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British Journal of Oral and Maxillofacial Surgery 58 (2020) 404–408

BRITISH Journal of Oral and Maxillofacial Surgery

www.bjoms.com

Review

Leading article: What can we do to improve individual and team situational awareness to benefit patient safety?

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Accepted 28 January 2020
Available online 27 February 2020

Abstract

It is increasingly being recognised that human factors can contribute to error in complex safety systems. Healthcare, however, has a long way to go before the promotion of training in, and awareness of, human factors will catch up with other high-risk organisations. A critical component that is deemed essential both for improving clinical performance and reducing medical error is situational awareness (SA). This is dynamic and can reduce quickly or be lost entirely, particularly when the workload is heavy. Tunnel vision, in which healthcare professionals concentrate on a single aspect of a patient's care, is just one example of reduced awareness that can be detrimental to safety. As in aviation and other high-risk organisations, a reduction in SA, if not recognised by individuals or the wider team, can lead to serious or potentially fatal outcomes. We therefore give an overview of SA and show how it can easily be reduced. We also suggest some simple but effective ways to improve it and in turn improve patient safety. We emphasise the importance of clinical teams looking out for each other, particularly in the operating theatre.

Keywords: Human factors situational awareness; patient safety; medical error; tunnel vision; team working

Introduction

Human error - meaning something that has been done that was not intended - affects us all. The Latin phrase *errare humanum est,* which is often used as a part of a longer English proverb *to err is human, to forgive, divine,* is apt: we are all human and we all make mistakes. It is well known in high-risk organisations (including aviation and the nuclear industry) that human factors contribute to many errors, and that regular training in human factors and awareness helps to reduce risk. Healthcare still has a long way to go before this is embedded for all staff.

An important area that can lead to medical error is the reduction in, or loss of, situational awareness (SA). SA itself can be defined as *the perception of environmental elements within time and space, the understanding and processing of their meaning and the projection of their status in the near future*.[1] When discussing it at an operator level, we can define it more simply as what has happened, what is happening right now, and what might happen in the future (Fig. 1). It is dynamic and can change rapidly, or remain stable for long periods, depending on conditions. It cannot be measured – levels can, however, be inferred from observable behaviours

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https://doi.org/10.1016/j.bjoms.2020.01.030

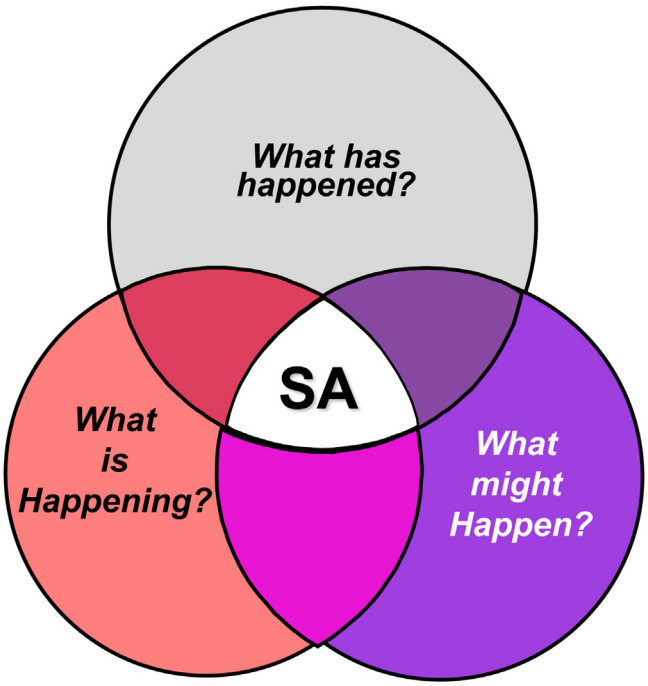

Fig. 1. An easy graphical way to understand situational awareness (SA) and appreciate that it is a dynamic process.

Fig. 2. Situational awareness is critical in many circumstances, no more so than in situations like this flown by one of the authors (SM).

– for example, surprise, which would indicate that it was lacking.

What is the background of the recognition of SA in medicine?

The term SA was used in early texts such as *The Art of War* over 1000 years ago,[2] but it probably had its modern origins during the Korean War when American fighter pilots needed constantly to anticipate, and to be aware of, their enemy. It is now widely used in both commercial and military aviation in the development of communication tools and platforms to improve the self-awareness of the aircrew and team (critical in some circumstances such as in Fig. 2),[3] and as one of the key competencies of pilots.

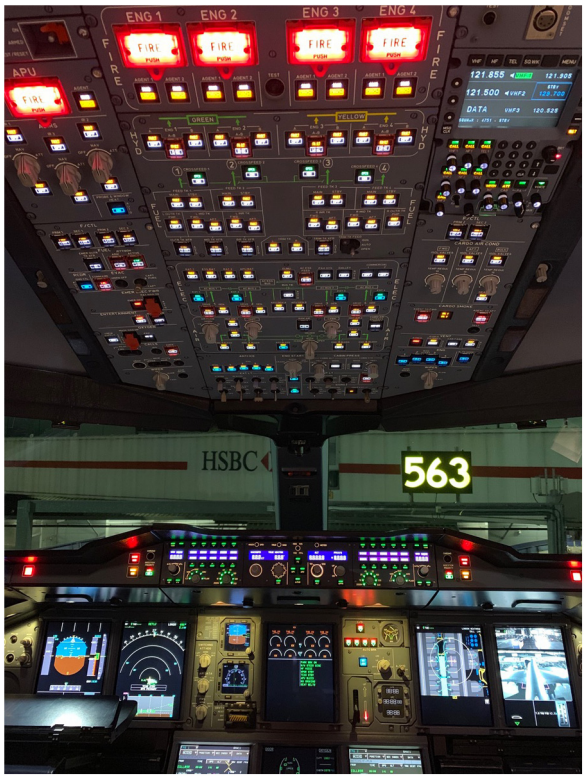

Fig. 3. Automation can distance team members from the reality of the situation. As on the flightdeck (in this case an Airbus A380), the operating theatre can have complex dynamics that can lead to loss of situational awareness.

In many industries, interest in the importance of high levels of SA and the recognition that it can reduce error, is growing. In healthcare it is vital to ensure patient safety and reduce clinical error. The scale of medical error is shocking - a recent meta-analysis of over 337 000 patients found that it occurs in approximately 1 in 20 hospital admissions, and that up to 6% of these errors result in serious incidents or death.[4]

The clinical setting, particularly the operating theatre, is complex, dynamic, and constantly changing. Unlike aviation in which technology rarely fails, our patients are sick and regularly have either expected or unexpected complications. When the effects of the human element are added to this, a situation can change or deteriorate very quickly (sometimes in seconds) so the appreciation and recognition of SA are essential.

Technology has the potential to distance healthcare professionals from the current situation. This has also been recognised on the flight deck at the pilot-technology interface, particularly when the workload is heavy - for example, automated systems can distance pilots from the actual situation that is developing (Fig. 3).[5] If not recognised at an early stage, a loss of SA by divers can rapidly lead to a downward spiral and quickly result in complications or even death.[6] In medicine, a well-known example is the case of Elaine Bromiley, a young, healthy woman who died during routine sinus surgery. The anaesthetists lost her airway at an early stage and in the confusion there was a lack of leadership. Repeated

attempts to intubate resulted in the team developing tunnel vision and losing all track of time, and she died from cerebral hypoxia. This tragic case could have had a different outcome if members of the team had recognised that they had lost awareness and had responded better to others. A few seconds' pause, for example, to think about alternative options would have resulted in a simple needle cricothyroidotomy. Rather than blaming the team, her husband Martin, an airline pilot, recognised that the root cause of the tragic outcome lay in a loss of SA, and as a result formed the Clinical Human Factors Group.[7]

How can we build SA in a team?

The above case shows how our decisions and actions can be based on the information gathered and processed by the whole team, particularly when no one is leading the process. The team briefing before the start of any operating list is an ideal opportunity to develop and improve the SA of everyone present and reduce the perceived hierarchical gradient. It is also an opportunity to discuss "what if", to identify the high-risk elements of the procedure, and assign tasks to the various members in the event of one occurring.

At this stage, empowering junior doctors or other healthcare professionals to speak up without fear of retribution can ensure that all members of the team look out for each other.[8] The involvement of trainees when decisions are made about patients can promote information-sharing between colleagues of different levels of experience, and help to develop the overall SA of both the trainee and the team.[9] It can also help junior doctors to understand the goals expected by consultant colleagues, to make use of the skills, knowledge, and expertise of the whole team, and allows consultants to identify gaps in the knowledge or understanding of their trainees.

A good team briefing is essential to prepare for the development of an unexpected situation or complication.[10] The briefing should go far beyond the standard WHO checklist, and a thought-provoking question that changes members' engagement for the better is: *would you behave differently if your own life or limb depended on this team briefing and checklist?* We also advocate the use of several practices from aviation - for example, two highly effective questions that can be asked at the start of a theatre briefing: *what if..?* and *what am I expected to do if something goes wrong?* This prepares the team for possible complications, as *what if?* situations will have been discussed and will therefore be fresh in our minds. Every member of the team should know in advance their role in the unlikely event of a major problem or complication.

Occasionally, members of the team can be allocated specific duties, such as the prioritisation of tasks in the event of a complication, and a leader/coordinator chosen to convey important information. The latter is particularly important when the nursing team might change because of shifts. Even when a situation develops that is different from the one discussed during the briefing, many of the benefits remain, and members of the team will speak up with queries or concerns, offer support, and seek assistance when needed.

Checklists can reduce the likelihood of complications, infection rates, and mortality, and can help to develop the SA of the team during training and simulation sessions.[11]

Factors that can influence the SA of the whole surgical team

Several human factors, such as attention and working memory, can influence the accuracy and completeness of SA in the complex environment of an operating theatre. The attention we give to others and to the task in hand is based on the importance, processing, and understanding of the information received.

Some of the errors that have resulted from a loss of SA have occurred in situations when all the information was present, but members of the team did not act on it appropriately, probably because of distraction.[12] The latter can disrupt the procedure, reduce patient safety, and be a major cause of medical error.[4,13,14] Since our working environment is constantly changing, we need to keep our eyes and senses wide open and, at the same time, focus on more detailed information. The person with the lightest workload is often best placed to monitor the whole team.

An example of this would be a surgeon who loses track of time during a complex operation because he/she is so focused on the task in hand. Intense concentration can narrow the attention (effectively, another example of tunnel vision) and lead to a potential loss of SA.[15] In these situations, it can be beneficial if team members look out for each other - for example, if the scrub nurse or assistant notices that the operating surgeon is performing less well, he/she (having been empowered to speak up at the team briefing) can point out the need to take a short break.[16]

The overall SA of the team is only as good as the lowest SA of any of its members, and this should be remembered. It is sometimes the least qualified person who realises that something is wrong, again highlighting the importance of the team briefing to empower everyone to speak up. A useful practice that can be discussed at the briefing is to stop when something does not seem quite right. During long and complex cases that can take many hours, we routinely stop for a break every two to three hours, and the scrub nurse keeps an eye on the time. The value of this cannot be emphasised enough, as it allows the team to return fresh, hydrated, and adequately fed, improving performance.[17] The mnemonic HALT (meaning stop if you are hungry, angry, late or lonely, or tired), which is good basic advice that can be used as an adjunct to improve SA, is known to improve patient safety.[18]

Short reviews can also help to align SA as matters progress. Briefly setting out where we are, and reiterating the key points of what lies ahead, not only helps everyone remain up to speed, but allows anyone to question ambiguities or highlight changes.

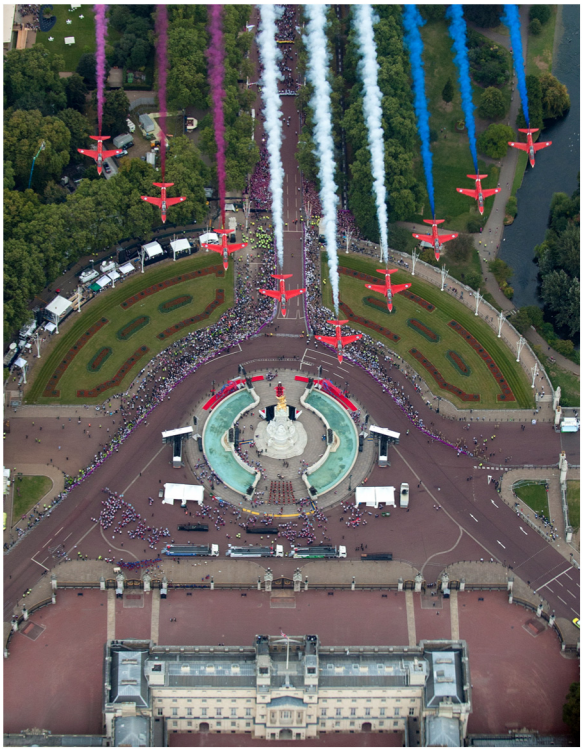

Fig. 4. Team "SA" at its best.

Cognitive biases can have a substantial impact on SA. Confirmation bias, defined as *the unconscious preference for evidence that supports, confirms or fits our beliefs as opposed to supporting evidence that contradicts,* should be remembered as a factor that can lead to medical error.[19] It is easier to use evidence unconsciously to confirm what we think to be correct than to stop and re-evaluate the situation with other members of the team (for example, some unusual anatomy), probably because it is the brain attempting to take the route of least mental effort.[20]

Is it possible to train surgeons to improve their SA?

It is not clear whether cognition, the capacity for mental processing, and speed can be improved, although regular training has improved the SA of pilots.[21] A recent review that evaluated SA in the operating theatre found that no method of training had been fully validated or implemented within surgical curricula, and most research has focused on the development of SA in the individual rather than in the whole team.[22] While the formal training of surgeons and healthcare professionals to improve their SA may be difficult, that of the team can undoubtedly be improved by following basic principles, including those described above. At its best, effective SA in a team can be unrivalled (Fig. 4). A simple mnemonic to assist and build awareness both for individuals and teams is SLAM (Table 1).

Table 1
SLAM - a useful mnemonic that helps to build situational awareness both for individuals and the whole team.

Stop	Down tools, think through the task and engage brain!
Look	Is anything out of the ordinary or not quite right?
Assess	Are you and the team prepared for the unexpected?
Manage	Regroup, talk with the whole team, change actions as necessary

The Non-Technical Skills for Surgeons (NOTSS) course (run by the Royal College of Surgeons of Edinburgh), which has high levels of reliability and validity, includes an assessment of SA within a rating scale for behaviour in the operating theatre.[23,24] Many courses on human factors include elements of NOTSS, and these will aid our understanding and appreciation of the contribution that SA makes to medical error.

Conclusion

The loss of SA, either by individuals or teams, can have an adverse effect on patient safety. SA is a dynamic process that is constantly changing, and it depends on circumstances, other human factors, and the interaction between healthcare providers and technology.

The importance of a thorough team briefing before an operating list cannot be emphasised strongly enough. It should empower all members of the team to speak up without fear if they have concerns or notice something that does not seem quite right, and in this way the whole team can look out for each other. "What if?" questions should be discussed before the list so that everyone is familiar with the process as well as their role in the event of an unexpected complication.

Conflict of interest

We have no conflicts of interest.

Financial support

None.

Ethics statement/confirmation of patients' permission

Not applicable.

References

1. Schulz CM, Endsley MR, Kochs EF, et al. Situational awareness in anesthesia: concept and research. *Anesthesiology* 2013;**118**:729–42.
2. Gilson RD. Situation awareness — special issue preface. *Hum Factors* 1995;**37**:3–4.

3. Jensen RS. The boundaries of aviation psychology, human factors, aeronautical decision making, situation awareness, and crew resource management. *Int J Aviat Psychol* 1997;**7**:259–67.
4. Panagioti M, Khan K, Keers RN, et al. Prevalence, severity, and nature of preventable patient harm across medical care settings: systematic review and meta-analysis. *BMJ* 2019;**366**:l4185.
5. de Carvalho PV, Gomes JO, Huber GJ, et al. Normal people working in normal organizations with normal equipment: system safety and cognition in a mid-air collision. *Appl Ergon* 2009;**40**:325–40.
6. O'Connor PE. The nontechnical causes of diving accidents: can U.S. Navy divers learn from other industries? *Undersea Hyperb Med* 2007;**34**:51–9.
7. Clinical Human Factors Group. Available from URL: www.chfg.org. (Last accessed 27 January 2020).
8. Brennan PA, Davidson M. Improving patient safety: we need to reduce hierarchy and empower junior doctors to speak up. *BMJ* 2019;**366**:l4461.
9. Reader TW, Flin R, Mearns K, et al. Team situation awareness and the anticipation of patient progress during ICU rounds. *BMJ Qual Saf* 2011;**20**:1035–42.
10. Gillespie BM, Gwinner K, Fairweather N, et al. Building shared situational awareness in surgery through distributed dialog. *J Multidiscip Healthcare* 2013;**20**:109–18.
11. Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med* 2009;**360**:491–9.
12. Wright MC, Taekman JM, Endsley MR. Objective measures of situation awareness in a simulated medical environment. *Qual Saf Health Care* 2004;**13**(Suppl. 1):i65–71.
13. Willett M, Gillman O, Shin E, et al. The impact of distractions and interruptions during Cesarean Sections: a prospective study in a London teaching hospital. *Arch Gynecol Obstet* 2018;**298**:313–8.
14. Yoong W, Khin A, Ramlal N, et al. Interruptions and distractions in the gynaecological operating theatre: irritating or dangerous? *Ergonomics* 2015;**58**:1314–9.
15. Endsley MR. Measurement of situation awareness in dynamic systems. *Hum Factors* 1995;**37**:65–84.
16. Green B, Mitchell DA, Stevenson P, et al. Leading article: how can I optimise my role as a leader within the surgical team? *Br J Oral Maxillofac Surg* 2016;**54**:847–50.
17. Brennan PA, Oeppen R, Knighton J, et al. Looking after ourselves at work: the importance of being hydrated and fed. *BMJ* 2019;**364**:l528.
18. Ragau S, Hitchcock R, Craft J, et al. Using the HALT model in an exploratory quality improvement initiative to reduce medication errors. *Br J Nurs* 2018;**27**:1330–5.
19. Reynard J, Reynolds J, Stevenson P. Situation awareness. In: *Practical patient safety.* Oxford University Press; 2009. p. 201–46.
20. Rasmussen J, Vicente KJ. Coping with human errors through system design: implications for ecological interface design. *Int J Man Mach Stud* 1989;**31**:517–34.
21. Banbury S, Dudfield H, Hoermann HJ, et al. FASA: development and validation of a novel measure to assess the effectiveness of commercial airline pilot situation awareness training. *Int J Aviat Psychol* 2007;**17**:131–52.
22. Graafland M, Schraagen JM, Boermeester MA, et al. Training situational awareness to reduce surgical errors in the operating room. *Br J Surg* 2015;**102**:16–23.
23. Jung JJ, Borkhoff CM, Jüni P, et al. Non-Technical Skills for Surgeons (NOTSS): critical appraisal of its measurement properties. *Am J Surg* 2018;**216**:990–7.
24. Whittaker G, Abboudi H, Khan MS, et al. Teamwork assessment tools in modern surgical practice: a systematic review. *Surg Res Pract* 2015;**2015**:494827.