Situational Awareness and Patient Safety

Avi Parush, PhD[1]
Catherine Campbell, B.A. Sc, P.Eng, M.Des[1]
Aren Hunter, PhD candidate[1]
Chunyun Ma, MA candidate[1]
Lisa Calder, MD, MSc[2]
James Worthington, MD[2]
Cynthia Abbott, MA[3]
Jason R. Frank, MD, MA(Ed)[2,3]

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[1]Carleton University
[2]Department of Emergency Medicine, The Ottawa Hospital
[3]The Royal College of Physicians and Surgeons of Canada

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Introduction

Let us start with a simple clinical example. You are an emergency physician and your next patient to assess is an elderly patient with a fever and cough, and a HR of 120 and a BP of 95/40. The vital signs are noted on the nursing note. Did you read and take note of the nursing vital signs? Have you considered the implications of such vital signs? Are you thinking ahead what may happen if these vital signs persist with no intervention?

All of these questions and considerations reflect elements of situational assessment and awareness. What are the benefits of having an adequate situational assessment and awareness? How would you build and maintain adequate situational awareness? What are the risks associated with having an incomplete or even a wrong situational assessment and awareness? We will address these questions throughout this primer, which offers an overview of situational awareness and its implications to patient safety in healthcare. In doing so, we are going to use the following case to illustrate and analyze situational awareness, various influencing factors, and what can be done in order to have adequate situational awareness and avoid its pitfalls.

A Case: Emergency Shoulder Reduction and Procedural Sedation

Dr. Leblanc is near the end of his busy night shift in the emergency department. It is 7 A.M. and the ED is overcrowded. Every bed is filled with patients. Dr. Leblanc has an hour to see as many of the remaining patients as possible, complete evaluations of the housestaff on shift, and prepare for handovers to the day physician before he can get home. He is also interrupted every two minutes with calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs. The nurse reminds Dr. Leblanc that an

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elderly woman is still waiting to reduce her dislocated shoulder. She had dislocated the shoulder 12 hours earlier but there had been no bed overnight to perform the reduction. The exhausted physician curses under his breath and walks over to the patient's bed. With a Respiratory Therapist present, Propofol is administered to the elderly woman to sedate her in order to reduce her shoulder. Upon starting the procedure a "stroke code" is called overhead. Dr. Leblanc sends the resident and student to take care of the stroke code. Turning to the patient to complete the procedure, Dr. Leblanc finds it is a particularly difficult reduction. Dr. Leblanc decides to pull harder on the arm, stopping briefly to administer more Propofol. The reduction is so difficult that both the RT and nurse come to assist with countertraction. When the shoulder is reduced an audible crack is heard. With frustration Dr. Leblanc curses and asks for an x-ray to rule out a fracture. When all present look up they realize the patient is not breathing and the monitor is flashing. The audio alarms had been turned off.

The patient arrests and is resuscitated but subsequently dies in ICU.

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To understand what happened in the above case with respect to situational awareness we will start by introducing a framework for considering a very broad range of influencing factors on human behaviours and performance: the Human Factors framework.

A Broader Framework – Human Factors

Human Factors (HF) is a discipline addressing human behaviour, abilities, limitations, and relationship to the work environment (physical, organizational, cultural), and applies it to the design and evaluation of safer and more effective tools, machines, systems, tasks, jobs, and environments. The following is an overview of the key elements in the framework that will guide our treatment of situations, situational awareness, and performance.

As can be inferred from the human factors definition, there are many interdependent components and factors, some related to the person and some related to the environment, that play a role in the behaviour and performance of individuals and teams. When you analyze a situation that may have many factors influencing performance, start with the basic elements of a situation, the physical and human environments. *The physical environment* includes aspects of the physical space where situation occurs, the devices in that space, their layout

and spread, other conditions including lighting, noise, temperature, etc. The human environment includes any other healthcare worker that you either work with or that are just there in your environment doing their own job. *The human environment* also includes organizational aspects such as shift work and handovers, staffing, management and authority gradients, policies and protocols, training and supervision of residents, consultations, etc. You may be able to understand now why the environment is in the foundation tier of the human factors framework: it includes all the factors that are a "given"; you walk into a situation with all the environmental factors in place and you have to deal with them. The task is also something you start with: you have a goal, and within the given circumstances, you are doing whatever you need to do in order to accomplish that goal.

Next, consider the individuals or teams that come into a given situation and bring with them their capabilities and limitations. All of these act together in an interdependent fashion to produce effects and behaviours such as distractions, interruptions, fatigue, workload, and stress (for more studies showing the impact of interruptions in medical settings, see Chisholm et al., 2000; Jeanmonod et al., 2010; Rivera-Rodriguez et al., 2010). In the shoulder reduction case, the cluster of behaviours and effects in the middle tier include a rather *high workload* expressed as: "…Dr. Leblanc has an hour to see as many of the remaining patients as possible, complete evaluations of the house staff on shift, and prepare for handovers to the day physician.."; there are also *interruptions*: "…He is also interrupted every two minutes with calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs". We also see *fatigue* expressed as: "Dr. Leblanc is near the end of his busy night shift in emergency. It is 7 A.M…". What seems to be a key effect associated with all these factors is the physician's reduced patience and probably heightened *stress* expressed as: "The exhausted physician curses under his breath…" and "With frustration Dr. Leblanc curses…". We can conclude that the various environmental factors, physical and particularly human, influenced the resulting behaviours and effects in the story. In the final analysis, we will refer to these as influencing factors.

The eventual performance of the task is influenced by the inter-dependent impact of all the factors. Before proceeding to address situational awareness itself we will explore what a situation is.

The Fundamental Elements in a Clinical Situation

Using the human factors framework presented earlier and the key points of the definition above, the elements in a given situation are composed of various task and environmental factors (bottom tier of the human factors framework). When you participate in a clinical situation, the components of the situation will become your building blocks for situational assessment and awareness. The following outlines the components of a typical clinical situation (taken from the human factors framework described in the previous section):

Patient: In terms of the human factors framework presented earlier, the patient is part of the environment and part of the task. The patient is singled out here because the patient is probably the most important element of the situation. The patient arrives at the situation in a certain state. The patient has some static unchanging aspects starting from their name, age, sex, and any other pertinent demographic information. The patient may have some static clinical aspects such as allergies, medical history, etc. The patient also has certain vital signs when the situation commences, and these are dynamic and can change as the situation unfolds. In the shoulder reduction case, it is: "an elderly woman … waiting to reduce her dislocated shoulder. She had dislocated the shoulder 12 hours earlier".

Environment: The patient is typically brought into a given environment, emergency department, operating room, the office of a family physician, etc. To recap what we discussed already when talking about the human factors framework: this environment has physical and human aspects. *The physical environment* includes aspects of the physical space where situation occurs, the devices in that space, their layout and spread, other conditions including lighting, noise, temperature, etc. In the shoulder reduction case, it is the overcrowded emergency department in a hospital that provides the physical environment to the situation. *The human environment* includes all other healthcare workers such as the nurse and the respiratory therapist in our case, and other residents, medical students, nurses and physicians. The human environment also includes organizational aspects such as shift work and handovers, staffing, policies and protocols, training and supervision of residents, consultations, etc. In the shoulder reduction case, that aspect of the human environment is articulated as: "Dr. Leblanc has an hour to see as many of the remaining patients as possible, complete evaluations of the house staff on shift, and prepare for handovers to the day

physician before he can get home. He is also interrupted every two minutes with calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs." Finally, and here we go beyond the key points of the situation definition presented earlier, the human environment includes yourself. You are a critical part of the situation, and as such everything about you is an influencing factor. As we will mention later, knowing yourself and being aware of your own situation is critical to good situational awareness.

Task: You and your team have a task or several to perform when attending to the patient in any environment. You may be thinking now: "this is really redundant. We always know what we are supposed to do." Well, apparently not always. Here is something from a recent issue of the New England Journal of Medicine (363;20 November 11, 2010, Case 34-2010: A 65-Year-Old Woman with an Incorrect Operation on the Left Hand): "Patient was admitted to the day-surgery unit, and carpal-tunnel release surgery was performed without complications. Immediately after completing the procedure, the surgeon realized that he had performed the incorrect operation". The correct operation was supposed to be trigger-finger release. What is known as wrong patient, wrong procedure, wrong site, is a rare but serious error in healthcare. Such an error has to do with not being well aware of the task at hand. The task in the shoulder reduction case is: "to reduce the patient's dislocated shoulder". The task maybe the same for the entire situation, but it can also change as a result of the dynamics of the situation, particularly resulting from changes in the state of the patient or as a result of other actions and events. In the shoulder reduction case, an additional task associated with reducing the shoulder was performing procedural sedation with Propofol to sedate the patient. The physician also had many secondary tasks such as responding to calls, discussing cases with residents, and responding to the stroke code.

Time: The element of time in any clinical situation is a significant determinant in the dynamics and the manner in which the situation unfolds. Let's examine some time-critical elements in our case: "It is 7 A.M. and the ER is overcrowded…. The patient had dislocated the shoulder 12 hours earlier…" The following time element is implicit: "Propofol is administered to the elderly woman". But when was it administered? How long has it been since the last time anyone looked at the patient's vitals? These reflections of the time element in the situation will be discussed further later.

Now that we understand what the situation elements are, it is time to discuss what situational awareness is.

Situational Awareness

Simply put, situational awareness is "knowing what is going on around you" (Endsley, 2000). When working with others, which is rather common in various clinical contexts, situational awareness includes having team awareness, being aware of what team members are doing (Pew, 1995). But what is situational awareness really? Is it knowledge that you have? Some definitions suggest that it is "an abstraction that exists within our minds…" (Billings, 1995; also, Endsley, 1988; Hamilton, 1987; and others). Is it a process you go through? Many other definitions suggest that it is to "quickly detect, integrate and interpret data gathered from the environment" (Green et al., 1995; also, McMillan, 1994; Sarter & Woods, 1991; Smith & Hancock, 1995; Vidulich, 1994; and others). Is it an ability you possess? Yes, some definitions suggest that situational awareness is "One's ability to remain aware of everything that is happening at the same time and to integrate that sense of awareness into what one is doing at the moment" (e.g., Haines & Flateau, 1992). Does situational awareness cause behaviour and performance? Not necessarily. Good or poor performance could result from good or poor situational awareness, but it could also be that situational awareness is improved or degraded with better or poor performance that is influenced by other factors. There are findings that show that good situational awareness is not always associated with good performance (Flach, 1995; Tenney at al., 1992). For the purposes of this primer, we will use a definition that encompasses the views that situational awareness is both a process of assessing the situation and the resulting knowledge or awareness of the situation.

In the mid-1990s, when situational awareness was still used and trained almost exclusively in the aerospace domain, an article on situational awareness in anaesthesiology was published in a special issue of the Human Factors journal devoted to situational awareness (Gaba & Howard, 1995). In that article the authors stated that situational awareness is an equally important factor in the complex, dynamic, and risky field of anaesthesiology. Fifteen years later, situational awareness is thought to be one of the most essential non-technical skills for the achievement of safe anaesthesia practice (Fioratou, Flin,

Galvin & Patey, 2010). SaferHealthcare, an international organization specializing in providing training solutions to healthcare, calls situational awareness "a vital skill for today's healthcare professional". As such, there is a current need for a better understanding of situational awareness and the development of new ways to teach situational awareness in healthcare settings. In a recent report to the World Health Organization, situational awareness was listed as critical in all healthcare areas.

Situational Awareness Activities

In this section we will focus on the key activities of situational awareness during the situation itself. Specifically, we focus on getting the information, understanding it, and thinking ahead.

Get Information: When you receive a patient you need to know who they are, their vital signs, who works with you, what tools you have, and more. The most fundamental and essential activity for knowing what is going on is first getting information about the situation. To ensure you are getting all the information you need whenever you need it, consider the following:

The *nature* of the information: The best way to think about the information you need to gather is in terms of the situational elements, Patient, Environment, Task, and Time (PETT). Is the information about any of the elements static (e.g., patient identity; the procedure; the location of the vital signs monitor; etc.) or continuously dynamic and changing (e.g., patient's vital signs; elapsed time since last drug administration; or even presence or absence of another healthcare worker, etc.)? Does it change rapidly? The practical implications of these information characteristics are the strategies you should employ to ensure having the information you need. In other words, static information requires you to acquire it only once, or maybe refresh your memory once in a while. In contrast, dynamic information requires you to look for it often or at least ensure that it is somehow delivered to you as it changes. This brings us to the information delivery and acquisition issue.

Information *delivery* characteristics: The way in which one gathers information can be passive or active. For instance, monitoring vital signs presented on a display would represent an active acquisition of information because you need to look up once in a while at

the monitor. Another form of active information gathering can be soliciting information from another team member. In the shoulder reduction case the initial important information about the patient was delivered to the physician by the nurse, so the physician was a passive recipient of the information. It is not clear from the story if the physician was more active in acquiring additional information about the patient. The critical point where the team should have been more active in their information gathering was to keep on checking the vital signs monitor. The practical implications of the information delivery and acquisition aspects are in terms of you becoming more active in gathering information and not always relying on the information being delivered to you. And that brings us to the sources of the information.

Information *sources*: What are your sources of information for everything you need to know in order to perform your tasks adequately (effectively, safely, efficiently, and with quality)? Information sources could be people or tools, devices, and documents. People include the patient of course and other healthcare workers. In our case, the initial source of information about the patient is the nurse: "The nurse reminds Dr. Leblanc that an elderly woman is still waiting to reduce her dislocated shoulder." As the situation unfolded, the critical source of information became the vital signs monitor. In our case, the critical information was not acquired from that source: "When all present look up they realize the patient is not breathing and the monitor is flashing and the audio alarms had been turned off." This brings us to the next consideration of how to gather and acquire the information.

What do you need to do to ensure you get the information you need?

Scan and search: be proactive about getting the information. Don't wait until the information is delivered to you. Look for it in your environment or solicit it from your team.

Pay attention: While attending and focusing on your own task, pay attention to what goes on around you.

Remain watchful: Even if everything proceeds smoothly and as planned, remain watchful and expect the unexpected.

Communicate: You rarely work alone. Think aloud and communicate with your team and peers, even with the patient when relevant. All are information sources. And you become an information source for others.

Understand the Information: Once the information has been gathered, you need to go beyond it. The next step in situation assessment is to comprehend or assign meaning to the gathered information. In doing so the information extracted from the environment must be used to build a comprehensive picture of the situation. It is at this stage of the situation assessment, when you actually "think" about the information, reason, assess, and make judgments and diagnoses.

How should you comprehend the information and give it meaning?

Compare: Start by comparing the information to what you know and what you expected. Are things as planned? Or is the information suggesting some variation or deviation from what was planned or from the routine or from your training and experience?

Critique: And then move on to think critically about the information. As part of the critical thinking, you should check information integrity (accuracy, completeness, source, and relevance), cross-reference it with additional information, and assess conflicts and contradictions.

Diagnose: Complete your understanding by asking yourself: What does it mean? Why did this happen or not happen?

In our case, an elderly patient was brought in with a dislocated should in need of reduction. From the physician's actions it seems he understood very well what this information means and he called the respiratory therapist in order to administer Propofol to sedate the patient before the shoulder reduction took place.

Think Ahead: The final cognitive activity that completes situational assessment and awareness is thinking ahead. This is the ability to take all of the information gathered and understood and use it to extrapolate the status of the situation in the near and extended future. Accuracy at this stage is based on the integrity of the information gathered at earlier stages and it also requires physicians to consider the progression of information and the timeline. This cognitive activity of thinking ahead is critical to adequate decision making and taking proper actions.

Extrapolate and project beyond the "now": How will the situation unfold if the current conditions persist? Persist for how long?

Ask "what if?": Consider various outcomes and contingencies and communicate those possibilities to others. Assess possible consequences so that they can drive adequate decision making or initiate a search for additional information and the need to better understand that information. This latter activity is something that can help you maintain situational awareness, detect possible loss, and facilitate recovery.

In the shoulder reduction case there was a point when "Dr. Leblanc finds it is a particularly difficult reduction." Clearly, the physician had the information he needed: an elderly patient with a dislocated shoulder, under Propofol sedation, and a particularly difficult reduction. From his subsequent decision to pull harder and call the nurse and RT for help we can infer that the physician understood what the difficult reduction meant. But then he proceeded with administering more Propofol. Did the physician think ahead about the implication of a higher dose of Propofol which could cause more respiratory depression with an elderly patient? Here is what probably would have happened had the physician thought ahead: Propofol is known to cause respiratory depression, particularly with the elderly; if the patient is not closely monitored continuously there are chances they may become apnemic and that may lead to a cardiac arrest. The lack of thinking ahead is probably the critical element where the situational awareness of the team failed and led to the adverse outcome in this case.

Possible Obstacles to Adequate Situational awareness

As can be seen from the analysis of the clinical case up to here, some elements of situational awareness were not constructed and maintained adequately. There can be many possible causes, direct and indirect, of the inadequate situational awareness. The approach we suggest maintains that the situation elements result in influencing factors such as increased workload, frustration, stress, interruptions and distractions, and more. These factors along with human capabilities and limitations result in possible obstacles to situational awareness.

Human information processing has limited cognitive resources and a tremendous quantity of information to parse through. As such, heuristics become inherently useful. Having said that it is also important to note that often times heuristics limit or pigeon-hole the physician. For instance, Groopman (2007) indicates that on average a physician will

interrupt a patient after 18 seconds of hearing the patient's symptoms having already made a diagnosis. On the one hand, experience, heuristics, and biases help reduce cognitive load, but on the other hand they can stop or influence the iterative process that leads to the achievement of situational awareness. An understanding of the basic biases in relation to building and maintaining situational awareness will render physicians more successful in achieving adequate situational awareness.

The research and theoretical literature on biases in perception, reasoning, problem solving, and decision making are fraught with many "biases" and "illusions". Here we will focus on the most common perceptual and cognitive obstacles to getting the information, understanding it, and thinking ahead. Specifically, we present two main types of biases: cognitive biases: biases influencing thinking, problem solving, and decision making; and attentional biases: biases influencing perception and attention.

Anchoring. In order to "know what is going on" you need to first perform an assessment of the patient, environment, task, and time. Research on problem solving, judgements and decision making suggest that people start by making a judgement about where to start looking and what elements are important, and then adjust it to arrive at a final solution/decision. This is referred to as the Anchoring heuristic (Tversky & Kahneman, 1974). Anchoring becomes a cognitive bias when there is a fixation on the initial assessment, making it unlikely that the initial assessment will be reassessed and updated with new information. In effect, anchoring makes the initial elements salient and more difficult to relinquish in the face of new information. Being able to step back and evaluate the situation as it progresses and changes is an important part of achieving good situational awareness. As such, physicians should be aware of this phenomenon and avoid a skewed view of the situation based on the initial assessment.

In our case of the shoulder reduction, there was probably very little to no negative impact of anchoring. The physician's initial assessment of the situation was adequate, and he proceeded according to this initial assessment. Even when new information presented itself in terms of the shoulder reduction being particularly difficult, going along with the initial assessment was still adequate.

Confirmation Bias (Croskerry, 2009). This is the tendency to look for evidence that confirms or matches the current situation or decision. Like anchoring, confirmation bias

restricts the assimilation of new information needed to accurately update situational awareness as the situation evolves. More specifically, confirmation bias leads physicians to "hand-pick" information that supports their current state of awareness, while dismissing information that is in opposition. Having built a picture of the situation one needs to continue cycling through the analysis process in order to maintain good situational awareness.

If you ever looked through binoculars you probably noticed that it helps you focus better on the object of your interest. But at the same time it narrows your field of view and, if you want to see what else is there, you need to turn your head around with the binoculars. Such a "narrowing of your field of view" can also happen to your attention.

Tunnelling. In stressful situations attention tends to narrow. Although this helps to keep us from becoming overwhelmed with information, it also prevents the assimilation of new, and often unexpected, information. Tunnelling is basically allocating your attention to a particular channel of perception (e.g., only looking or only listening), or focusing on the information for a specific task or on a specific aspect of that task. That focus is typically at the expense of the perception of other information that is not directly relevant to the attended information or task. It is worth noting that other attentional biases such as *inattention blindness*, *change blindness*, or *focusing illusion* basically lead to the same effect: you focus your attention on just one aspect of a situation and ignore other aspects of a situation that maybe important.

In our case, tunnelling was probably the main obstacle to adequate situational awareness. It probably started with "Turning to the patient to complete the procedure, Dr. Leblanc finds it is a particularly difficult reduction. Dr. Leblanc decides to pull harder on the arm, stopping briefly to administer more Propofol." Let's remember that this was a busy shift, the physician was constantly interrupted, he felt increased workload and some stress even before attending to the case of the dislocated shoulder, and the specific situation with the elderly patient became more complicated. Probably at that point, the physician "narrowed" his attention to the task at hand: reduce the shoulder, while ensuring the patient is sufficiently sedated. The situation continued to unfold with this: "The reduction is so difficult that both the RT and nurse come to assist with counter traction. When the shoulder is reduced an audible crack is heard. With frustration Dr. Leblanc curses and asks for an x-

ray to rule out a fracture." The team assisting the physician, the RT and the nurse, seem to also "narrow" their attention to focus on the difficult task of shoulder reduction. The attention tunnelling thus resulted in "When all present look up they realize the patient is not breathing and the monitor is flashing and the audio alarms had been turned off." The team was blind to other aspects of the situation, the patient's deteriorating breathing, and not performing the monitoring task for some time.

The Situational Awareness Checklist

Get Information

- Scan and search: be proactive about getting the information. Don't wait until the information is delivered to you. Look for it in your environment or solicit it from your team.
- Pay attention: While attending and focusing on your own task, pay attention to what goes on around you.
- Remain watchful: Even if everything proceeds smoothly and as planned, remain watchful and expect the unexpected.
- Communicate: You rarely work alone. Communicate with your team and peers, even with the patient when relevant.

Understand the Information

- Compare: Compare the information to what you know and what you expected. Are things as planned? Or is the information suggesting some variation or deviation from what was planned or from the routine or from your training and experience?
- Critique: Think critically about the information. As part of the critical thinking, you should check information integrity (accuracy, completeness, source, and relevance), cross-reference it with additional information, and assess conflicts and contradictions.
- Diagnose: Complete your understanding by asking yourself: What does it mean? Why did this happen or not happen?

Think Ahead

- Extrapolate and project: beyond the "now": How will the situation unfold if the current conditions persist? Persist for how long?
- Ask "what if?": Consider various outcomes and contingencies and communicate those possibilities to others. Assess those possible consequences so that they can drive adequate decision making or initiate a search for additional information and the need to better understand that information.

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