EXPLORING MEDICAL STUDENTS' UNDERSTANDING OF NON-TECHNICAL SKILLS: A THEMATIC ANALYSIS

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ABSTRACT

Introduction: Non-technical skills (NTS) are a developing area of clinical education, partly due to the recognition that poor NTS can contribute to adverse patient events. Simulation is an appropriate teaching environment to consider these skills. Post-scenario discussions often focus on specific NTS, but these may not necessarily be what the participants think of when considering NTS. The aim of this study was therefore to analyse what one group of healthcare professionals, medical students, focused on when observing the NTS of their colleagues in simulated clinical scenarios.

Method: Medical students from two English universities were asked to observe simulated acute medicine scenarios. They were instructed to document their observations on written worksheets focusing on specific NTS comprising communication, teamwork, task management, decision-making, situational awareness and, for the last scenario, a general worksheet asking the students to consider all the NTS discussed so far. These worksheets were then transcribed and analysed using thematic analysis to elicit themes that best outlined the students' perceptions.

Results: Five themes were discovered from analysis of the five NTS from all six worksheets: team dynamics, team communication, awareness of self and events, coping under pressure and misinterpretation

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of NTS. These themes showed a difference between what the students concentrated on compared to what they were asked to consider. Analysis of these themes gave us an initial understanding of the prior knowledge and assumptions medical students bring with them to discussions on NTS.

Conclusions: Understanding prior assumptions and interpretations of NTS can better help us understand how to teach the skills effectively and build upon what our students consider important, to help construct new knowledge and skills. As analyses of adverse events in clinical practice often point to errors of NTS as causative factors, improving these skills is an essential aspect of clinical education.

Keywords: non-technical skills, simulation, medical students, thematic analysis

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INTRODUCTION

Non-technical skills (NTS) are commonly defined as the cognitive, social and personal skills that, alongside technical skills, help promote safe and effective performance in tasks (Flin, O'Connor and Crichton 2017). Historically neglected from the medical curriculum (Pearson and McLafferty, 2011; Lee et al., 2021) research into the incorporation of NTS in undergraduate medical education has grown recently. Different categories of NTS have been developed (Flin et al., 2010; Flin, O'Connor and Crichton 2017), but they generally include communication, teamwork and leadership, task and stress management, decision-making and situational awareness.

As analyses of adverse events often point to errors in NTS as causative factors (Gawande et al., 2003; Mishra et al., 2008; Hull et al., 2012; Flin, O'Connor and Crichton 2017), it is therefore unsurprising that a focus on teaching and evaluating these skills is being integrated into undergraduate medical training. Simulation has frequently been highlighted as an appropriate method for focusing on NTS (Scalese, Obeso and Issenberg, 2008; Castanelli, 2009) and its use in healthcare education has been encouraged by the United Kingdom's Department

of Health (DOH, 2008, 2011) as well as medical ethicists (Ziv et al., 2003).

Simulation-based teaching aims to replicate real patients, clinical tasks and the environments in which the scenarios occur (Scalese, Obeso and Issenberg, 2008) and are generally performed in small groups with a facilitated post-scenario debrief.

Simulation as a method for teaching NTS aligns well with the constructivist philosophy, as facilitated reflection and debrief allows learners to consider their prior knowledge, actions and interpretations and construct new views (Bada and Olusegun, 2015) through the simulation experience. Similarly, situated learning theory emphasises that learning happens in the context and community in which the learner will then use that knowledge (Lave and Wenger, 1991), an environment that simulation lends itself well too. By allowing the learners to work through a scenario in a small team in a safe and supportive environment, the learners are given the opportunity to practise and discuss their NTS together, supported by a trained facilitator.

There is evidence that simulation-based teaching can result in improved NTS in healthcare professionals (Lewis, Strachan and Smith, 2012) and some limited evidence that suggests this improvement could result in better patient outcomes (Gordon, Darbyshire and Baker, 2012). Large variations in teaching methods and outcome measurements make patient outcome conclusions difficult (Gordon, Darbyshire and Baker, 2012).

There is generally a shared agreement in what constitutes NTS amongst researchers (Peddle, Bearman and Nestel, 2016). However, very little research has been done to establish what our students' understanding of NTS are. Constructivism assumes prior knowledge as a significant influencing factor to creating new knowledge (Dennick, 2016). Whilst it is possible that students attend simulation sessions with pre-formed (or lack of) concepts about NTS and how to work effectively as members of a team, there is a lack of literature in this area. To adequately teach NTS, it is important to first explore what the student understands as non-technical skills, and what they believe to be examples of good and bad practice. For this reason, this study aims to explore what medical students perceive as important in NTS, through analysis of their written records whilst observing simulated clinical scenarios prior to facilitated discussions.

METHOD

Development

As part of their usual medical education, students from two English universities participate in a series of hospital based acute medicine scenarios in a simulation suite. The scenarios are repeated each session with new students to ensure all participants receive a similar learning experience. Students take turns participating in the scenarios, while the rest of the group observe their peers. To help the observing students focus on NTS they are handed worksheets to complete. Each worksheet has a brief definition of a recognised NTS and some examples of behaviour to look out for. An example worksheet is shown in Figure 1, with the definitions and examples for all six worksheets shown in Table 1. The students were asked to write on the worksheet what they believe the team did well, how the team could improve, and any important learning points gained from observing the scenario in relation to that specific NTS. The skills covered in the worksheets included communication, teamwork, task management, decision-making, situational awareness and, for the last scenario, a general worksheet titled 'what have we changed today' asking the students to consider all the skills discussed so far.

Reflexivity

Collecting in and reviewing these worksheets after the sessions showed the students were making some interesting and diverse observations about NTS. The authors then discussed different ways of further exploring medical students' understanding of NTS. Prolonged engagement with the students and a triangulation of methods was not possible due to time constraints (Holloway and Galvin, 2017). As the initial worksheets showed promising data, analysis of future worksheets as the method of exploration was decided upon.

Ethical Approval

Approval was sought and granted by the Trust's research department to begin a qualitative analysis of future written worksheets, with full ethical approval not required. The scenarios and worksheets were continued in the same manner as prior to the study, to conserve the

Communication

COMMUNICATION
The imparting or exchanging of information

"Learning to communicate effectively means making the most of every opportunity to interact with others: to be positive and encouraging to your team, to show empathy and concern to your patients, and to be able to deal with demands and difficult emotions"

Green M., Parrott T., Crook G. Improving your communication skills BMJ 2012; 344

Key things to look out for:

- Introductions are made

- Names used

- Clear and polite

- No jargon used

- Clarifies important aspects

- Closed-loop communication

- Time-out/huddles

- SBAR handovers

What went well?
Include some specific examples

What could be improved?
Include some specific examples

Key communication learning point
One thing you will change in your practice after watching this SIM

Figure 1. An example worksheet

educational experience the students received. No material prior to the study commencement was used in the analysis.

The sessions were run as previously, and informed written consent for participation was obtained from the students at the end of the sessions with the option to withdraw their writing should they not wish it to be analysed. Gaining consent at the end of the session ensured there was no impact of the study on the student's observations, and no student was disadvantaged educationally by not wishing to participate. The students were given participant information sheets, the study aims explained, and written consent obtained before their worksheets were collated. Every student agreed for the anonymous analysis and publication of their observations, and so no worksheets needed to be destroyed.

Table 1. The definitions and examples from each of the six worksheets

Non-technical skill	Definition	Quote	Examples to look out for
Communication	The imparting or exchanging of information	'Learning to communicate effectively means making the most of every opportunity to interact with others: to be positive and encouraging to your team, to show empathy and concern to your patients, and to be able to deal with demands and difficult emotions' Green M., Parrott T., Crook G. Improving your communication skills BMJ 2012; 344	- Introductions are made - Names used - Clear and polite - No jargon used - Clarifies important aspects - Closed-loop communication - Time-out/huddles - SBAR handovers
Teamwork	The effective and efficient combined action of a group	'…teamwork relates to performance regardless of characteristics of the team or task. Healthcare organisations should recognise the value of teamwork and emphasise approaches that maintain and improve teamwork for the benefit of their patients'. Schmutz JB, Meier LL, Manser T. How effective is teamwork really? The relationship between teamwork and performance in healthcare teams: a systematic review and meta-analysis. BMJ Open. 2019; 9(9)	- Communicated well as a team - Delegated tasks (and to the correct person) - Worked efficiently together - Discussed ideas openly - Support each other - Challenge appropriately

Task Management	The process of tracking a task through its life cycle and making decisions based on its progress	'In modern day medicine, where resources are increasingly expected to go further, there is too much to do and too little time to do it in, while at all times the highest standards of patient care have to be maintained' Christie Sarah, Green Matt. How to improve your time management skills BMJ 2012; 344	- Plans what is needed - Prioritises appropriately - Avoids overloading team members with tasks - Attends to patient's needs - Thinks ahead to likely outcomes and prepares accordingly
Decision-making	The act or process of deciding something, especially with a group of people	'**Decision-making** in health care involves consideration of a complex set of diagnostic, therapeutic and prognostic uncertainties. Medical therapies have side effects, surgical interventions may lead to complications, and diagnostic tests can produce misleading results'. Hunink, M., Weinstein, M., Wittenberg, E., Drummond, M., Pliskin, J., Wong, J., & Glasziou, P. (2014). Decision-making in Health and Medicine: Integrating Evidence and Values (2nd ed.). Cambridge: Cambridge University Press	- Shared decision-making - Takes into account patient preference - Uses up-to-date evidence - Decisions appropriate to clinical state and setting - Changes decision based on changing circumstances

(Continued)

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Table 1. (*Continued*)

Non-technical skill	Definition	Quote	Examples to look out for
Situational Awareness	Knowing what is going on around us, or – more technically – the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future	'…doctors begin with a limited amount of situational awareness and often fail to maximise their situational awareness using a team approach'. Singh H., Peterson LA., Thomas E.J, Situational awareness in medicine. BMJ Quality & Safety 2006; 15:384	- Leader takes a step back and sees the big picture - Team is aware of changing circumstances as they develop - Key aspects communicated to all -Patient re-assessed
Key Learning Points	We've gone through a lot today, your job is to summarise the learning and look at how the group has developed.	**So far we've looked at:** - Communication - Teamwork - Task Management - Decision-making - Situational Awareness Can you put them all together and think of how the group has improved?	- Re-assessing as things change - Clear, group decision-making - Prioritising tasks - Involving the patient - Calling for the appropriate help in a timely manner - Patient safety

Data Collection

Data collection commenced in September 2020 and ran until December 2020, and in total 66 students consented to participate. A non-selective convenience sampling strategy was employed with participants selected on a first come first serve basis (Holloway and Galvin, 2017). A large number of students were recruited as it was evident from the pre-study worksheets that some students record few or no observations. To gain enough data to extrapolate meaningful themes it was anticipated that a large sample size would be required.

From the 66 participants, 54 came from the penultimate and final years of a graduate-entry medical degree programme and 12 came from the final year of an undergraduate-entry medical degree programme. They all attended as part of a rotation through acute medicine in a teaching hospital. Each student participated in or observed the same six acute medicine scenarios in groups of 5–6 students. Each scenario lasted roughly 15 minutes, followed by a 20–25 minute debrief, and had 2–3 student participants and at least 2 student observers. The six scenarios are described further in Table 2. Each session was facilitated by two or three of seven trained facilitators. The facilitators were all healthcare professionals with at least five years of postgraduate experience as well as simulation and debrief training, and included consultants, registrars, and an advanced clinical practitioner.

Transcription and Analysis

As the study aimed to elicit common meanings from the thoughts and perceptions of medical students, thematic analysis was chosen as the most suitable method (Kiger and Varpio, 2020). Thematic analysis is a qualitative analysis method that seeks to identify, analyse, and then describe patterns across a data set (Braun and Clarke, 2006). To guide the analysis, Braun and Clarke's six steps were used (Braun and Clarke, 2006).

The worksheets were collected and stored securely and anonymously until the end of the data collection period. They were then split into the six worksheet topics and distributed to the authors. To enhance credibility the worksheets were transcribed verbatim (Holloway and Galvin, 2017) from written to typed word using Microsoft Word. If

Table 2. The six scenarios

Scenario title	Basic description	NTS focus 1	NTS focus 2
Sepsis	30-year-old patient in ED with chest sepsis, improves with sepsis six treatment.	Communication	Team Work
Atrial fibrillation and heart failure	80-year-old patient on the ward with a recent myocardial infarction. Improves with Advanced Life Support (ALS) treatment.	Team Work	Communication
Seizure	45-year-old patient on the ward treated for an infection but in alcohol withdrawal. Needs treatment and bag mask ventilation before improving.	Task Management	Decision-making
Anaphylaxis	70-year-old patient in ED with confusion. Treated for sepsis but goes into anaphylaxis that responds to treatment.	Decision-making	Situational Awareness
COPD and non-invasive ventilation (NIV)	70-year-old patient in ED with non-infective exacerbation of COPD with type 2 respiratory failure. Has NIV then develops a pneumothorax.	Situational Awareness	Task Management
Supraventricular tachycardia (SVT)	20-year-old in ED with SVT after a night out. No response to treatment and goes into cardiac arrest. Circulation restored with ALS treatment.	What have we changed today	

the students had written a name on the worksheets these were changed to titles such as 'STUDENT' or 'PATIENT' to maintain anonymity. Whilst the worksheets for the two universities were initially transcribed separately, early analysis did not pick up any major differences between the two data sets and so further analysis was done collectively.

The transcripts were checked by the lead author and uploaded to Taguette (www.taguette.org), a free open-source web-based qualitative analysis tool. Before analysis began the authors met to discuss thematic analysis, agree on the aims of the study and learn how to use Taguette. All authors were given access to two worksheet topics, as a primary analyser for one topic and a secondary analyser for a second topic. Inductive thematic analysis carries a risk of the researchers own experiences influencing their analysis. Acknowledging this and using a second person to agree on the themes helps to diminish this effect (Holloway and Galvin, 2017). The primary analyser for each topic familiarised themselves with the data, generated initial codes and searched for recurring themes. The secondary analyser double checked the primary analyser's work, reviewing the themes and ensuring that all data was coded correctly.

The primary author then completed a third review of the coded work, checking the transcribing was consistent, collating the quotes together under the emerging themes and organising the coded data. All authors then met to do the final analysis of the themes collectively and grouped them into six topics, defining and naming the resultant overarching themes and their subthemes as a team.

RESULTS

Whilst each NTS was initially analysed individually, the considerable overlap between the themes from each skill justified moving to a collective analysis, and the concentration of the codes into final overarching themes that consisted of data from across the five skills. The final worksheet, 'what have we changed today', highlighted what the students found most relevant, and was also included in the analysis and formation of the themes. In all, 5 overarching themes were elicited: team dynamics, team communication, awareness of self and events, coping under pressure and misinterpretation of NTS. Whilst there is

obvious overlap between some of these themes and the five NTS the students were asked to consider, the subthemes and examples included give us greater insight into what the students consider as important.

Team Communication

Whilst communication was one of the 6 individual non-technical skills the students were asked to focus on, aspects of communication appeared so frequently in the other skills that it can be argued that the requirement for good communication is paramount for the successful execution of other skills like teamwork and task-management, and underpins the students understanding of what makes for good NTS.

Team communication was defined as the ability of the team to communicate well with each other and the patient. Communication amongst the team was generally perceived to have been effective, whilst communication with the patient was often described under 'areas to be improved' section of the worksheet. Communication with the team involved the use of huddles or time-outs to keep everyone up-to-date and feeding back when tasks had been completed (closed-loop communication). Communication with the patient involved the need to introduce each member of the team by name and role, update frequently (keeping the patient informed) and to reassure them. The common subthemes and example quotes (as well as the worksheet the quotes were taken from) for team communication are outlined in Table 3.

Team Dynamics

Team dynamics was defined as the ability of a team to work effectively as a collective. Whilst closely related to teamwork, it was again present across multiple NTS. The students frequently commented that, for a team to work effectively, it required role allocation, task delegation, collaborative thinking and reaching a consensus. Interestingly, strong leadership was not frequently mentioned outside of the need to assign roles and tasks fairly. It was considered more important to discuss events, double check investigations and prescriptions, and reach a shared management plan as a team, than for one person to take overall leadership responsibility. Common subthemes are outlined in Table 4, alongside example quotes.

Table 3. Common subthemes from team communication

Subtheme	Quotation as it appears in the raw data
Huddles / time-outs	Tried to discuss things together (Communication) Good communication within team huddles (Teamwork) Make sure everyone's on the same page (Situational Awareness) Might be worth taking a step back on occasion to reassess or get input from your team (Situational Awareness)
Closed-loop communication	Should talk about her findings so STUDENT 1 knows what's going on – closed loop communication (Communication) Good closed loop communication (Situational Awareness) Close the loop of communication, i.e. 'cannulas now in' (Communication)
Introductions to the patient	Introductions made, names used (Communication) Maybe introduce STUDENT 1 earlier (Communication) In the beginning before taking hx STUDENT 1 should have told the pt *(sic – patient)* that her colleague will start assessing her (Teamwork)
Keeping the patient informed	Including patient in management plan (Communication) Involved the patient – took into account preference + explained (Decision-making) Leader standing at the end of the bed keeping the patient in the loop (Situational Awareness)
Reassuring the patient	Reassure patient more (Communication) Talked to patient before doing something to patient. Good reassurance (Teamwork) Could have tried a bit more reassurance to the patient (Situational Awareness)

A regular descriptor subtheme in team dynamics was 'clarity'. For example, it was not enough for roles to be allocated, they needed to be done clearly to ensure everyone in the team was aware. It was seen as important that people stuck to their roles and tasks and fed back any changes to the team, to ensure that nothing was missed. This allowed for the team to be utilised effectively, with 'effective' and its synonyms being another common descriptor.

Table 4. Common subthemes from team dynamics

Subtheme	Quotation as it appears in the raw data
Roles defined	Everyone was partnered with their roles (Communication) Clear allocation of roles at the start (Decision-making)
Tasks delegated	Good delegation of tasks: e.g. fluid prescription (Teamwork) Good job allocation (Decision-making)
Collaborative thinking	Collaborated ideas (Teamwork) Good discussion amongst member, listened to all members. Everyone allowed an opinion. (Teamwork)
Reaching a consensus	Group came together to come to a solution (Teamwork) Agreed to call for help – problem solve how to do initially (Teamwork)
Double checking	Double checking with each other (Teamwork) Communicated well. Double checking (Teamwork)
Clarity	Clear instructions to teammates (Communication) Clear instructions from STUDENT 1 – 'lets *(sic)* start on A-E' (Communication) Clear allocation of roles immediately (Teamwork)
Effectiveness	Delegated the A-E task & split it mong the team, so things were being done simultaneously (Teamwork) Utilized team members well (Teamwork) Quick at assigning roles (Decision-making)

Awareness of Self and Events

Awareness of self and events was defined as the ability of team members to notice, analyse and react to an ever-changing scenario. It required all team members to be aware of their roles and limitations and verbalise if they felt they were out of their depth. The students appreciated the need for good quality assessment (and re-assessment) to keep on top of the clinical case and highlighted using a familiar structure, such as an A-E assessment, to guide them as being helpful. The importance of early recognition of deterioration was supported by doing a structured re-assessment.

Awareness that team members were becoming task focused and needed to step back and see the bigger picture or prioritise different tasks was highlighted in some circumstances. Recognition of the need to follow up on instructions from other members of the team, such as investigation requests, was highlighted to ensure important aspects of patient care were not omitted. And when the students felt out of their depth and needed help, early escalation to the appropriate team or person was frequently commented on. The common subthemes and example quotes for awareness of self and events are outlined in Table 5.

Table 5. Common subthemes from awareness of self and events

Subtheme	Quotation as it appears in the raw data
Recognising own limitations	Call for help as soon as unsure (Communication) Remember you're an fy1 if unsure call for help (Communication) Asking teammates for help (Decision-making)
Assessing and re-assessing the situation	Good reassessment when pt *(sic – patient)* felt worse (Task Management) Did a review part way though to re-evaluate *(sic)* and check everything is done (Decision-making)
Early recognition of deterioration	Early recognition of breathing as the main problem (Task Management) Good awareness of obs *(sic – observations)* + any changes (Situational Awareness)
Prioritisation	Focused on key aspects of the history (Task Management) Prioritise or delegate analgesia to optimise patient comfort (Task Management) Early prioritisation of concerns (Decision-making)
Follow-up on tasks	Pick up ABG results when you run it (Task Management) Closed loop communication – when tasks were completed (Communication)
Timely and appropriate escalation	Called for help early (Task Management) (Decision-making) Got help at appropriate time (Situational Awareness)

Coping Under Pressure

Coping under pressure was defined as the ability for the team to collectively manage a stressful situation. Those who did so with a calm and polite demeanour were viewed favourably, as were teams who supported each other and spotted when team members were overloaded or unsure. The use of delegation and assigning roles (from team dynamics) was seen to facilitate this, to avoid multi-tasking or losing focus. Falling back on assessment structures or guidelines were seen as an effective coping mechanism, and making decisions in a timely fashion, particularly when seeking help or escalating care, was beneficial. Table 6 outlines the subthemes and quotes further.

Table 6. Common subthemes from coping under pressure

Subtheme	Quotation as it appears in the raw data
Calm and polite	Leader was very calm and clear (Communication) STUDENT 1 – clear and polite, explaining interventions to patient (Communication)
Supporting each other	Recognition of overloaded tasks + helping (Task Management) Team leader helped when they needed (Teamwork) STUDENT 2 kept asking nurse to do job, which he could have managed, especially when there were more team members (Task Management)
Using a structure	Have a clear/systematic process (Task Management) Always reassess if uncertain (go back to thorough A->E approach) (Situational Awareness) SBAR -> could have been a little more slick (Communication)
Using guidelines	Good time to consult the guidelines- used guidelines well (Task Management) Delegatd (sic- Delegated) well to look at alcohol withdrawal guidelines. Good discussion between team finding guidelines (Teamwork)
Speed of decision-making	Quick decision-making (Decision-making) Maybe quicker call with peri arrest (Task Management) Took some time to call for help (Situational Awareness) Identify early the need for escalation (Teamwork) Spent time discussing calling for help without action (Decision-making)

Table 7. Examples of misinterpretation of NTS, as they appear in the raw data

Bloods when cannulating (Task Management)
Do a pregnancy test (Task Management)
Venturi for COPD (Task Management)
Remembered COPD diagnosis (Situational Awareness)
CXR *(sic- Chest X-Ray)* (Decision-making)
?RR *(sic- Respiratory Rate)* ?temp *(sic- temperature)* ?pain (Communication)
Aortic regurg? *(sic- regurgitation)* Mitral? (Communication)

Misinterpretation of NTS

The final theme elicited was the misinterpretation of NTS. This was defined as comments the students made about technical or clinical skills as opposed to the NTS they were asked to focus on. Whilst good clinical knowledge and skills are of course paramount in managing an acute medical scenario, the frequency they were focused on was surprising given that the students were provided worksheets with specific skills, definitions, and examples of what to look out for. Examples of misinterpretation include highlighting the correct interpretation of an investigation, the successful completion of a technical skill such as cannulation, and the appropriate diagnosis being reached. Further examples of this theme are show in Table 7. It could be argued that these comments were made with regards to task prioritisation or decision-making, but asking the students for the reasons behind their comments are not possible due to the anonymity of the participants.

DISCUSSION

This analysis aimed to explore what medical students perceive as important in NTS, to help form an understanding of the concepts medical students hold surrounding good or bad clinical practice. It did not aim to redefine known NTS, but to see how students' prior assumptions may differ from what we aim to teach. As previously mentioned,

constructivism assumes prior knowledge as a significant influencing factor to creating new knowledge (Dennick, 2016). As feedback (including debrief) has been argued to be the most important part of a simulation-based education (Issenberg et al., 2005), facilitators need to understand what this prior knowledge may be, before aiming to create new knowledge.

This study helps educators understand the foundation of knowledge their students have, which can help during simulation debrief. For example, the importance students place on assigning roles, delegating tasks and working collectively as a team, instead of having a strong leader could be contrary to what some simulation facilitators may be looking for when they assign a 'leader' in a scenario. As effective debrief requires facilitators to guide their learners rather than lecture them (Fanning and Gaba, 2007), trying to guide students to talk about the benefits of strong leadership in this case may fail and create friction between the facilitator and students, damaging learning.

It is clear from the frequency that technical skills were mentioned instead of NTS, that medical students still tend to concentrate on the technical and practical aspects of the scenario, even when asked to focus on a specific NTS. The reasons behind this are unclear. Perhaps this is due to a misunderstanding of what NTS are, or how to identify and describe them, or simply a preference to focus on and discuss the technical aspects of the scenario. This may suggest facilitators should make time to discuss technical as well as non-technical aspects of the scenario, a proposition backed by multiple theories that support the use of simulation for teaching technical skills (Castanelli, 2009).

Whilst there is some overlap amongst the themes, the use of thematic analysis allowed the authors great flexibility in exploring what the students perceive. As these worksheets were completed during the scenario, and before the post-scenario debrief, they are a good insight into the perceptions and understandings of our students and not influenced by the opinions of the facilitators.

There is not much published literature in this area for comparison. Hamilton et al. (2019) conducted semi structured interviews around NTS with 16 medical students after an acute simulation session in order to develop a behavioural marker system. They found that the medical students considered situational awareness, teamwork and communication, decision-making and prioritisation, self-awareness

and escalating care to be their main categories. They also discovered overlapping in their themes, with escalating care in particular being incorporated into all their categories. Their inclusion of a 'self-awareness' category is similar to our 'awareness of self and events', highlighting that this may be an area previously overlooked when discussing NTS in acute care simulations.

This study has highlighted the NTS that medical students perceive are important aspects of good clinical practice. There was a strong focus on working as a team, with the team dynamics, team communication and supporting each other a significant part of their observations. It was also seen as important to have a defined role in the team, or specific tasks to complete, to work well together. The recognition of when they or their colleagues were struggling and then supporting each other or seeking support from seniors or other teams was another major focus. Other supportive measures included using guidelines or recognised assessment structures to help direct their actions and manage the patient.

Strengths and Limitations

This study included a large number of medical students from two different universities. Whilst this study collated the observations of 66 medical students, it was still centred around the teaching environment of one single-centre hospital. It is possible that the scenarios, equipment, room layout, facilitators and culture of the establishment could all play a role in modifying the results. The similarities between our themes and those of Hamilton et al. (2019) reduce the likelihood of this. There is also a risk of power bias, though the collection of private written observations rather than what was verbally discussed helps to mitigate against this.

The authors were all trained in NTS, simulation and performing a facilitated debrief, with a variety of prior experiences in clinical work and education. The use of multiple people to analyse, double check and collectively discuss the data limits the risk that the resultant themes were based on an individual's prior assumptions.

The study is limited by its retrospective design. The data was created during scheduled simulation sessions and then included in the study only with the informed written consent of the students, thus avoiding any

influence that knowledge of the study may have on their observations. But this method did not allow for analysis of the themes further than the raw data allowed. A next step could be to discuss these themes in a focus group, to gain a deeper understanding and to further consider the reasons behind the misinterpretation of NTS on the worksheets.

Conclusion

When asked to consider the commonly researched NTS of communication, teamwork, decision-making, task management and situational awareness, the medical students instead focused on overlapping themes of team dynamics, team communication, supporting each other and coping under pressure. They also frequently focused on technical skills, and discussed aspects of practical skills, history taking and management instead of focusing on the assigned NTS. Further research to establish the reasons behind this would be warranted. Understanding these prior assumptions surrounding what constitutes NTS, and contributes to good patient care, can help develop our understanding and inform future teaching in this area.

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Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Authorship credit is based upon the following:

(1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; (AT, JJ, MB, QK, CB, RS)
(2) drafting the article (AT) or revising it critically (JJ, MB, QK, CB, RS) for important intellectual content; and
(3) All authors read and approved the final manuscript

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