SYSTEMATIC / NARRATIVE REVIEW ARTICLE

Overview of situational awareness in healthcare and the need for early exposure

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ABSTRACT

Medicine and healthcare can rightly be considered as High Reliability Organization (HRO) when it strives to promote and maintain reproducible and safe outcomes for all patients. Situational awareness (SA) as a concept meant to augment patient safety has often been discussed in the literature, but our own local contribution to this important discussion is decidedly deficient. Being initially implemented in the aviation industry, this concept has been extended to be a crucial element in high-demand activities, including healthcare. As such, extensive exposure is given early on during the training of medical personnel in many countries. We believe that our own medical students and other healthcare candidates in training should be similarly exposed to this concept as it can have a tremendous impact on patient well-being and safety. This paper attempts to provide a short overview of the SA in healthcare and how we can similarly promote its inclusion in our training programmes.

KEYWORDS:
Situational awareness, patient safety, medical education, training

INTRODUCTION

Situational awareness (SA) is a concept initially brought forward within the aviation industry after the Korean War when US pilots were out looking for the enemy. It has since been inculcated extensively into the aviation and other high-reliability industries. Only recently has SA been gaining more foothold in healthcare in order to deliver a more enhanced patient safety with improved clinical outcomes.[1,2]

SA can be defined as 'the perception of elements of the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future'.[3] Essentially, SA requires an individual maintains an adequate internal representation of the environment in interacting domains where time constants are short, and conditions may change on extremely short notice. It allows a person, in this case a healthcare personnel, to always remain cognisant of his immediate surroundings (patient, patient data, monitor readings, verbal communications, etc.) while he attempts to focus his attention on his role and responsibility, being prepared to immediately shift gears in response to any change in the environment. SA is not only a fundamental and critical aspect of clinical decision-making, performance, and teamwork. It is also an important precursor due to the restraints of time and space.[4,5] By maximising SA, apart from striving for better clinical outcomes, it is even possible to improve the understanding of diagnostic errors, thereby potentially reducing them and their consequence.[2] Loss of SA inexplicably leads to a downward spiraling situation that can lead to serious morbidity and even mortality.[1]

The main purpose of this review is to introduce the vast concept of SA to those unfamiliar with it, in a broad manner. A secondary purpose is to impart the importance of establishing SA amongst clinicians in their daily practice and to inculcate early exposure of the concept amongst novices.

COMPONENTS OF SA

SA can be viewed in several individually distinct, but inter-related, dimensions.

Individual SA

As expounded by the definition, 'Individual SA' can be divided into three hierarchal levels: perception (SA level I), comprehension (SA level II), and projection (SA level III). SA level I involves the exposure to stimuli and information from the environment. The individual identifies key elements that define the current environment: patient's history, relevant clinical findings, investigations results, ebb and flow of the patient's vital signs, team interactions, and so forth.

At SA level II, the individual attempts to compile and integrate, interprets, and retains all the disjointed information he has accumulated at level I. In a way, all the different data he has acquired are individual paint strokes that will come together to form a 'big picture' that will serve him in his designated role and responsibility. From there, clinical judgment forms in relation to the scenario at hand.

SA level III allows the individual to then use that judgment to plan for the immediate future of the patient and the dynamics that can happen if that judgement if followed through or not. As can be imagined, the accuracy of this level of SA is highly dependent on the precision of the perception and comprehension phases (Levels I and II).

Some authors have suggested a level IV of SA (resolution). This involves a situation whereby more than one possible judgment is formed, and the individual then seeks identify the best path to follow out of all the possible options available (Table I).

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In the development of SA from level I through III (or IV according to some authors), the necessary knowledge base and clinical skills and acumen are gained through experience. It is not surprising therefore that trainee and novice doctors are able to receive environmental input but may have difficulty in interpretation, whereas clinical judgment and their possible outcomes are more in the realm of senior clinicians.

Team SA

Clinicians generally work within a team to provide the best possible inter-disciplinary healthcare for patients. Each team member brings their own individual SA for their designated role and responsibilities; collective decisions are then made based on input from all members. As with any team lineup, there will be an overall leader (usually the one with SA level III) overseeing the other members. Each member in their designated role pursues an agreed upon mental model(s) for the planned and unplanned (contingency) events.

In determining the effects of teamwork on healthcare with particular emphasis on labour and delivery, Harris et al. found significant challenges in creating a teamwork culture without obstacles such as hierarchical gradient preventing effective communication between members. While total avoidance of all adverse events could not be avoided with teamwork alone, ongoing vigilance and the establishment of an effective teamwork culture eventually promotes an environment of safety.[6]

In line with the team approach towards improving patient safety especially the avoidance of surgical mistakes, the World Health Organization (WHO)-led initiative of Safe Surgery Saves Lives (SSSL) was implemented. Malaysia joined the initiative in 2009 under the banner of "Safer surgery through better communication", with some of the main strategies being 'improving communication and team building to ensure safer surgery' and the 'creation of checklist(s) to improve the standards of surgical safety'.[7] A multi-centre study involving eight hospitals in eight cities managed to show that such checklist implementation is associated with concomitant reduction in the number of surgical morbidity and mortality. Between October 2007 and September 2008, in-patient complication rates dropped from 11.0% to 7.0% while the percentage of deaths was reduced to 0.8% from 1.5%.[8] The success of the SSSL initiative is a clear endorsement of effective teamwork and team SA.

Distributed SA (DSA)

Patient care has become increasingly complicated with advances of medical science and technology. As these advances play some role in the delivery of input (especially at SA level I), their contribution is recognized as Distributed SA (DSA). This recognition allows for better overall understanding of the interaction between individuals (e.g., surgeons, aneaesthetists, nurses) and external objects (charts, medical equipment, etc.) to form a coherent picture. DSA emphasizes the continuous, mutually altering interaction between the individual (or team) and the environment the individual (or team) is engaged in reference.[9] It is interesting to note that sometimes it takes someone 'from the outside' to provide the necessary input to stimulate a different mental model and thus and unexpected outcome.

Mental model

A platform of common ground is important for effective communication between team members to occur, so that a mutual goal can be achieved.[11] Mental models between team members can be defined as "individually held knowledge structures that help team members function collaboratively in their environments".[12] They comprises inter-related memories, concepts, and beliefs that create an understanding of how a system works and can be held at a higher or lower level of acuity based on the individual's own knowledge and experiences.[13] Different team members being their own perspective of the situation at hand to the table – without this common ground of shared mental models, effective communication, and thus improved patient safety, is difficult at best.

A mental model can then be thought of as a common action plan that is carried out when an expected outcome is reached in the workflow, "What happens next?". Additionally, it can help envisage a contingency plan should the unexpected be encountered, "What should I do if…?". With a shared mental model, planned and unplanned possible scenarios can be tackled with greater efficiency and is less disruptive. Furthermore, other team members with lesser roles to play may anticipate and render assistance to those requiring it.[4]

How can SA be lost?

It is conceivable that certain scenarios may happen as to cause disruption of individual SA, which inevitably may similarly disrupt the overall team dynamics.

SA level I: One of the main culprits is information overload upon a novice personnel. It must be accepted that not all the information received are relevant to the patient/situation at hand. If the novice is unable to discern which input are vital, important, and useful from the useless ones, it is unlikely that a clearer 'big picture' can be created. Another reason for loss of SA is distraction and interruption from the work at hand – again, from the multiple simultaneous input sources. Fatigue has also been shown to be a major disruptor of SA at all levels.

SA level II: Here, the individual involved has compiled all data, but failed to attach significance to them. As a result, the 'big picture' he created does not truly reflect the actual condition of the patient, or the severity of the situation. There are a few hypotheses that attempt to explain this, which in effect, is akin to tunnel vision:

Primacy effect – when the individual refuses to consider other possible causes for the situation when faced with two or more 'confirmatory evidence'

Confirmation bias – the willingness to accept evidence that 'confirm' the individual's belief/diagnosis rather than those that support the contrary i.e., contradicts (1).

SA level III: This situation is more likely the culmination of the loss at levels I and II. The resulting understanding of the situation thus far has led to the individual choosing the wrong subsequent course of action. However, the situation may still be redeemable if the senior clinician/team leader is able to revisit and re-evaluate from the beginning and revise the mental model.

Table I: Individual Situational Awareness (SA) levels

SA level	Main function	Competency level	Example of SA failure
Level I (Perception)	Receive environmental input	Trainee/Novice doctor	Informational overload
Level II (Comprehension)	Integrates input into useful 'bigger picture'	Mid-level registrar/medical officer	'Big picture' not reflective of patient status/tunnel vision
Level III (Projection)	Decides on plan for immediate future	Senior clinician/consultant	Future not correctly anticipated
Level IV (Resolution)	Chooses best of possible paths		

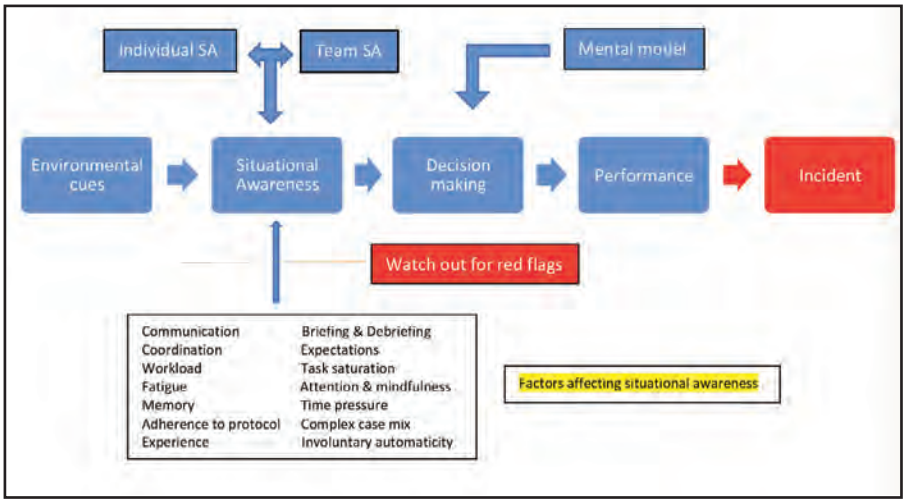

Fig. 1: Factors that shape situational awareness (Adapted from Edozien LC. Situational awareness and its application in the delivery suite.[10]

Team SA loss: A lot of work has been done on teamwork in high-reliability industries such as aviation, petrochemical, electrical, and the military. In healthcare, SA compromise could be due to a multitude of issues such as distraction, complacency, task saturation, e.g. high patient-to-staff ratio, inability to comprehend display monitor and data display etc.[4,5,14] Fatigue, for example, is known to cause lapses in attention and memory, with reduced speed and accuracy of brain processing capacity.[5] This could happen to any member irrespective of their SA level.

Disruptions in the dynamics of team SA could be from a lack of communication between members, primarily due to the presence of a 'hierarchical gradient'.[1] A steep gradient occurs when a senior clinician who is considered beyond reproach and could do no wrong, received no cues from other knowing staff even as he is about to embark on a ghastly mistake. Or, the gradient could be flat in that the team leader lacks the self-confidence and assertiveness, especially in a crisis, to effectively manage his team. An effective team is more possible when members can respectfully voice concerns and suggestions both ways without fear of blame or retribution.[15,16] It is essential that these non-technical skills be reiterated across the board to be as equally important as leadership and decision-making skills, in an environment inculcated with mutual respect.[17,18]

In response, Crew Resource Management (CRW) training programmes were borrowed from the aviation industry. They attempt to increase patient safety by considering the role that human factors play in the performance and delivery of patient care.[17] Across the world, various training protocols and programmes have been set up to address this dire need to promote effective communication and teamwork.[19]

Need for early exposure to SA

Many authors have expounded the implementation of SA into their workflow, from obstetrics,[10] and orthopaedics,[20] to emergency medicine[21] and surgery and the operating theatre.[22] Due to the increasing need to improve patient safety and outcome in line with increasing medical and technological advancement, it is prudent that SA be exposed early in the medical career. Multiple papers have shown the results of earlier exposure to SA, and how this could be instilled in medical undergraduates.[23–29] Most are based on simulation assessment of SA with end-of-course debriefing and discussions on results, member involvement, and self-enhancement. Fischer and colleagues further explored how SA amongst medical students could be assessed using the widely accepted Objective Structured Clinical Examination (OSCE) stations: their findings of the literature indicated that such an approach could enhance information gathering and processing with improvement in the ability to read and understand clinical scenarios (clinical reasoning).[30] Another innovative approach towards instilling SA amongst students involve early exposure to visual and verbal clinical clues and cues[25]: presence of a walking cane indicates mobility issues, inhalers by the bed might represent a patient with asthma, etc. Repeated enforcement will ultimately promote SA, and eventually effective clinical reasoning.

Clinical reasoning (CR) is an attribute all clinicians strive for. Definition of this skill is varied[30-32] but can be simplified as complex interconnecting thinking process of interpreting a patient's problem and presentation, culminating in the sound formulation of treatment and rehabilitation regimen. SA is a major component of CR acquisition, and just like SA, CR develops exponentially as the clinician blossoms from novice to expert with increasing experience and exposure to myriad of cases. Both can be exposed early in the training of potential healthcare providers and enhanced further in their careers.[30]

State of affairs in Malaysia

It can thus be seen how a strong SA at all levels of patient care can only improve patient outcome and safety. As far as medical students in Malaysia are concerned, no clear advocacy is made to inculcate this trait as they transition from students to novice/trainee doctors just as the more senior clinicians have developed their own SA over years of service and experience. Students still undergo traditional training of a pre-clinical organ-based approach, before venturing into a more 'clinical' medical interview and physical examination. While standard interviews and physical examination inculcate certain levels of SA, SA in and of itself is not formally addressed.[33] In Malaysia, there is scarce literature specifically addressing SA. While the MOH (WHO-initiated) SSSL programme is a sound example of team SA being promoted,[7] it does not exactly extend beyond the operating theatre and into the other specialties of medicine in this country. Singh and Nasruddin recently addressed issues affecting patient safety in a private hospital using the Donabedian model of High Reliability Organizations: issues that ultimately reflect team SA in healthcare provision.[34] It was in noticing this lack of local literature that prompted this short review, and hopefully a more robust discussion on the topic.

CONCLUSION

It is well established that SA is an essential element for improvement in patient safety and clinical outcomes. And we have outlined the different aspects of SA as well as how it can fail. Because the development of high-quality clinical acumen and judgment takes time and is primarily dependent on training and experience, we propose the early exposure of medical students and trainees. Real-time simulations appear to be the best platform for training and assessment.

CONFLICT OF INTEREST

There is no conflict of interest related to this review article.

REFERENCES

1. Green B, Parry D, Oeppen RS, PLint S, Dale T, Brennan PA. Situational awareness – what it means for clinicians, its recognition and importance in patient safety. Oral Dis 2017; 23(6): 721-5.
2. Singh H, Giardina TD, Petersen LA, Smith M, Wilson L, Dismukes K, et al. Exploring situational awareness in diagnostic errors in primary care. BMJ Qual Saf 2012; 21(1): 30-8.
3. Schultz CM, Endsley MR, Kochs EF, Gelb AW, Wagner KJ. Situational awareness in anesthesia: concept and research. Anesthesiology 2013; 118(3): 729-42.
4. Penko DZ. Situational awareness during crisis in the OR. Hospital Healthcare Europe newsletter. 2018.
5. Sculli G, Paull DE. Situational awareness is an important part of high reliability. Hospital Safety News. Patient Safety and Quality Healthcare 2018
6. Harris KT, Treanor CM, Salisbury ML. Improving patient safety with team coordination: challenges and strategies of implementation. J Obstet Gynecol Neonatal Nurs 2006; 35(4): 557-66.
7. Safe surgery saves lives initiative: Implementation guidelines 2009. Medical Development Division, Ministry of Health Malaysia.
8. Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AHS, Dellinger EP, et al. Safe Surgery Saves Lives Group: A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 2009; 360: 491-9.
9. Fioratou E, Flin R, Glavin R, Patey R. Beyond monitoring: distributed situation awareness in anaesthesia. Br J Anaesth 2010; 105: 83-90.
10. Edozien LC. Situational awareness and its application in the delivery suite. Obstetr Gynecol 2015; 125(1): 65-9.
11. Wu AW. Reaching common ground: The role of shared mental models in patient safety. J Pat Saf Risk Manag 2018; 23(5): 183-4.
12. McComb S, Simpson V. The concept of shared mental models in healthcare collaboration. J Adv Nurs 2014; 70(7): 1479-88.
13. Holtrop JS, Scherer LD, Matlock DD, Glasgow RE, Green LA. The importance of mental models in implementation science. Front Public Health.
14. Calder LA, Bhandari A, Mastoras G, Day K, Momtahan K, Falconer M, et al. Healthcare providers' perceptions of a situational awareness display for emergency department resuscitation: a simulation qualitative study. Int J Qual Health Care 2018; 30(1): 16-22.
15. Green B, Oeppen RS, Smith DW, Brennan PA. Challenging hierarchy in healthcare teams – ways to flatten gradients to improve teamwork and patient care. Br J Oral Maxillofac Surg 2017.
16. Leape LL, Shore MF, Dienstag JL, Mayer RJ, Edgman-Levitan S, Meyer GS, et al. Perspective: A culture of respect, Part 2: Creating a culture of respect. Acad Med 2012; 87: 853-8.
17. Wauben LSGL, Dekker-Van Doorn CM, Van Wijngaarden JDH, Goossens RHM, Huijsman R, Klein J, et al. Discrepant perceptions of communication, teamwork and situation awareness among surgical team members. Int J Quality Health Care 2011; 23(2): 159-66.
18. Gross B, Rusin L, Keisewetter J, Zottmann JM, Fischer MR, Prückner S, et al. Crew resource management training in healthcare: a systematic review of intervention design, training conditions and evaluation. BMJOpen. 2019.
19. Crew Resource Management training in healthcare: A systematic review of intervention design, training conditions and evaluation. Compilation of study characteristics. CRM Review Supplemental Digital Content 2019.
20. Bleakley A, Allard J, Hobbs A. 'Achieving ensemble': communication in orthopaedic surgical teams and the development of situation awareness—an observational study using live videotaped examples. Adv Health Sci Educ 2013; 18: 33-56.
21. Rosenman ED, Dixon AJ, Webb JM, Brolliar S, Golden SJ, Jones KA, et al. A simulation-based approach to measuring team situational awareness in emergency medicine: a multicenter, observational study. Acad Emerg Med 2018; 25(2): 196-204
22. Gillespie BM, Gwinner K, Fairweather N, Chaboyer W. Building shared situational awareness in surgery through distributed dialog. J Multidiscipl Healthcare 2013; 6: 109-18.
23. Ziv SD, Small SD, Wolpe PR. Patient safety and simulation-based medical education. Medical Teacher 2000; 22(5): 489-95.
24. Thain S, Ang SB-L, Ti LK. Medical students preferred style of learning patient safety. BMJ Qual Saf 2011; 20(2): 201.

25. Gregory A, Hogg G, Ker J. Innovative teaching in situational awareness. Clin teacher 2015; 12: 331-5.
26. Farnan JM, Gaffney S, Poston JT, Slawinski K, Cappaert M, Kamin B, et al. Patient safety room of horrors: a novel method to assess medical students and entering residents' ability to identify hazards of hospitalisation. BMJ Qual Safety 2016; 25(3): 153-8.
27. Walshe NC, Crowley CM, O'Brien S, Browne JP, Hegarty JM. Educational interventions to enhance situational awareness. Simul Healthcare 2019; 14(6): 398-408.
28. Zimmermann C, Fridrich A, Schwappach DLB. Training situational awareness for patient safety in a room of horrors: an evaluation of a low-fidelity simulation method. J Patient Safety 2020.
29. Chmielewski J, Łoś K, Waszkiewicz N, Łuczyński W. Mindfulness is related to the situational awareness of medical students confronted with life-threatening emergency situations. J Clin Med 2021; 10: 1955.
30. Fischer MA, Kennedy KM, Durning S, Schijven MP, Ker J, O'Connor P, et al. Situational awareness within objective structured clinical examination stations in undergraduate medical training – a literature search. BMC Med Educ 2017; 17: 262.
31. Modi JN, Anshu, Gupta P, Singh T. Teaching and assessing clinical reasoning skills. Indian Pediatrics 2015; 52: 787-94.
32. Durak HI, Caliskan SA, Bor S, Vleuten CVD. Use of case-based exams as an instructional teaching tool to teach clinical reasoning. Medical Teacher 2007; 29: e170-e174.
33. Alexander EK. Moving students beyond an organ-based approach when teaching medical interviewing and physical examination skills. Acad Med 2008; 83(10): 906-9.
34. Singh P, Nasruddin E. Patient safety culture in perspective of millennials: Case study in a Malaysian private hospital. Int J Ind Manag 2020; 8(1): 63-72.