screening colonoscopy took part in the study. 23/25 (92%) of invitees, in teams of 6-8 participants, attended from 4 BCS accreditation centres across England. Thirteen % ($n = 3$) were male and 87% ($n = 20$) were female. The age of participants varied from age ranges 25-35 (13%), 35-45 (35%), 45-55 (39%) to > 55 (13%). Table 1 summarises the professional subtypes.

Patient safety knowledge

There was a highly significant improvement in post course patient safety knowledge in the context of BCS endoscopy (Table 2).

Patient safety attitudes

A change in patient safety attitudes was observed for 12/41 (29%) of items assessed. A significant change in participants' attitudes was found following the training in the areas of perceived patient safety knowledge and awareness (Table 3 categories A and B). There was no significant change in perceived influence on patient safety (C), attitudes towards error management (D), error management actions (E) or personal views following an error (F).

Global course evaluation

The overall feedback was positive: 91% of delegates strongly agreed/agreed that they were satisfied with the course. Both quantitative (Table 4) and qualitative (Table 5) measures indicate that the participants viewed the training intervention very favourably.

DISCUSSION

Key findings

This is the first multi-disciplinary patient safety and non-technical skills training intervention targeted towards BCS endoscopy teams. The key findings of this study are that training improved patient safety knowledge scores and some patient safety attitudes in expert teams after a single days training. In endoscopy patient safety training to multiple teams without special resources such as simulation is feasible. Importantly, expert endoscopy teams value non-technical skills training and believe this should be developed and disseminated.

This training intervention resulted in significant improvements in patient safety knowledge in highly experienced multi-disciplinary BCS teams. This highlights that experienced endoscopists and nurses in BCS training centres were able to improve their knowledge after just a single day's training, despite there being a large volume of novel information to assimilate in a single day.

Patient safety attitudes were more complex: Perceived patient safety knowledge and awareness both significantly improved, however influence on patient safety and attitudes towards error management did not change following the intervention. This finding may be explained by the fact that these are self-selected senior attendees with an interest in patient safety and teamwork skills. The baseline patient safety attitude scores were quite high and the training is therefore likely to have had less impact on attitude in these teams. This may also be explained by the fact that attitudes can be quite deeply embedded and less likely to be significantly changed after a single day's training. This is corroborated by Arora *et al*'s^[26] study of safety skills training in surgical residents, where similarly, there was no significant change in 4 out of the 6 safety attitude domains following training. Overall, this is a common finding in such training courses^[26,27,33] – some attitudes improve, and some remain unchanged. A one-day course alone cannot change deeply held attitudes about safety; typically these take longer to change and are associated with changes in the clinical workplace as well.

Nevertheless, the safety attitudes questionnaire responses revealed important areas to target for subsequent training: The highlighted stems in Table 3 show items in the attitudes questionnaire that did not significantly change following training. These areas could be targeted in future training courses for example by making explicit a “take home message” of key patient safety actions the teams could implement in their own clinical practice.

Strengths and weaknesses of the study

The strengths of this study comprise inclusion of diverse multidisciplinary expert teams, use of a validated safety attitudes questionnaire and a robust evidence-based approach to course set-up and evaluation. Weaknesses include a small sample size in terms of absolute numbers, although this novel training intervention targeted 4 out of 10 Bowel Cancer screening training centres in England. Delivering interactive small group training and video analyses is not feasible for larger groups, and the educational strategy was not intended to be purely didactic.

There was inevitably also a degree of selection bias, with interested, motivated teams and those with the capacity to cancel clinical commitments more likely to attend.

Participants therefore consisted of interested endoscopy leads already actively engaging in patient safety measures. It could be argued that any positive benefit may be attenuated, as the baseline appreciation of these issues is high in this select group. There are, however, also advantages to targeting motivated groups from the point of view of future implementation: trained interested experts can become “champions” for this type of training and hence drive its implementation on a wider national scale. Additionally, from a design perspective, a control group for comparison purposes would have been very desirable. As in other similar studies^[26,27,33], however, we felt it was not feasible to obtain a closely matched group of experts willing to accurately complete the extensive MCQ and safety attitudes questionnaire without the incentive of training. Finally, we cannot provide definitive evidence from this single study that teamwork training directly impacts adverse events in endoscopy. It is difficult to prove that training interventions of this type improve patient safety due to the relative rarity of severe adverse events, the complexity of medical error and the length of follow up required for such a study. It is, however, well accepted that team training can improve safety attitudes and behaviours and in the surgical arena a reduction in mortality has also been shown^[34,35].

Strengths and weaknesses of the training intervention

There are many benefits to training multi-disciplinary teams, such as promoting cohesive team working and breaking down inter-professional communication barriers. By adopting the approach of training the core team, it is more likely that improvement measures will be translated to patient care compared to limiting training to a single profession. However, this brings challenges to designing and implementing a training intervention that is suitable for all the professional sub-groups. One of the challenges is to ensure that the educational content is appropriate for the varied skill sets of the different professional groups. It is acknowledged that perception of patient safety varies by professional subgroup^[36] and these differences may be more difficult to address in a multi-disciplinary team training intervention. Whilst knowledge and attitudes were directly assessed, patient safety skills assessment was beyond the scope of this course. Furthermore, whilst a full day’s training offers the opportunity to cover the

fundamentals of endoscopy patient safety, it remains a 'one-off' teaching intervention with no guarantee that knowledge acquired will be retained or practically applied in each team's respective screening centre. Translating knowledge, skills and attitudes acquired during patient safety training to actual clinical practice is important but difficult to ascertain. To address this it is possible to use the validated non-technical skills framework for endoscopy to assess the team's safety behaviours in the workplace – this was beyond the scope of this training but can be done scientifically^[37]. Training sustainability has to be balanced with the time, resources and logistics of travel and loss of service provision involved in extending such training to its full potential, and is work in progress.

Comparison to other patient safety training programmes

Our training intervention has been compared with three other similarly designed patient safety training interventions in our research group: Arora *et al*^[26] delivered a half day training programme to surgical residents with significant improvement in knowledge and some improvement in safety attitudes, consistent with our results. This study has similarities with our own particularly in its design, but differed in the duration of training and the demographic of participants (trainees of a single specialty versus expert teams). Ahmed *et al*^[27] developed a training programme for senior doctors to become faculty leaders for a patient safety programme targeted towards trainees. This was a longitudinal study over a two-year period with evaluations taking place pre and post course as well as 8 mo post course. This study showed sustained improvements in patient safety knowledge, attitudes and reported skill. This study differed from ours in its aim to train faculty to deliver patient safety training to "Foundation Trainees". The number of participants was much greater as this was a regional training initiative. The concept of this study showed that senior clinicians are keen to partake in patient safety training and that "training the trainers" is feasible and a resourceful way of utilising clinical expertise. Hull *et al*'s^[33] study was designed to address the inequalities in patient safety measures in developing countries. A single day's surgical safety training was delivered to clinical and non-clinical participants in Columbia. Similarly, assessments showed improvements in knowledge and attitudes following training. Additionally

observation skills using a validated surgical teamwork rating tool^[38] also improved following training. This training intervention aimed to bridge the gap for patient safety training in developing settings. The 4 studies are summarised (Table 6).

Compared to other studies, our study is the only one that targeted a specific expert team with BCS endoscopists representing a highly skilled cohort of endoscopists. The other training interventions had a broader range of participants. One of the limitations of our study is that we did not have sufficient data to support long-term retention of knowledge or skills acquired from the training. Further developments of our training intervention could include observational assessment (live or recorded) of a BCS team conducting a colonoscopy, and rating the teamwork and non-technical skills pre and post course.

Future developments

Participants' feedback included suggestions that team training should be mandatory for all endoscopy teams in order to improve patient safety, and that teamwork optimisation was a highly important but under-recognised theme. The video case analyses of endoscopy teams were well received and suggested course developments included endoscopy team simulations with structured feedback. Additionally, it was thought that the training intervention was highly relevant to day-to-day endoscopy practice and just as important (if not more so) for non-BCS endoscopy teams.

As a pilot training intervention, this is the first step in a phased roll out of training where resources permitting, the remaining six BCS training centres will also receive teamwork training. This would then enable a core Faculty to be trained across England facilitating teamwork training to all Endoscopists through JAG. By imparting patient safety and non-technical skills training to motivated teams, the foundation has been laid to "train the trainers". This would enable local team training and thus facilitate wider dissemination of endoscopy teamwork and patient safety issues. Recent work in the domain of surgical non-technical skills has shown a United Kingdom cross disciplinary consensus regarding the importance of training faculty to assess and de-brief non-technical skills performance^[37].

Although this study used BCS teams, this training is highly transferable to other

endoscopy teams: emergency endoscopy, upper and lower GI therapeutic endoscopy as well as surveillance procedures. It could also be readily adapted for prospective GI trainees, which would enable patient safety issues to be embedded at an earlier stage in training and more widely disseminated.

Further developments could also include a practical scenario utilising a simulated or real endoscopic procedure(s). Trained faculty would closely observe the endoscopy team in action in diagnostic, therapeutic and emergency cases followed by a structured “de-brief”^[39] of the patient safety issues and relevant non-technical skills using the Endoscopic Non-Technical Skills framework as a guide.

This study shows it is feasible and valuable to deliver a comprehensive training package addressing endoscopic patient safety, non-technical skills and adverse event analysis using a multifactorial approach. This type of human factors training is novel in endoscopy and cancer screening. As patient safety is a clear priority in the context of expanding screening services, we take the view that such training should be disseminated and developed within training endoscopy units to promote safe, high quality care. Strategies to incorporate endoscopic non-technical skills and patient safety into routine endoscopy training should be explored and developed at a national and international level.

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Table 1 Participants' demographics

Participant specialty	<i>n</i>
Bowel Cancer Screening endoscopist	6
Specialist screening practitioner	6
Endoscopy nurse	8
Administrative staffs	3

Table 2 Participants (*n* = 23) patient safety knowledge assessment: Multiple Choice Question scores pre and post training

Knowledge assessment		Pre-training mean ± SD	Post-training mean ± SD	Change Mean (95%CI)	<i>P</i>-value
Correct Choice responses	Multiple Choice Question	43% ±16%	55% ± 16%	+12% (6-18)	< 0.001

Table 3 Participants (*n* = 23) patient safety attitudes pre and post training on a 5-point Likert scale (1: Strongly disagree, 5: Strongly agree)

Patient safety attitude	Pre-course mean ± SD	Post-course mean ± SD	<i>P</i>-value
Perceived patient safety knowledge			
Different types of medical error	3.3 ± 1.2	4.2 ± 0.6	< 0.001
Factors contributing to error	3.5 ± 1.0	4.5 ± 0.5	< 0.001
Factors influencing patient safety	4.0 ± 1.0	4.5 ± 0.5	0.04
Ways of speaking up about error	3.5 ± 1.1	4.3 ± 0.6	0.009
What should happen if an error occurs	3.6 ± 1.2	4.3 ± 0.7	0.01
How to report an error	3.8 ± 1.3	4.3 ± 0.7	0.11
Perceived patient safety awareness			
Able to identify situations leading to error	3.9 ± 0.6	4.3 ± 0.5	0.03
Able to take steps to ensure patient safety	4.0 ± 0.5	4.1 ± 0.5	0.45
Able to investigate errors to prevent re-occurrence	3.5 ± 0.8	4.1 ± 0.6	0.006
Understand the role of human factors in error prevention	4.0 ± 0.8	4.5 ± 0.6	0.01
Able to see potential for error and rectify it	3.8 ± 0.6	4.0 ± 0.6	0.09
Understand factors resulting in wrong site procedure	3.8 ± 0.8	4.7 ± 0.5	< 0.001
Able to prevent wrong site procedures	4.0 ± 0.7	4.5 ± 0.6	0.004
Understand factors behind drug errors	3.9 ± 0.8	4.4 ± 0.6	0.004
Able to prevent drug errors	3.9 ± 0.8	4.4 ± 0.6	0.002
Perceived influence on patient safety			
Easier to find someone to blame following an error	2.5 ± 1.2	2.4 ± 1.0	0.79
Confident addressing a colleague disregarding patient safety	3.9 ± 0.8	4.3 ± 0.6	0.07
Able to talk to a colleague who has made an error	3.7 ± 0.7	4.0 ± 0.7	0.06

Able to ensure safety is not compromised	3.5 ± 0.8	3.9 ± 0.8	0.10
Incident forms improve patient safety	4.0 ± 1.0	4.0 ± 0.8	0.59
Able to talk about my own errors	4.1 ± 0.5	4.3 ± 0.5	0.16
Attitudes towards error management			
Identifying incident causation contributes to patient safety	4.3 ± 0.6	4.5 ± 0.5	0.13
Learning from my mistakes will prevent medical error	4.2 ± 0.8	4.4 ± 0.6	0.45
Dealing with errors is an important part of my job	4.5 ± 0.5	4.5 ± 0.5	1.00
Able to challenge practices that compromise patient safety	4.5 ± 0.5	4.6 ± 0.6	0.65
It is acceptable to be honest about mistakes in my work-place	4.5 ± 0.6	4.4 ± 0.6	0.48
Admitting error would lead to fair treatment by management	4.0 ± 0.7	4.1 ± 0.6	0.32
Error management actions			
I report errors in my workplace	4.4 ± 0.7	4.5 ± 0.6	0.76
I challenge patient safety complacency	4.2 ± 0.7	4.4 ± 0.5	0.24
I communicate safety expectations to my team	4.3 ± 0.6	4.4 ± 0.5	0.39
I support team members involved in an incident	4.5 ± 0.6	4.7 ± 0.5	0.10
I inform colleagues about errors they make	4.2 ± 0.6	4.1 ± 0.6	0.71
I intervene if a patient is exposed to harm	4.4 ± 0.7	4.6 ± 0.5	0.23
I actively learn from others' mistakes	4.4 ± 0.6	4.5 ± 0.5	0.41
Personal views following an error			
Following an error I would feel afraid	3.1 ± 0.9	3.1 ± 0.8	1.00
Following an error I would feel ashamed	3.6 ± 0.9	3.6 ± 1.0	1.00
Following an error I would feel guilty	4.1 ± 0.7	3.9 ± 0.8	0.15
Following an error I would feel upset	4.5 ± 0.5	4.3 ± 0.6	0.24

I know whom to inform following an error	4.4 ± 0.7	4.5 ± 0.6	0.24
I know whom to escalate a problem to arising during a list	4.5 ± 0.7	4.4 ± 0.7	0.56
Able to request a debrief +/-support following a mistake I have made	4.1 ± 1.1	4.2 ± 0.9	0.94

Highlighted stems show areas that did not significantly change after training and would be addressed in future training sessions.

Table 4 Summary of quantitative course evaluation for 23 participants following the training intervention on a 5-point Likert scale (1: Strongly disagree, 5: Strongly agree)

Course evaluation	Statement	mean ± SD
Content	Improved my understanding of patient safety, human factors and the systems approach to error	3.95 ± 0.72
	Improved my understanding of how to analyse an adverse event and learn from error	4.14 ± 0.77
	Improved my understanding of solutions to prevent error	4.18 ± 0.66
	Enhanced my understanding of non-technical skills	4.32 ± 0.57
	Will enable me to use the Endoscopic Non-Technical Skills framework to reflect upon patient safety issues	4.23 ± 0.53
	Provided me with a set of strategies to enhance safety in the endoscopy suite	4.09 ± 0.43
	Will change my practice in endoscopy to enhance patient safety	4.14 ± 0.83
Implementation	The learning objectives were met and the take-home message was clear	4.32 ± 0.57
	Teaching and learning materials were of an appropriate quality	4.27 ± 0.55
	This course should be mandatory for all members of the Bowel Cancer Screening team	3.91 ± 1.11

	This course should be offered to non-Bowel Cancer Screening endoscopy teams	4.36 ± 0.79
Satisfaction	This course was well delivered and engaging	4.23 ± 0.53
	Overall, I was satisfied with the course	4.18 ± 0.73
	I would recommend this course to a colleague	4.18 ± 0.80

Table 5 Summary of qualitative course evaluation

Free text comments

Highly relevant to day-to-day endoscopy practice

ENTS is no-brainer need to educate others' on the topic

Video cases were really interesting and good interactive discussion

Excellent faculty, and well organised weith high quality handbook

Highly important topic, training should be mandatory for all endoscopy teams

Suggested improvements

More clinical cases

More adverse event analysis

More time for video analysis

Practical ENTS sessions in real teams

Table 6 Summary of patient safety training intervention studies

Ref.	Number of participants	Target audience	Duration of training	Patient safety outcome measures	Long term evaluation
Matharoo <i>et al</i> ^[25]	23	English BCS teams from training centres	Full day	Knowledge Attitude	No
Arora <i>et al</i> ^[27]	27	Surgical residents in North West London training region	Half day	Knowledge Attitude PSI observations	Yes
Ahmed <i>et al</i> ^[28]	216	Senior clinicians from 20 hospitals in the North Western Deanery	Half day	Knowledge Attitude Error analysis Uptake of training role	Yes
Hull <i>et al</i> ^[34]	30	Postgraduate students (clinical and non-clinical specialties) in Colombia	Full day	Knowledge Attitude Observations of theatre teams using OTAS	No

BCS: Bowel Cancer Screening; OTAS: Observational teamwork assessment for surgery; PSI: Patient safety incident.