Situational Awareness and Patient Safety

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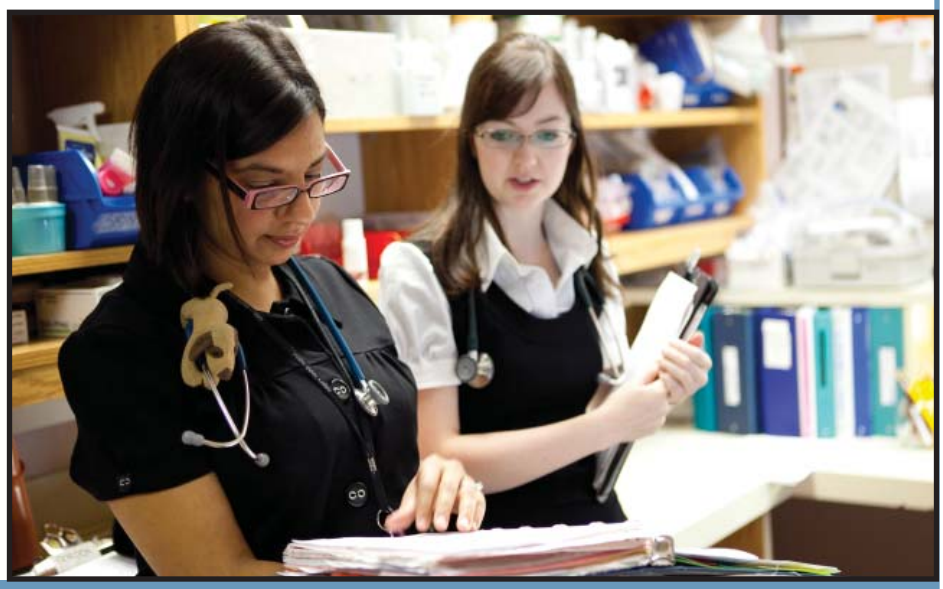
Chapter 1



About this learning package

1.0 About this learning package

This learning package on situational awareness and patient safety consists of the following:

1.1 Learning package overview

The course overview gives you a general introduction to the course. Information contained in the course overview will help you determine:

- If the course is suitable for you.
- What you can expect from the course.
- How much time you will need to invest to complete the course.

We strongly recommend that you read the overview before starting your study.

The overview also provides guidance on:

- Where to get help.
- Course assignments and assessments.
- How the binder is structured

1.2 Learning package content

The learning package is composed of several sections separated by tabs in your binder. These sections include:

- The learning package overview
- A description of the background and motivation for development of this course
- The Situational Awareness Primer, which presents the core lessons of this learning package
- A slide set for in-class learning

Sections of this learning package can be used in multiple ways, in combination or as stand-alone by various users such as:

Teachers

Front-line clinical teachers will find tools and resources to include situational awareness and patient safety in bedside teaching and in academic sessions. Material from the learning package can be tailored to the audience and to the type of learning session being given. This package includes a presentation slide set with speaker's notes, tips for initiating discussion, practice workbook for participants and students, take-away checklists, and resources for additional learning. The learning package also uses a variety of teaching strategies such as video stimuli, small group exercises and interactive lecture.

Learners

The learning package has also been developed for physicians–in-training. A self-instructional module provides independent learning exercises to test understanding of key concepts.

Practicing Physicians

For established physicians, this learning package can be used as a personal continuing professional development exercise. The learning package uses examples of adverse events in different clinical contexts to identify enhancements that physicians can make in their daily practice to increase patient safety.

Many Clinical Settings

This learning package is adaptable to any clinical setting.

- For an ambulatory care, internal medicine or family medicine context, go to the Instructional Supplements and page 2 of the Case Studies section to find relevant examples.
- For relevant examples from a surgical setting, go to the Instructional Supplements and page 2 of the Case Studies section.

- If you work in a critical care setting, go to the Instructional Supplements and page 3 of the Case Studies section to find relevant examples. Chapter 3, the situational awareness primer, also uses a critical care example throughout the chapter and includes the Elaine Bromiley case from the UK to reiterate the importance of situational awareness to prevent adverse events.

1.3 Your comments

After completing the Situational Awareness and Patient Safety course we would appreciate it if you would take a few moments to give us your feedback on any aspect of this course. Your feedback might include comments on:

- Course content and structure.
- Course reading materials and resources.
- Course assignments.
- Course assessments.
- Course duration.
- Course support (assigned tutors, technical help, etc.)

Your constructive feedback will help us to improve and enhance this course.
Please direct all feedback to one of the addresses below.

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1.4 Welcome to Situational Awareness and Patient Safety

The term situational awareness denotes the achievement of comprehensive and accurate individual or team knowledge of the environmental context in dynamic safety-critical domains. Simply put, it means: "knowing what is going on around you".

Increasingly it is believed that poor situational awareness or a loss of situational awareness is a significant contributor to adverse events in healthcare. A comprehensive needs assessment with key stakeholders in medical practice identified situational awareness as the most important and least understood human factor in healthcare.

This learning package has been created to address these needs. It explains the key components of situational awareness, identifies factors that can affect situational awareness and provides you with tools and strategies for building and maintaining situational awareness in your own medical practice. Case Studies are used to illustrate important points and provide context for the potential impact of situational awareness on human performance and patient safety.

1.5 Situational Awareness and Patient Safety – Is this course for you?

This course is intended for physicians and physicians-in-training as a resource to enhance the ability to provide safe and high quality care in dynamic settings. While there are no prerequisites for this course, having experience in safety-critical environments will definitely enrich the learning of situational awareness. However, novices and those with less experience will still find rich scenarios on which to apply the principles of this module.

1.6 Situational Awareness and Patient Safety – Competencies and Objectives

Competency Framework

Upon completion of Situational Awareness and Patient Safety you will be able to:

1. Outline and explain a general human factors framework for the clinical care environment.
2. Describe the situational awareness construct, and recognize its place and significance within the overall human factors framework.
3. Define the key components of situational awareness, provide examples for each and identify interdependencies with other influencing factors.
4. Analyze medical case studies with respect to the situational awareness components and/or potential influencing factors.
5. Apply an understanding of situational awareness to real-life clinical practice.
6. Share the significance and potential medical impact of factors affecting situational awareness with peers, colleagues, and trainees.

Course objectives

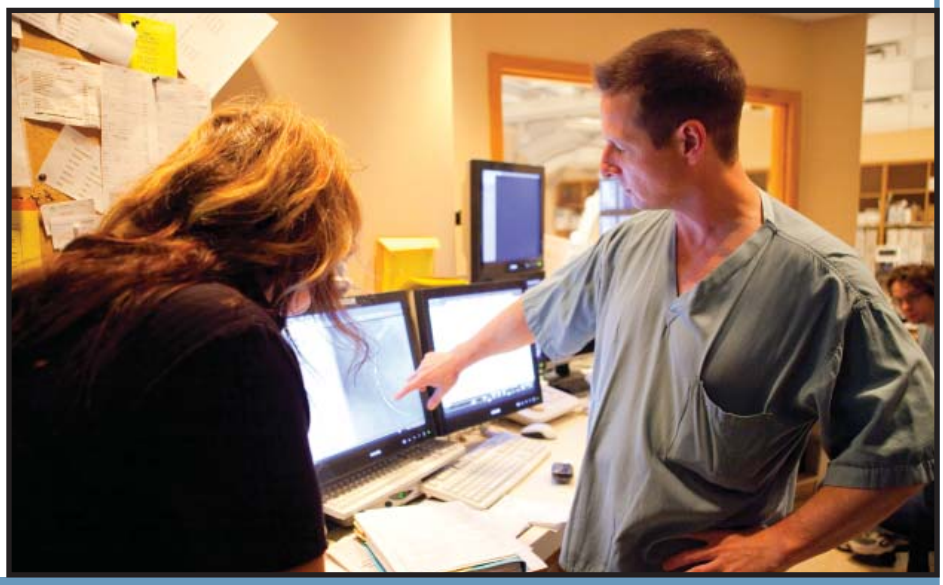
The objectives of this course are to:

1. Present a general framework for human factors in medicine.
2. Define and explain situational awareness, its components, and where and how it fits in the overall human factors framework.
3. Illustrate why situational awareness is important in medical practice by alerting physicians to those components and influencing factors in real life resident education instances.
4. Provide physicians with the opportunity to apply their understanding of situational awareness components and factors through analysis of case studies.
5. Provide physicians with the knowledge and skills required to be able to detect and identify situational awareness components and/or potential influencing factors in real life practice.

Timeframe

The Situational Awareness Slide Set is intended to support a three-hour in-class learning session.Independent study may be completed in a few hours of thorough review of the Situational Awareness Primer.

Chapter 2



Background and Motivation

2.0 Background and Motivation

Many adverse events in healthcare are associated with systemic issues and human error (Bogner, 1994; Kohn,Corrigan & Donaldson 2000). Recognition of the impact of the human component in patient safety generated a growing interest in human factors engineering. This discipline discovers information about human behavior, abilities, limitations, and relationship to the work environment (physical, organizational, cultural), and applies it to the design of safer and more effective tools, machines, systems, tasks, jobs, and environments. The Safety Competencies document (Canadian Patient Safety Institute & The Royal College of Physicians and Surgeons of Canada, 2008), recognizes the importance of human factors as one of the six domains for safe practice in the 21st century. The challenge is how to implement this competency among healthcare professionals to improve patient safety and reduce risk in medical practice. Stakeholders in many risky domains (e.g., pilots or air traffic controllers in aviation) are trained with human factors knowledge with the goal of increasing safety. In contrast, key stakeholders in healthcare such as physicians are only just beginning to be trained in human factors. This project aims to enhance physicians' ability to understand, learn from, reduce, and prevent medical adverse events, by training them with human factors knowledge and approaches.

2.1 Needs Assessment

In an effort to understand the need for a human factors learning program and determine an appropriate scope for this project, a comprehensive needs assessment was conducted in 2010. This included a systemic review of more than 250 publications related to human factors in healthcare and other safety critical domains. The information gathered in the literature review was used to identify existing gaps in patient safety based human factors and training. A list of the ten most common human factors was identified, including: situational awareness, teamwork, communication, fatigue, workload, information management, best practice checklists, work environment (distractions), interruptions, and design/machine interaction.

This list of factors was used to guide interviews with medical professionals. Thirty interviews were conducted with physicians from various medical disciplines, nurses, medical and nursing educators, patient safety personnel, and human factors professionals familiar with healthcare. The purpose of the interviews was to determine the current level of awareness, understanding and knowledge, skills, attitudes related to human factors in healthcare; to get an indication of the impact of these factors on quality and safety; to determine how these human factors are currently being trained; and finally to confirm and validate the target audience identified in the preliminary survey by exploring and determining the medical disciplines (e.g., surgery, emergency, anesthesia, etc.), and the relevant professional and administrative levels (e.g., fellow, staff, administration, etc.).

Analysis of the interview data identified situational awareness as the most important and least understood Human Factor in healthcare. Thus the project team set out to develop a high impact Situational Awareness learning package to address this need.

2.2 Development

The primary audience for this learning package are physicians in residency training, yet there is a recognized need to disseminate the elements of the package to other physicians and students. To accommodate a variety of audiences the package was developed such that each section could be used independently to meet specific learning objectives or contexts. For example, the Situational Awareness Primer is a comprehensive review of the topic and can be used for independent learning by all audiences; the Situational Awareness Slide Set is designed for in-class learning, and the Instructional Supplement reinforces the key messages in the Primer and the in-class sessions by providing exercises that can support individual or group learning.

As part of the development process, this learning package underwent a formative evaluation at the International Conference on Residency Education in 2010. In April, 2011, a summative evaluation of the learning package was conducted at a resident academic session, wherein it was revised and presented at the Canadian Conference on Medical Education in May, 2011. It's development, implementation, evaluation, and impact will be reported in scientific articles.

Chapter 3

Situational Awareness and Patient Safety: A Primer for Physicians

Awareness saves lives.

Contents

Purpose and Scope

Many adverse events in healthcare are associated with so-called "human factors" (Bogner, 1994; Kohn, Corrigan & Donaldson, 2000). Situational awareness is a key component of human factors and refers to a person's perception and understanding of the dynamic information that is present in their environment. Essentially it is the process of integrating relevant information from the environment into a concise picture based on which all decision making and action take place. A needs assessment that preceded the writing of this primer validated the need for physicians to learn more about the impact of human factors on patient safety (Gosbee, 2002; Helmreich & Davies, 1999; Karsh, Holden, Alper & Or, 2006; Lin, Vicente & Doyle, 2001; Weinger & Slagle, 2002). Situational awareness emerged as a factor reflecting the largest gap between current and desired knowledge and training of physicians.

Situational Awareness is knowing what is going on around you. Situational Awareness involves the perception, understanding, and integration of dynamic environmental information for decision making.

The purpose of this primer is to introduce situational awareness as it applies to clinical contexts and patient safety, discuss the elements that make up a situation, and review the process of assessing and constructing adequate awareness of such situations.

Introduction

Let us start with a simple everyday example to illustrate what we are talking about. You are driving on the highway, thinking about your very hectic and stressful day in your medical practice, and looking forward to relaxing at home. You are about to change lanes to the right in order to take the next exit ramp off the highway. Let's freeze the situation and take a snapshot: your speed is 110kph; are you aware of it? There are a couple of cars to your right; did you notice them? There is a serious traffic jam about a hundred meters ahead on the exit ramp; are you aware of it? Let's say you are aware of all of these facts. Have you considered what the implications are? Have you considered that changing lanes at 110kph is fast and maybe risky? Have you considered that changing lanes to the right with two cars to your right is not the smart thing to do? Have you realized that due to the traffic jam your exit off the highway is going to be slowed down significantly?

All of these questions and considerations reflect elements of situational assessment and awareness.

Now, let's transfer what we understand from the driving example to 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.

As you can see, situational awareness is an everyday occurrence (e.g., driving) as much as it is a part of more complicated and risky situations (e.g., a physician assessing a potentially septic patient or a pilot assessing the potential of runway incursion during the final approach). In all the examples, situational awareness involves several cognitive functions such as perceiving, understanding, reasoning, and thinking, which influence your decisions and actions.

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 new EKGs.

The nurse reminds Dr. Leblanc that an 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.

***

What happened in this case? Our main thesis is that, among other things, there was a problem with the situational awareness of the clinical team that may have led to the adverse outcome. In order to analyze the case and demonstrate what happened to the situational awareness, we need to consider what is going on in given situations that can influence the behaviour and performance of individuals and teams. 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 (Wickens, Lee, Liu & Gordon-Becker, 2004). The Core Safety Competencies document (Canadian Patient Safety Institute & The Royal College of Physicians and Surgeons of Canada, 2008) recognizes the importance of HF as one of the six domains of safety competencies. Specifically: "Optimizing the human and environmental factors that support the achievement of best human performance is an essential safety competency for all health care professionals." The following is an overview of the key elements in the framework that will guide our treatment of situations, situational awareness, and performance.

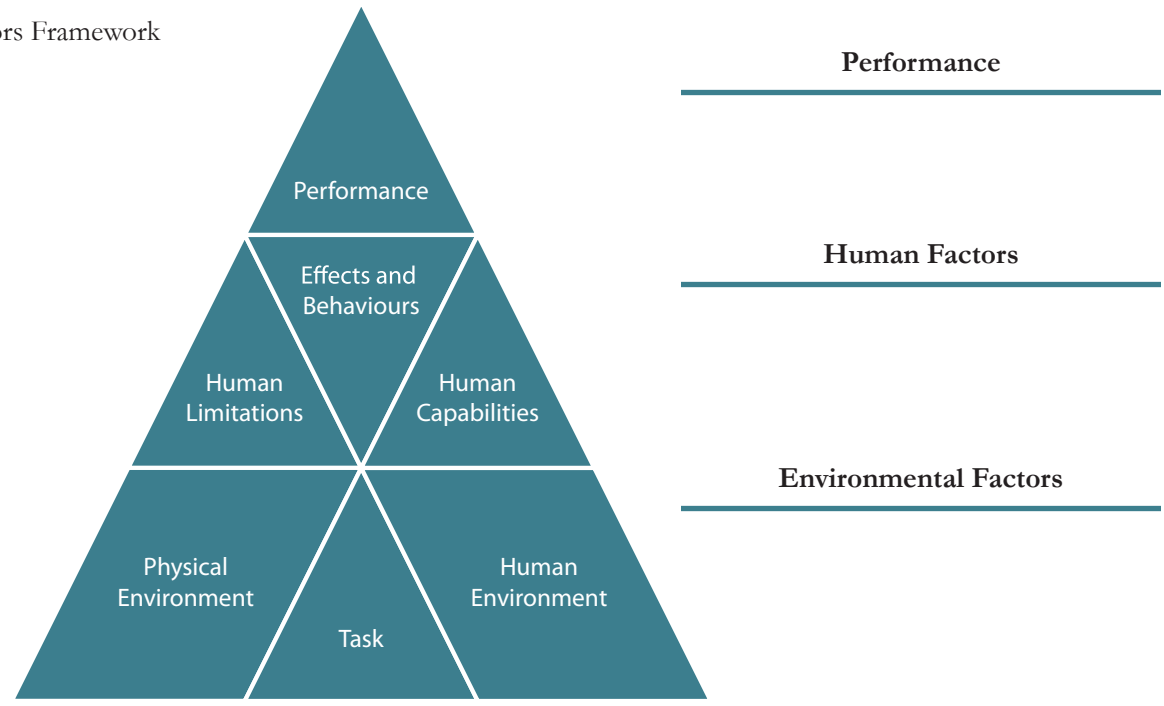
As can be inferred from the human factors definition, there are many interdependent components and factors, some related to the person and some related to the environment, that play a role in the behaviour and performance of individuals and teams. Let's go back to our first everyday driving example to illustrate what we are talking about. First, what do you do? You drive your car with the intent of getting home. Second, what can influence the success of this

important mission? Among the possible influences you can count is the suitability and state of your car, the state of the roads, the traffic, the weather, visibility condition, and other factors. Note that all of these are factors external to you: your physical environment. But there are other factors in your environment that can also influence: other drivers and their behaviours, rules of the road, the driving culture that is accepted and practiced in your area, etc. There are other distracting factors such as stress at home, fatigue, as well as interruptions from phone calls or home-related errands you need to do. Note that these additional environmental factors have to do more with the human, job-related, organizational, societal, and cultural aspects of your environment.

The environmental factors are not the only ones that can influence the success of your driving and getting home. We also need to consider you. You have certain skills pertaining to driving: the actual technical knowledge to drive, but also other non-technical skills, such as being able to see and pay attention to various details on the road (other cars, traffic lights and signs, etc.), think about what you see and understand what it means, make decisions about what to do next, and implement those decisions. Physicians have technical skills (e.g., knowing to administer anesthetics, operate, understand an MRI image) as well as non-technical skills (e.g., interpersonal communication, leadership). All of these fall within a category we refer to as human capabilities. Of course, along with our capabilities, we do have some limitations. For example, we are limited with our abilities to divide attention while doing several things at the same time, our memory is limited, and our decision making can be biased by our limited attention and memory.

The physical and human environmental factors act together with our capabilities and limitations, to generate effects and influence our behaviours. In the driving example, you had a very hectic and stressful day in your medical practice, and while driving you were looking forward to relaxing at home, but there were a lot of cars on the road that slow you down, and there was that big traffic jam on the exit you intended to take. Taken together, these environmental factors can cause more distractions from your driving, may increase your stress and impatience and, combined with your tiredness, cloud your thinking about the implications of that traffic jam on you getting home soon. You can imagine that this may lead to a wrong decision about what to do next.

Figure 1
The Human Factors Framework



The above analysis of the simple task of driving home illustrates the complexity of various factors that play a role in a given situation and can impact performance and the situation outcomes. The following is a conceptual framework that can guide the analysis and understanding of various situations and possible influences on situational awareness.

There are two key ideas in representing human factors with a pyramid composed of three tiers, each with interleaved blocks: 1. there are factors that serve as the basis (foundation tier - environment and task) upon which human capabilities and limitations are expressed and lead to effects and behaviours (middle tier), and to the eventual performance (top tier); 2. There are various clusters of factors all having inter-dependent influence on the eventual performance.

When you analyze a situation that may have many factors influencing performance, start with the foundation tier of the pyramid. The foundation tier includes factors that are the basic elements of a situation, the physical and human environments. The physical environment includes aspects of the physical space where the 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 workers 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 middle tier: individuals or teams that come into a given situation 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.

Building and maintaining adequate situational awareness is part of the Effects and Behaviours block of the framework. When addressing situational awareness, we will consider various factors based on this middle tier of the pyramid. According to this framework, 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.

What is a "Situation"?

"*Houston, we have a problem…*" (Jim Lovell, Apollo 13)

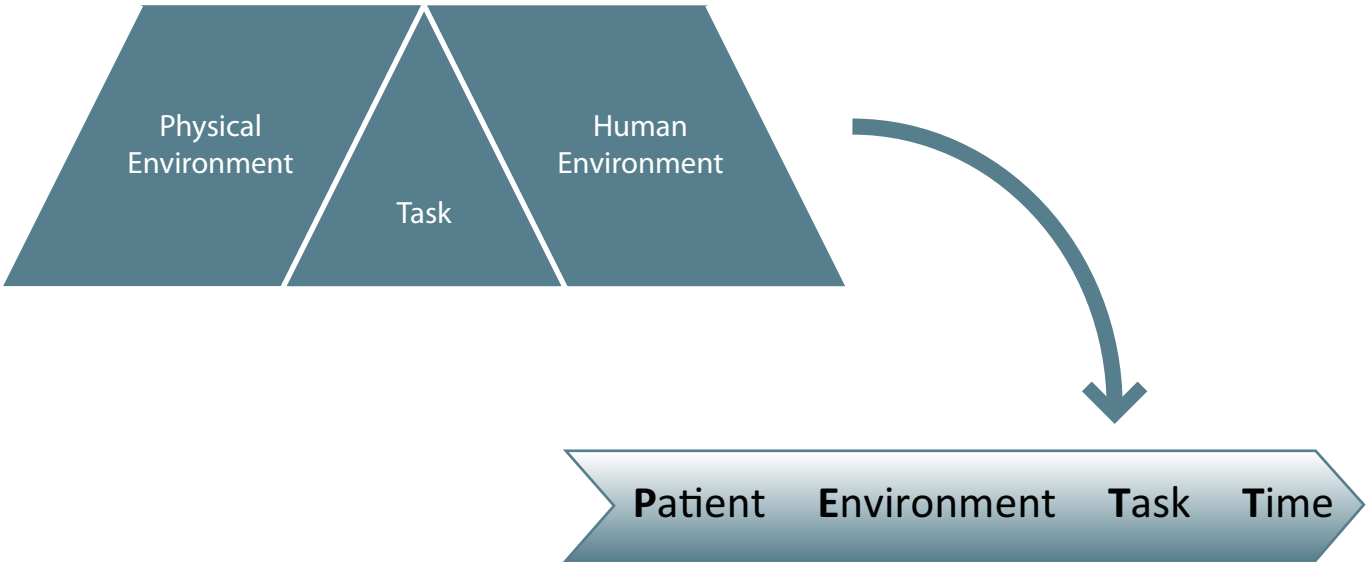
While Jim Lovell's famous sentence is by no means the best definition of a 'situation', there are some very relevant elements in that 'problematic situation' he was referring to, elements that we find often in various medical contexts. In the Apollo 13 situation, an oxygen tank exploded, causing additional damage to power and oxygen supply in the command module. The astronaut team and the ground control center in Houston dealt with a situation which was highly dynamic, stressful, rich with information, and with lives at stake. Sounds familiar?

To put it more formally, a situation is "…a set of environmental conditions and system states with which the participant is interacting that can be characterized uniquely by a set of information, knowledge and response options" (Pew, 2000). Thus, elements in the situation (environmental conditions and states) are external to the situation participant. Another important characteristic of situations, particularly clinical situations, is that they unfold over time. All these elements and their dynamics are characterized by data and information.

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):

Figure 2.
Patient, Environment, Task, Time (PETT)



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 and clinical features 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 your self. 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, unfortunately continues to persist 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.

The following table is a summary of the PETT elements in the situation of the shoulder reduction and procedural sedation case:

	Information about the Situation elements in this example
Patient	**Static information:** An elderly woman. **Dynamic information:** Vital signs; shoulder condition
Environment	**Physical environment:** Overcrowded ED **Human environment:** Shift work, nurses, residents, other patients, respiratory therapist and nurse to specifically help with the shoulder reduction
Task	**Primary task:** Reduce shoulder of the patient **Associated tasks:** Perform procedural sedation **Secondary tasks:** Manage team, monitor patient's status, respond to emergencies, charting
Time	**Start:** Early in the morning, after a hard night shift **Elapsed time:** Not clear how much time elapsed since the second sedation administration and deterioration in patient's status

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

Situational Awareness

A General Definition

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.

> Situational awareness is both a process of assessing a situation and the resulting analysis of that situation.

> Situational awareness is thought to be one of the most essential non-technical skills for the achievement of safe clinical practice.

Why is it so important?

In the mid-1990s, when situational awareness was still used and trained almost exclusively in the aerospace domain, an article on situational awareness in anesthesiology 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 anesthesiology. Fifteen years later, situational awareness is thought to be one of the most essential non-technical skills for the achievement of safe anesthesia 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 World Health Organization report, situational awareness was cited as critical in all areas of healthcare. (Fin, Winter, Sarac & Raduma, 2009)

To best illustrate the criticality of situational awareness in clinical contexts, here is a real case that is used in many medical training programs:

> *"Elaine Bromiley was a fit and healthy young woman who was admitted to hospital for routine sinus surgery. During the anesthetic she experienced breathing problems and the anesthesiologist was unable to insert a device to secure her airway. After 10 minutes it was a situation of 'can't intubate, can't ventilate'; a recognised anesthetic emergency for which guidelines exist. For a further 15 minutes, three highly experienced consultants made numerous unsuccessful attempts to secure Elaine's airway and she suffered prolonged periods with dangerously low levels of oxygen in her bloodstream. Early on nurses informed the team that they had brought emergency equipment to the room and booked a bed in intensive care but neither were utilised. 35 minutes after the start of the anesthetic it was decided that Elaine should be allowed to wake up naturally and was transferred to the recovery unit. When she failed to wake up she was then transferred to the intensive care unit. Elaine never regained consciousness and after 13 days the decision was made to withdraw the ventilation support that was sustaining her life."*

What happened in that case?

The first factor listed in the inquiry report is:
"Loss of situational awareness – the stress of the situation meant that the consultants involved became highly focussed on repeated attempts to insert the breathing tube. As a result of this they lost sight of the bigger picture i.e. how long these attempts had been taking. This 'tunnel vision' meant they had no sense of time passing or the severity of the situation" (from The 'How to Guide" for Implementing Human Factors in Healthcare, 2009, page 4). Among other factors, loss of situational awareness can cost lives.

A Bit of Research and Theory

Since its origin in aviation psychology literature in the late 1980's, situational awareness is considered central to safe and effective decision making and performance in many areas and domains. Situational and environmental conditions combined with tasks that are unstable, time-pressured, have high stakes, and involve multiple team members can very easily alter judgments and impact both individual and team decision making (Kobus, Proctor and Holste, 2001). Reason (1990) stressed the importance of contextual based decision making where the situation and environment are recognized as playing an influential role in the decision making process. As such, any degradation or loss of situational awareness is cited very often as being associated with environmental or situational conditions in addition to the more obvious human (individual and team) and performance issues.

It is essential to understand what situational awareness is, but this is not the same as knowing how to achieve situational awareness in your practice.

The theory of situational awareness is frequently used to explain how decision makers are able to incorporate information from the environment in a way that allows them to "know what is going on around them" and make critical decisions (Endsley & Garland, 2000). Jones and Endsley (2004) suggest that well informed decisions require that all relevant elements in the environment are understood. Of equal importance, is that the decision maker understands how these elements interact and impact the situation over time. Endsley (1988) suggests that situational awareness can be decomposed into three levels; perception, comprehension and projection. The integration of these three levels is best defined as 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" (Endsley, 1988). It is essential to understand what situational awareness is, but this is not the same as knowing how to achieve situational awareness in your practice. As such it is important to note the difference between situational awareness as a process and situational awareness as a level of knowledge. Definitions of situational awareness, such as the one provided by Endsley (1988), leave us with an understanding of situational awareness as a level of knowledge but gives little guidance on how to attain that knowledge (Patrick & James, 2004).

The process of situational awareness is termed situation assessment in the literature. According to Endsley (1995) the assessment of environmental information progresses through three interdependent levels: perception, comprehension and projection. Level one is based on an assessment of the perceptual elements in the environment. At this most basic level the perception of environmental elements is the first step to building up a comprehensive picture of the situation. In essence, this is honing-in and gathering information relevant to the situation. Consider for example driving a vehicle. In order to attain and maintain a high level of situational awareness you need to perceive the color of stop lights, road signs, pedestrians, cyclists, and other vehicles. Beyond perception one needs to assign meaning or comprehension to the perceptual elements that have been detected. Simply perceiving a vehicle in your side mirror is not enough. Comprehension is achieved when you assign meaning and begin to understand that the increasing size of the car's image in your mirror (perception) means that the car is probably accelerating (comprehension). You can see at this stage how interdependent the perception and comprehension stages really are. Evidently degradation of either perception or comprehension can lead to bad decision making that could result in an unsafe lane switch. The last and highest level of processing is projection, wherein, the future status of the elements in the environment are predicted or anticipated. For instance, the growing image of the car in your side mirror allows you to anticipate and predict when the car will pass you and consequently when it is safe to switch lanes. More simply, this process can be depicted in the following way:

The process	Perception > > > (Get information)	Comprehension > > > (Understand it)	Projection > > > (Think ahead)
A driver example	You **see** the car in your rearview mirror; you **see** it is getting larger	You **understand** that means the car is likely accelerating	You **anticipate** when the car will pass you
An anesthesiologist example	You see the patient's blood pressure is dropping; the surgeon tells you blood is no longer oozing from the liver laceration being repaired	You understand that this could mean that the patient is losing blood, though not from the original laceration; there could be another source of blood loss or potential anaphylaxis to the anesthetic provided or a cardiac problem	You predict that if the blood pressure is not corrected the patient will be in serious danger

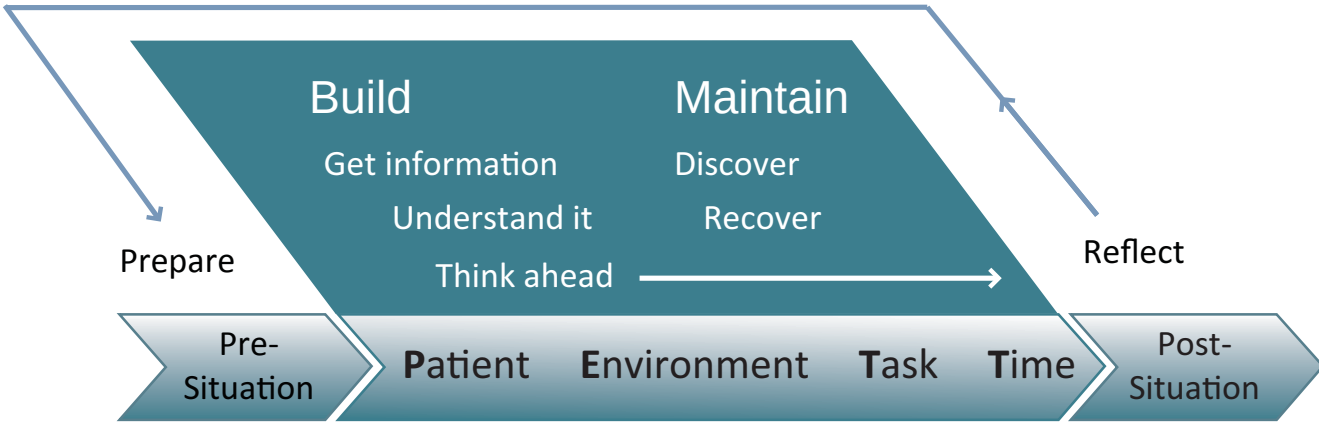
As mentioned above, decision making in safety critical domains often transcends individuals to involving multiple team members with varied roles. Although individuals in teams have defined roles it is important to note that they are all working together toward a common goal. In addition to sharing a common goal, teams also share task interdependencies, and goal dependent knowledge (Dickinson and McIntyre, 1997; Salas, Dickenson, Converse, & Tannenbaum, 1992). Teamwork is defined by coordinated behaviours and the sharing of goal oriented information between team members (Dickinson and McIntyre, 1997). Further, Prince and Salas (1993) argue that each team member must seek information and communicate it within the team but also from and to the environment external to the team. In a medical context this can be taken to mean that each team member should extract relevant information that is both internal to the team but also from other individuals or teams not participating in the current situation. By communicating relevant situation information, each team member demonstrates knowledge of their situational assessment, goals, and responsibilities, which supports the construction and maintenance of team situational awareness.

More recently, team situational awareness in healthcare has been defined as "task- and team-oriented knowledge held by everyone in the team and the collective understanding of the unfolding situation" (Parush et al., 2011). This definition asserts the importance of team coordination wherein the most relevant internal and external information must be exchanged between team members. Furthermore, when team members share information that is based on their own situational assessments there is a greater facilitation of team situational awareness. Greater team situational awareness results in better coordinated information and more goal oriented activities that allow for the construction and maintenance of shared knowledge within the team.

The Process of Situational Assessment and Awareness

Situational assessment and awareness as a process and a state of knowledge need to be as dynamic as the safety critical situation that is being assessed. We take a rather broad view on situational assessment and awareness and consider three basic phases: Pre-situation, the situation (consisting of the PETT elements), and post situation.

Figure 3
The Process of Situational Awareness and Assessment



Your situation assessment and awareness should start in the pre-situation phase, before the situation unfolds. In that preliminary and preparatory phase you perform activities such as briefing and planning (in the same manner a pilot checks the weather and identifies which runway is in use before even starting the engine). The preparation phase should be considered as the first critical step in building adequate situational awareness. In the preparation phase you have the opportunity to identify as many situational elements as possible: Who is the patient? What do we know about the patient? Where are we going to treat the patient? What is available there in terms of devices and tools? Who is going to work with me? What is the procedure we are supposed to perform? When do we start? Since when has the patient been in this state? And so on. Typically, answers to such questions can be provided in handoffs, pre-surgery briefings (e.g, following the WHO surgical checklist or during the pre-op pause), during rounds, or just by reviewing patient charts. In the shoulder reduction case there are very few details about the pre-situation preparation: "The nurse reminds Dr. Leblanc that an 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."

As the situation unfolds, the basics of the process are building and maintaining situational awareness. Building situational awareness requires continuously getting information on the various situational elements, understanding them, and thinking ahead. This last component of situational awareness completes the understanding of the situation and builds the bridge to making decisions and taking actions. Once there is a comprehensible picture of the situation, there is a need to maintain it. The maintenance process is cyclical wherein one must continuously acquire the most up to date knowledge to eventually implement and revise decisions and actions. The maintenance includes also being aware of one's own knowledge of the situation, detecting possible obstacles to building and maintaining situational awareness, looking for holes in that knowledge and loss of situational awareness, and then recovering. The cyclical nature of situation assessments requires one to detect and recover information to be used in the building and maintaining of situational awareness.

Finally, once the situation is terminated, participants in the situation reflect (debrief) on what happened. Debrief can again take place in handoffs, in education sessions, in rounds, and in writing documents. The outcomes of that reflection feed into the preparations and knowledge buildup for the next situation.

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

To drive safely around our city's streets you need to notice various things: traffic lights and their color, street signs, lane markings, other cars, pedestrians, your speed, and more. 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.

What do you need to do in order to get information?

- Scan and search
- Pay attention
- Remain watchful
- Communicate

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 really 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, be mindful of what goes on around you.

Remain watchful: Even if everything proceeds smoothly and as planned, remain watchful and anticipate risky developments.

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.

The following table is a PETT analysis example of the shoulder reduction case for getting the information:

		Get the information		
Situation Elements		Nature	Delivery	Sources
Patient	**Start:** An 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. **Final:** patient is not breathing	**Static:** Background info. **Dynamic:** patient status	**Passive:** nurse report. **Active:** scan and attend the monitor	The nurse; the monitor
Environment	**Background:** 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 house staff on shift, and prepare for handovers to the day physician before he can get home	Static	Active	Familiarity with the place, shiftwork, and other tasks
Task	**Primary:** To reduce the dislocated shoulder of the patient. **Associated task:** Procedural sedation; Monitor patient **Secondary:** calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs.	Starts static and may become dynamic	Passive and active	**Primary:** The nurse **Associated:** Respiratory therapist
Time	**Start:** Dislocated the shoulder 12 hours earlier **Present:** It is 7 A.M. **Elapsed time to outcome:** Unknown	Dynamic	Passive and active	The nurse; wall clock;

Understand the Information

Jerome Bruner, a famous psychologist who developed theories of learning and education, said: "Information is indifferent with respect to meaning" (Acts of Meaning, 1990, p.4). The fact that you have the information is necessary but insufficient for having an adequate and meaningful picture of the situation. Imagine you drive and see a red traffic light but you do not understand what it means. The outcomes are pretty obvious. To a layperson, the fact that a patient has a very high heart rate and very low BP means nothing. Yet, a trained physician will understand that this is a problematic situation.

> "Information is indifferent with respect to meaning" (Bruner, Acts of Meaning, 1990)

In giving meaning to the information we can adopt the title of another famous Bruner book: "Beyond the Information Given". 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 shoulder 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.

The following table is a PETT analysis example of our case for understanding the information:

		Understand the information		
Situation Elements		Compare	Critique	Diagnose
Patient	**Start:** An 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. **Mid-way:** Dr. Leblanc finds it is a particularly difficult reduction. **Final:** patient is not breathing	The case is urgent	Seems that no critical thinking was done to assess the additional implications of an elderly patient	Details are not in the case but the team probably understood why the patient ended up not breathing
Environment	**Background:** 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 house staff on shift, and prepare for handovers to the day physician before he can get home. **Later:** a "stroke code" is called overhead.	Seems like this is "business as usual"	No critical thinking about the implication of the environmental elements on internal state of the physician	None
Task	**Primary:** To reduce the dislocated shoulder of the patient. **Associated task:** Procedural sedation; Monitor patient **Secondary:** calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs.	When procedures like this are done: sedation is required; the task is unexpectedly difficult so assistance is required; everyone ignores the monitoring task	No critical thinking about what repeated Propofol administration can do to an elderly patient; no critical thinking about the impact of interruptions	
Time	**Start:** Dislocated the shoulder 12 hours earlier **Present:** It is 7 A.M. **Elapsed time to outcome:** Unknown		No critical thinking about getting the assistance of the RT at the expense of the respiratory therapist doing his job	Seems that the implication of 12 hours since dislocation was understood; elapsed time since Propofol administration was not comprehended

Think Ahead

Remember our simple driving example with you driving on the highway, thinking about your very hectic and stressful day in your medical practice, and looking forward to relaxing at home? You hear on the radio that there is a serious traffic jam about a hundred meters ahead on the exit ramp. You have the information, and you understand that this jam means a serious slowdown in getting off the highway. So far, you have built adequate situational awareness, but what's next? Are you thinking ahead that if you remain in the right lane you will get stuck in the traffic jam and that you will get home later than expected? Are you thinking ahead what if you will change lanes, how will the situation change? If your answer to yourself is that changing lanes will prevent getting stuck in traffic and perhaps getting home faster through another exit, then you have complete situational awareness. Now you are ready to make a decision what to do next.

> Thinking ahead is taking all of the information gathered and understood and using it to extrapolate the status of the situation in the near and extended future.

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.

The following table is a PETT analysis example of our case for thinking ahead:

		Think Ahead	
Situation Elements		Extrapolation	"What if"
Patient	**Start:** An 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. **Mid-way:** Dr. Leblanc finds it is a particularly difficult reduction. **Final:** patient is not breathing	A basic extrapolation was done in view of the decision to attend to this case immediately	
Environment	**Background:** The ER 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 house staff on shift, and prepare for handovers to the day physician before he can get home. **Later:** a "stroke code" is called overhead.	Not clear if extrapolation was done with respect to repeated interruptions and their future impact	Maybe some "what if" analysis was done with respect to the stroke code and sending someone else to deal with it
Task	**Primary:** To reduce the dislocated shoulder of the patient. **Associated task:** Procedural sedation; Monitor patient **Secondary: c**alls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs	No extrapolation on the potential impact of fewer team members monitoring this procedure	No "what if" was done with respect to possible unexpected difficulty that may require additional help from the start;
Time	**Start:** Dislocated the shoulder 12 hours earlier **Present:** It is 7 A.M. **Elapsed time to outcome:** Unknown	No extrapolation on the implications of deeper sedation with Propofol to an elderly patient	

Maintain

Clinical situations are typically dynamic and as time passes new and unexpected events and factors can be introduced in a way that will turn a routine case into a complex one. Thus, situational assessment and awareness is a continuous process. Once you have a comprehensive situation picture built, you need to maintain it. The maintenance work is basically continued information gathering and understanding. The critical aspect in maintaining situational awareness is to ensure you do not lose it. Applying critical thinking is good practice to ensure that you discover any potential loss of situational awareness. You need to ask yourself every so often: Do I know what is going on? Do I have all the information I need now? Is the information I have reliable and recent? If the answer to any of these questions is 'No', then you are in a state where you have detected potential loss of situational awareness. Another important aspect in maintaining situational awareness is the possible loss of self-awareness. We have discussed many of the situational elements that can bring about increased workload, fatigue, and stress. These can impact your behaviour, and can impact your ability to get information and comprehend it. Ask yourself: How do I feel? Am I too tired to do this now? Am I stressed, upset, impatient? Am I preoccupied with something else?

Discover and Recover: Discover potential situational awareness loss, and recover it by getting more information, understanding it, and thinking ahead.

Your next immediate task is to recover your situational awareness. The recovery activities are basically the same as the building activities: get more information and understand it. Your information gathering should be very active: scan your environment and communicate with your team. Communicating the fact that you don't know what is going on is a good practice to let your team mates know they need to update you and keep you in the loop to ensure full recovery. Finally, the additional activity that can facilitate maintaining situational awareness, discovering and recovering loss, is thinking ahead.

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.

Cognitive Biases

Anchoring. In order to "know what is going" 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.

Attentional Biases

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.

Putting it all Together

Throughout this primer we analyzed the shoulder reduction and procedural sedation case to illustrate and analyze situational awareness. We specifically focused on situational elements (PETT), the key influencing factors (from the middle tier of the human factors framework), and the three key cognitive activities in situation assessment and awareness: getting the information, understanding it, and thinking ahead. Finally, we considered a few biases and illusions that can be obstacles to situational awareness. All of these are compiled together in the following table to provide an integrated analysis of the case.

			Situation Assessment and Awareness		
Procedural sedation	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Leblanc is near the end of his busy night shift in emergency. It is 7 A.M. and the ER 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 house staff on shift, and prepare for handovers to the day physician before he can get home.	**Fatigue** at the end of a busy night shift **Workload** possibly resulting in **stress** and **rushing** to complete as many evaluations as possible before preparing handovers The staff evaluations might also be a **distraction** taking his attention away from patient care.				
He is also interrupted every two minutes with calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs.	Frequent **interruptions** of various types **Increase workload**				

			Situation Assessment and Awareness		
Procedural sedation	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
The nurse reminds Dr. Leblanc that an 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.	Carry over from above Increased **fatigue** leading to **frustration** The cursing reflects a problematic **mood** and state of mind that could lead or be a result of increased **stress**, or reduced **motivation**		Patient info is provided. The "reminder" suggests that Dr. Leblanc had forgotten about the elderly patient.	It is not clear whether there is any analysis or comprehension here. The immediate response of the physician suggests he understands this activity as taking priority over the staff assessments he was previously focussed on.	It is not clear if there is any thinking ahead at this time, though the "reminder" may suggest that the nurse is thinking ahead.
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.	**Interruption** Possible **reduced teamwork** because the resident and student leave the room		No evidence of reassessment of the patient prior to starting the procedure. Not stated whether Dr. Leblanc made the original diagnosis, or if he is assuming that it was/is correct The stroke code is perceived	Dr. Leblanc understands that the reduction needs to be done, that the respiratory therapist's presence is required.	He predicts that more hands are likely needed for the stroke code, but not the potential impact of fewer team members monitoring this procedure. Presence of the RT may suggest that Dr. Leblanc predicts potential risks associated with the administration of Propofol

			Situation Assessment and Awareness		
Procedural sedation	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
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.	Carry over from above **Workload**: MD is both performing the reduction and administering drugs, which is less than ideal.	**Tunnelling** by virtue of the attentional focus on the reduction	New information about the patient **Lack of teamwork**; there does not seem to be any communication to encourage further situational assessment activities	Seems to think that the difficulty may be a result of the patient not being sedated enough and does not seem to understand that giving more Propofol increases risk of respiratory depression especially in the elderly	Thinks that the administration of more propofol might relax the patient further and facilitate the reduction Does not anticipate any negative effects from the Propofol
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.	RT is **interrupted** from their primary task, which might have been monitoring the patient This is in addition to the factors that carry over from before. The "curse" is an additional reflection of **stress**.	Carry over from above	Still no questioning about why the reduction is so difficult, no reassessment of the patient No active information gathering, only passive, e.g. crack heard	Dr Leblanc understands that this is not a good sound, and sees the potential for fracture, thus orders x-rays.	No one seems to anticipate harm to the patient (they are so focussed on the task) or question why the reduction is so difficult (is this even the right patient?)

			Situation Assessment and Awareness		
Procedural sedation	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
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.	Carry-over from above: It was the end of the night shift, multiple distractions occurred that could contribute to the cognitive errors that occurred. Lack of communication may reflect **degraded teamwork** with no clear allocation of tasks so someone still continues to monitor the patient	Carryover from above **Inattention blindness:** they all focused on the shoulder reduction and ignored the vital signs.	An outcome that was missed for a while; there was no awareness of elapsed time and no info gathering by any of the team members, i.e. lack of scanning.	There was a lack of acquisition and perception (not watching the patient's respirations to notice that she has stopped breathing – plus the alarms were turned off so there would be no audible cue – removing the RT from his/her role to monitor respirations and asking them to help with the procedure)	This is preventable since this property of Propofol is widely known and we know that if you pick up early that the patient's breathing has slowed down or stopped that you can perform interventions to increase the oxygen in their circulation and prevent deterioration to cardiac arrest.

3.1 The Situational Awareness Checklist

Pre-situation

- **Plan:** Prepare and review approaches, procedures, and techniques relevant to the upcoming situation.
- **Brief:** Share the plan with your team, confirm task allocation and responsibilities, and work out anticipated problems.

Steps in Situational Assessment and Awareness

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?

Situational Awareness Checklist

Pre-situation:

- ☐ Plan
- ☐ Brief

Situation:

- ☐ Get information
- ☐ Understand it
- ☐ Think ahead
- ☐ Discover loss
- ☐ Recover

Post-situation:

- ☐ Debrief

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.

Maintain

- **Discover loss:** Maintain self-awareness and be watchful for the possibility of losing situational awareness.
- **Recover:** Recover lost situational awareness by actively seeking information, and performing further analysis to understand the information and think ahead.

Post-situation

- **Debrief:** Review with yourself and team the events and actions that took place during the situation and draw lessons for the future.

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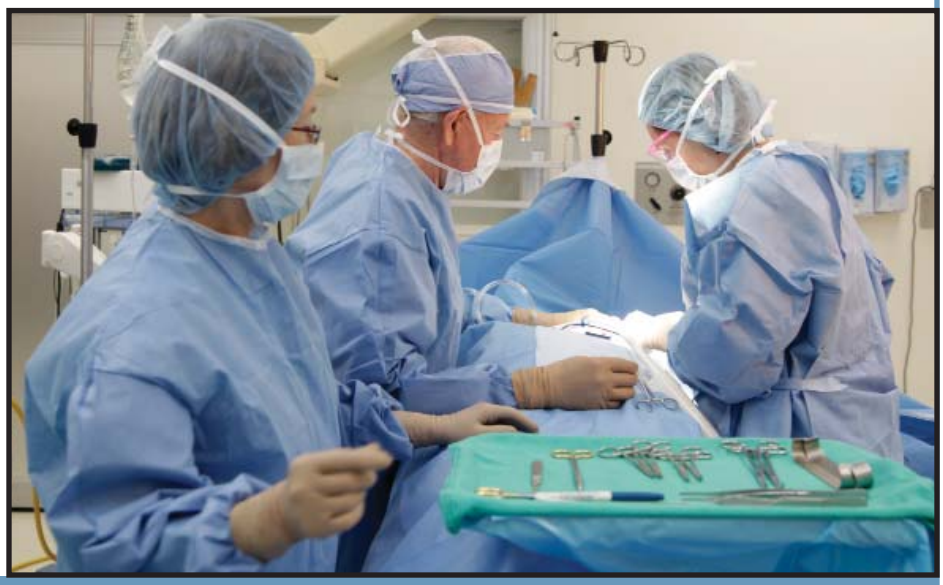
Chapter 4



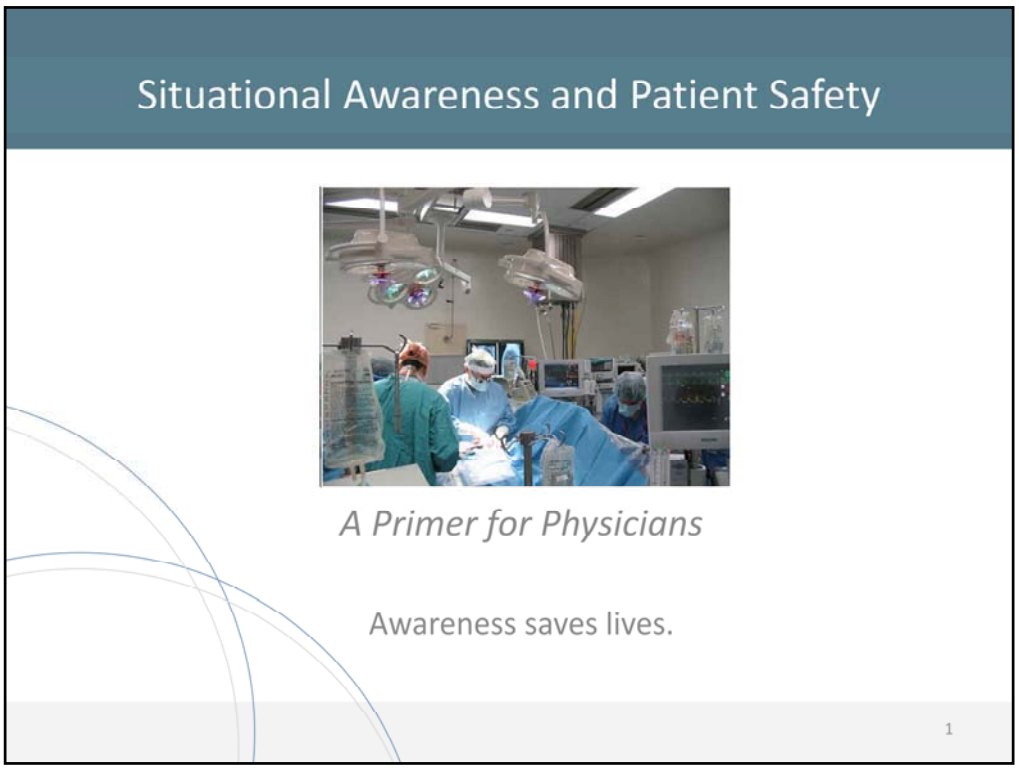
Situational Awareness Workshop

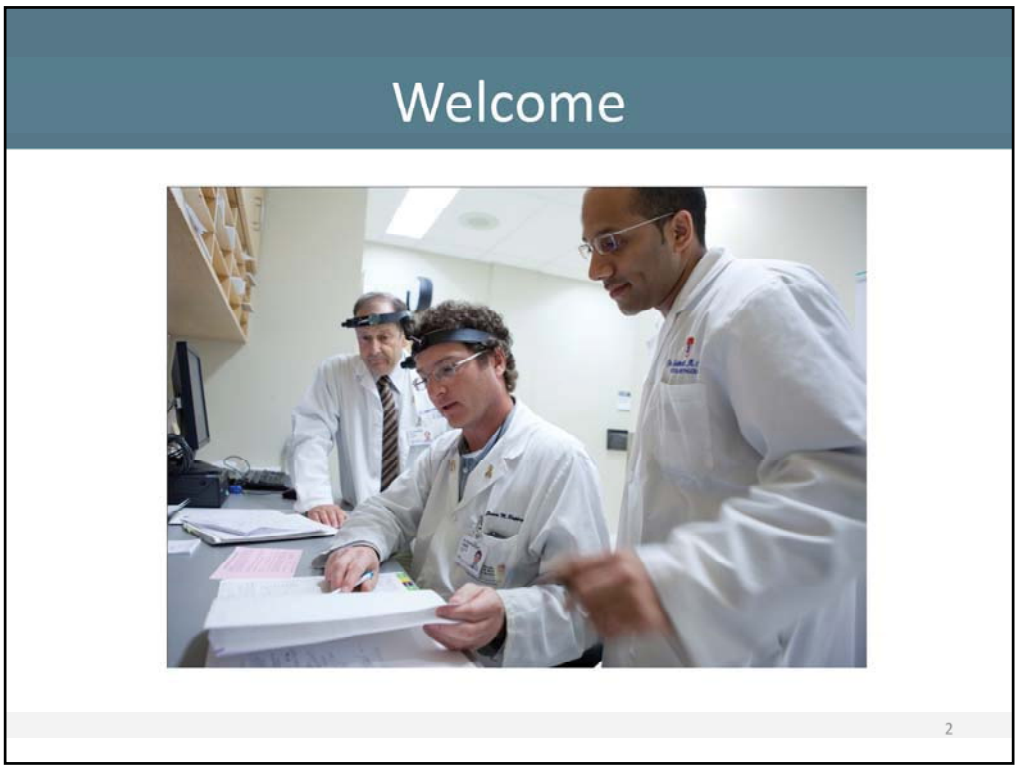
4.1 Introduction and Instructional Design

This section provides resources for introducing the Situational Awareness core content in an interactive brief workshop format. A model instructional design is below. An instructor's slide set with talking points is provided in this chapter and can be found on-line at: www.royalcollege.ca or by contacting canmeds@royalcollege.ca

Time (min)	Content	Resources
Start-10	Introductions, welcome, orientation	Slides 1-4
10-25	**Exercise 1:** What do you know about Situational Awareness? Video, think-pair-share	Video 1, slides 5-7
25-35	Human Factors concepts	Slides 8-15
35-60	Situational Awareness concepts	Video 2, 3, 4, slides 16-34
60-75	Break	Slide 35
75-120	**Exercise 2:** Elaine Bromiley case application	Video 5, slides 36-45
120-135	The Situational Awareness Checklist	Video 6, slides 46-51
135-145	Application to participants' context	Slide 52-53 54 for trainees 55 for practicing MDs
145-180	Conclusions, Q&A	Slides 56-59
	Extra Slides	Slides 60-69

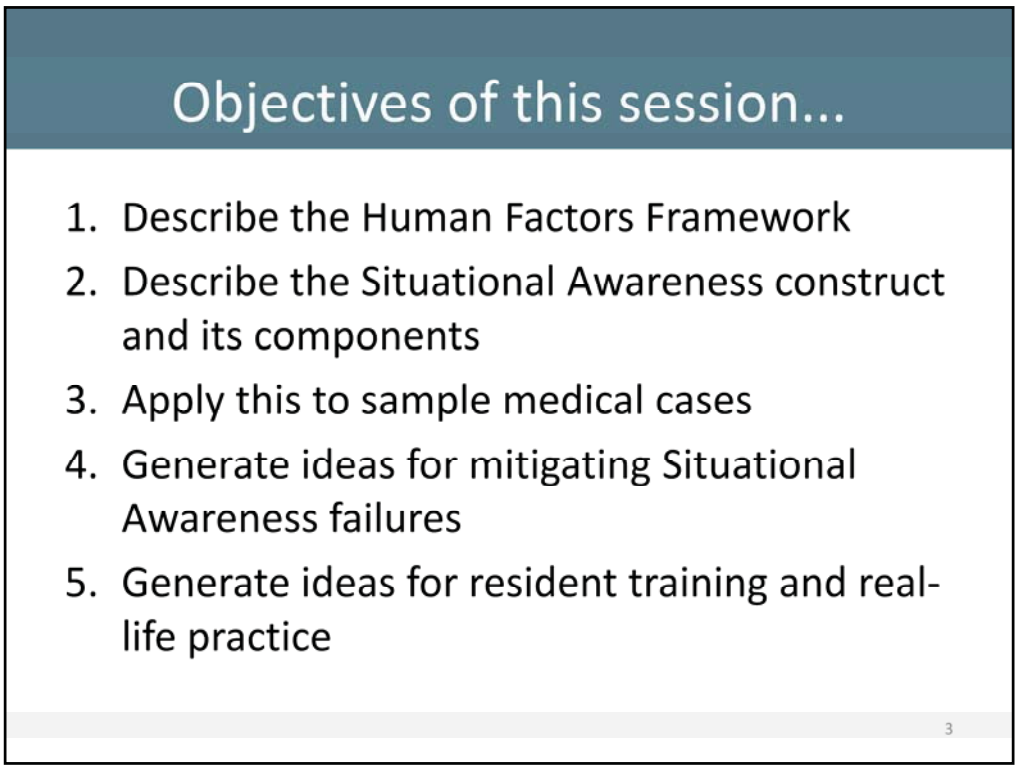
4.2 Situational Awareness Slide Set for Instructors





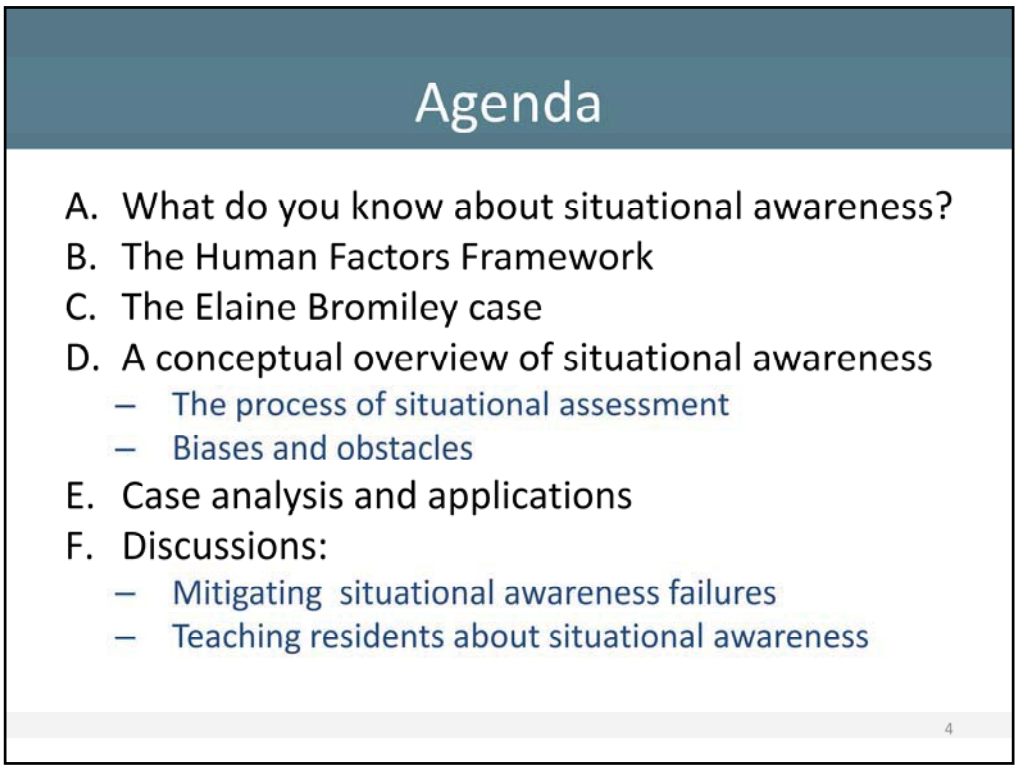
This educational training module was funded by the Canadian Medical Protective Association. A comprehensive needs assessment on human factors and patient safety was conducted with medical professionals, allied professionals and other patient safety experts in North America. The results from the needs assessment identified situational awareness as the most important and least understood “human factor” in healthcare.

We’d like to do a go-around. Please tell us your name, your specialty, and whether you had any previous training on situational awareness.

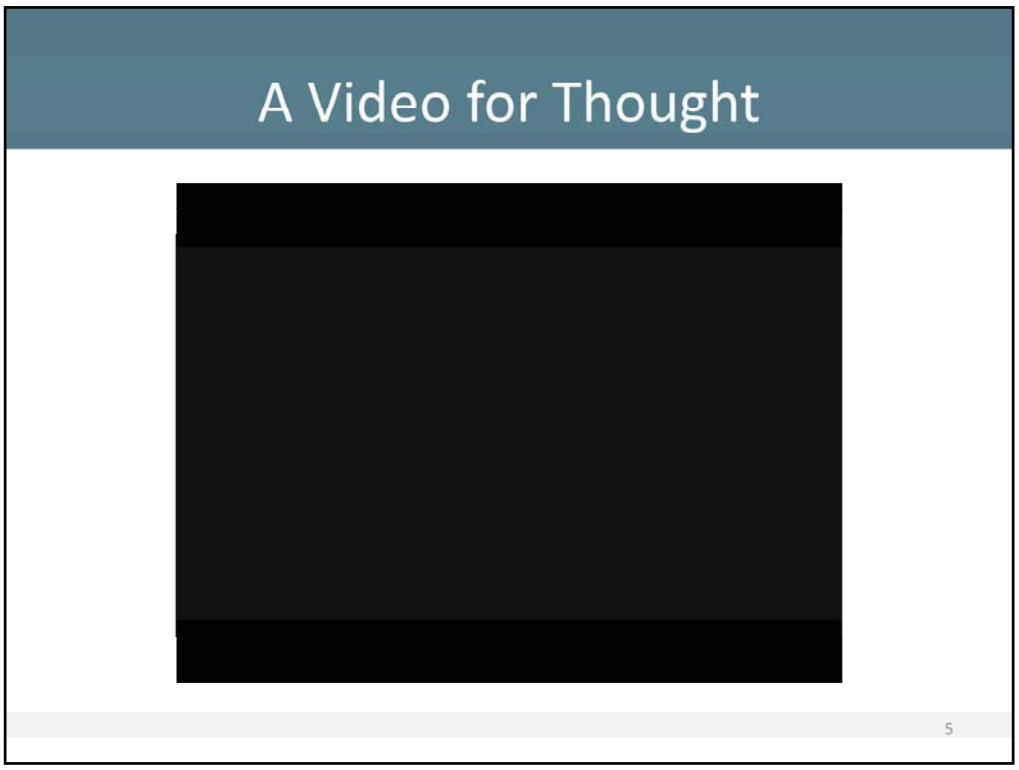


By the end of this session you should be able to…

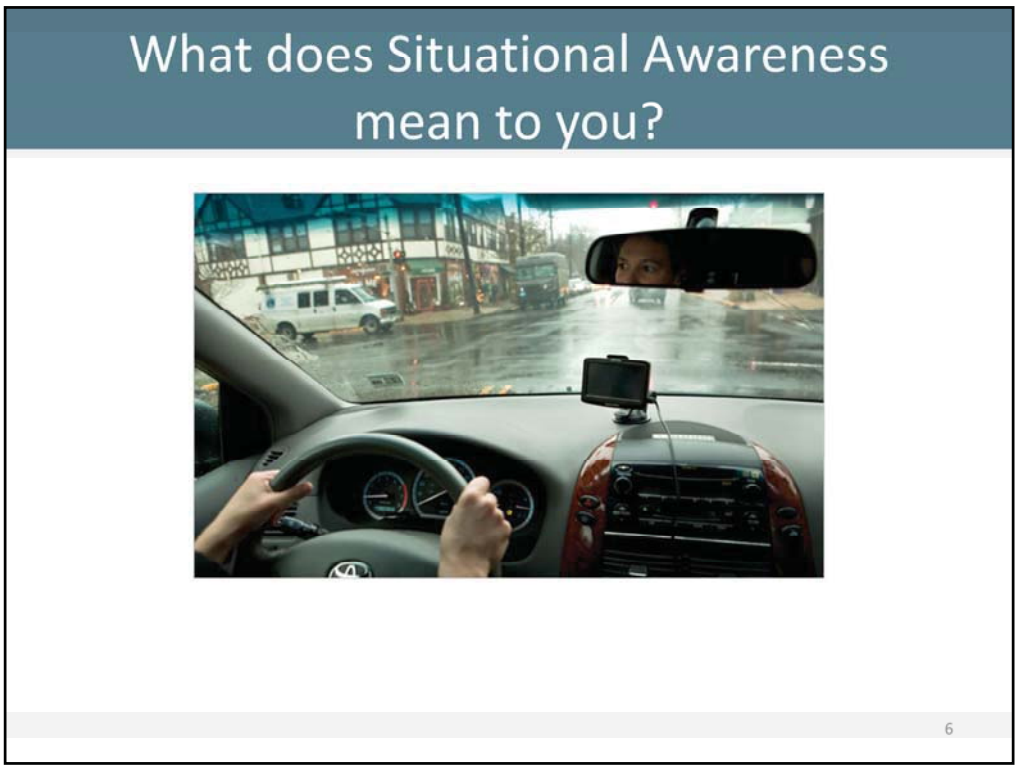
1. Describe the Human Factors Framework
2. Describe the Situational Awareness construct and its components
3. Apply this to sample medical cases
4. Generate ideas for mitigating Situational Awareness failures
5. Generate ideas for resident training and real-life practice



The first half of the presentation will develop a deeper, scientific understanding of situational awareness and then tie this to clinical cases. The second half of the presentation will be used to analyse medical cases focusing on the situational awareness dimension of each case.

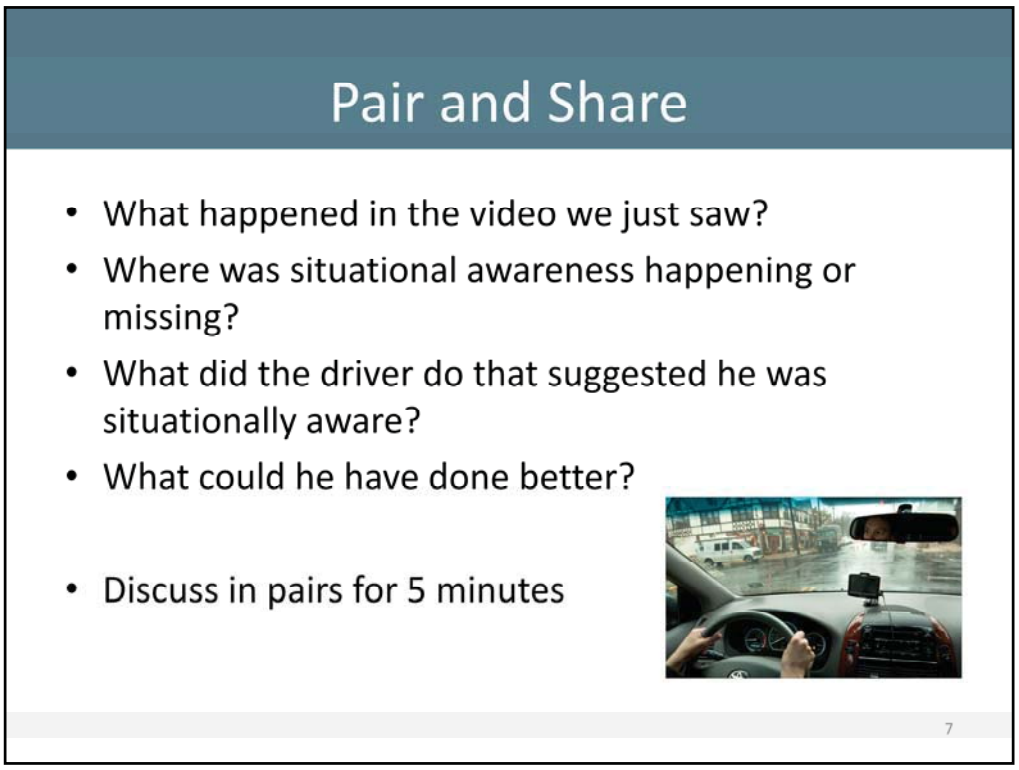


Here is an “everyday example” of situational awareness
(show driving video clip)



Now, tell me what you think happened in the video we just saw? Where was situational awareness happening or missing? What did you see in this video which suggested the driver was situationally aware? What behaviours did he exhibit? What could he have done better?

(pair and share instructions on next slide)



Note to instructors: Leave this slide on screen for the duration of the exercise and review

Pair and Share Instructions:
We are going to start things off with a short exercise: Pair-up and think of everyday examples of driving where situational awareness occurs.

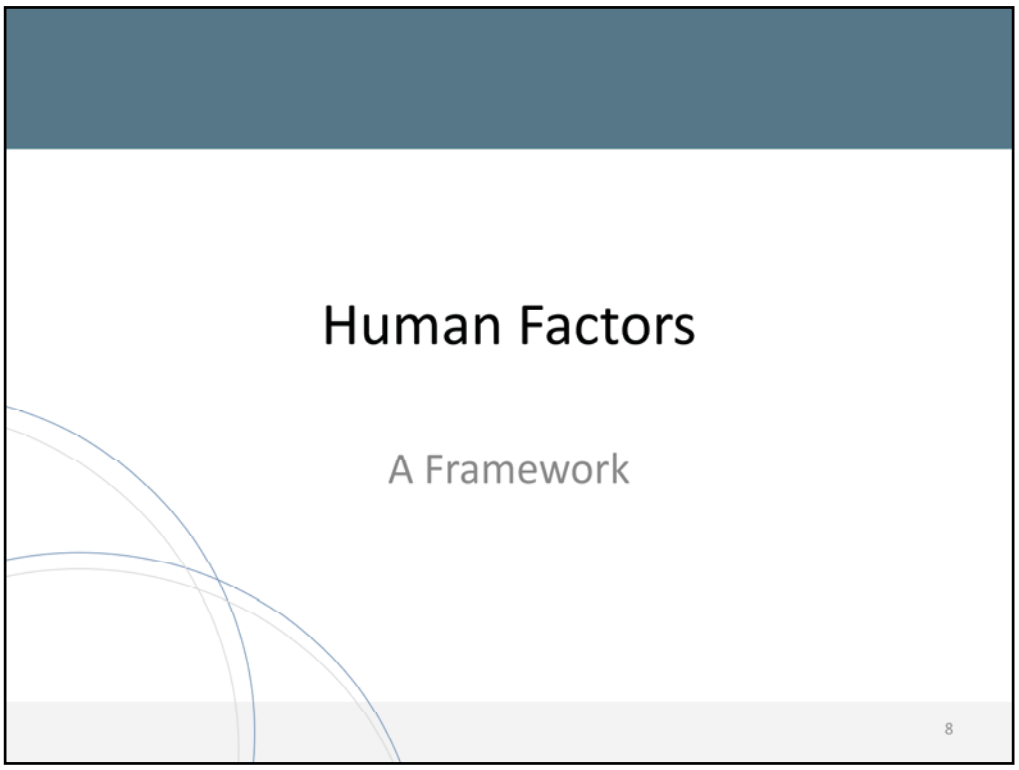
Take about five minutes to share your ideas with your partner.

(small group discussion for 5 minutes)

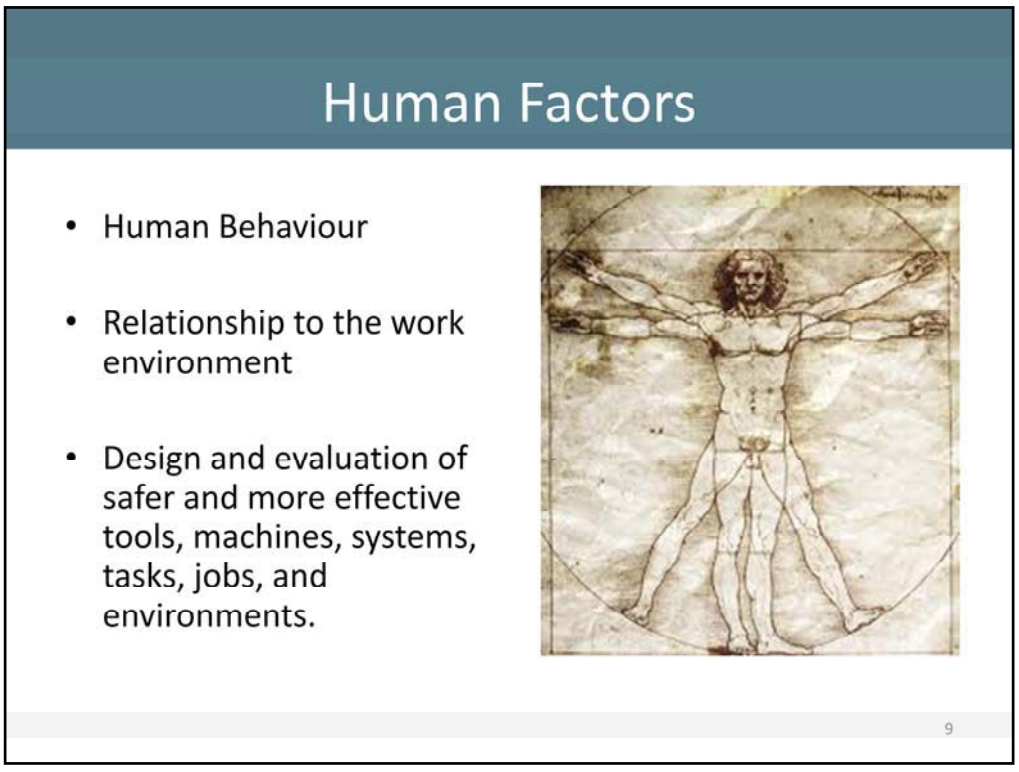
(response from audience 5min)

Further Discussion Questions:
Consider the last time you had a "close call" while driving. Was there anything you could have done to be more situationally aware? Anything the other driver could have done?
So what does the term "situational awareness" mean to you? Can anyone define situational awareness?
Can you give me other scenarios where situational awareness is important, driving-related or otherwise?

Note: Additional ideas for discussion questions are provided in the Instructional Supplement - Instructors Module



We will begin the theory portion of this session by placing situational awareness within a broader “human factors” framework.

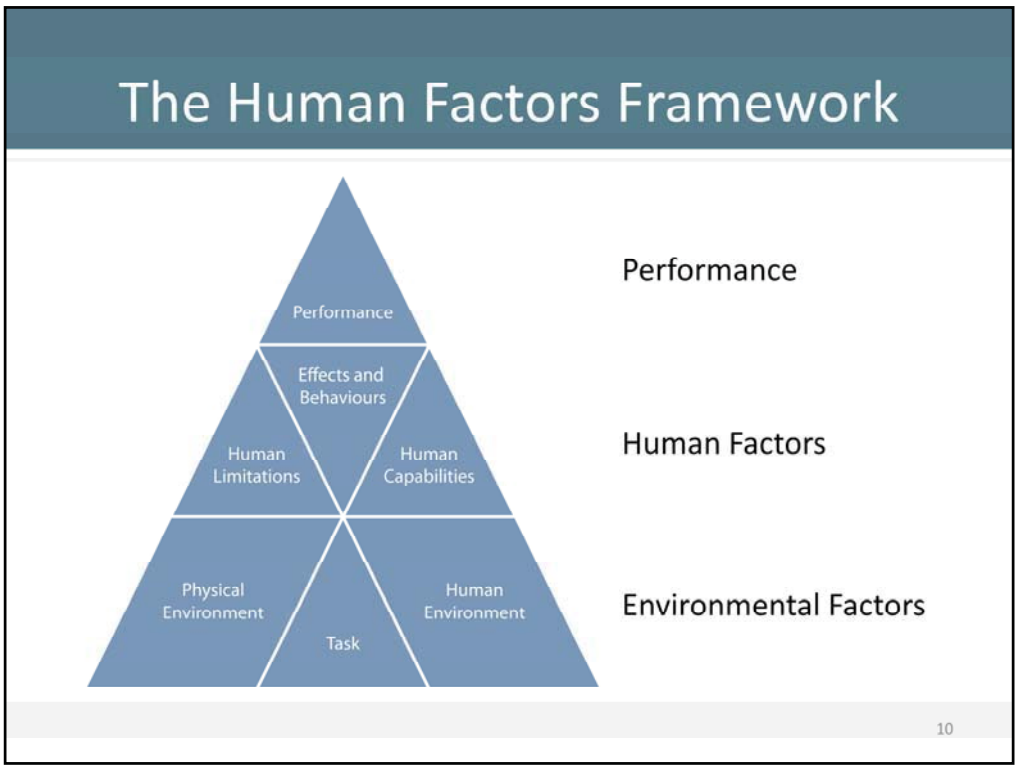


Is anyone familiar with Human Factors? What is “Human Factors”?

Human Factors include inherent human behaviours, abilities, limitations, and relationships between people and the work environment. This includes the physical environment, organizational environment, and cultural context of the work environment.

The discipline of Human Factors is all about understanding people and how they work so that we can design better, safer, more efficient tools and systems.

Being aware of human factors in our work environment allows us to design safer environments in order to facilitate and support better performance. The aim of understanding and being aware of human factors in our environment is also to develop better procedures and training to allow us to deliver our best performance within that environment.



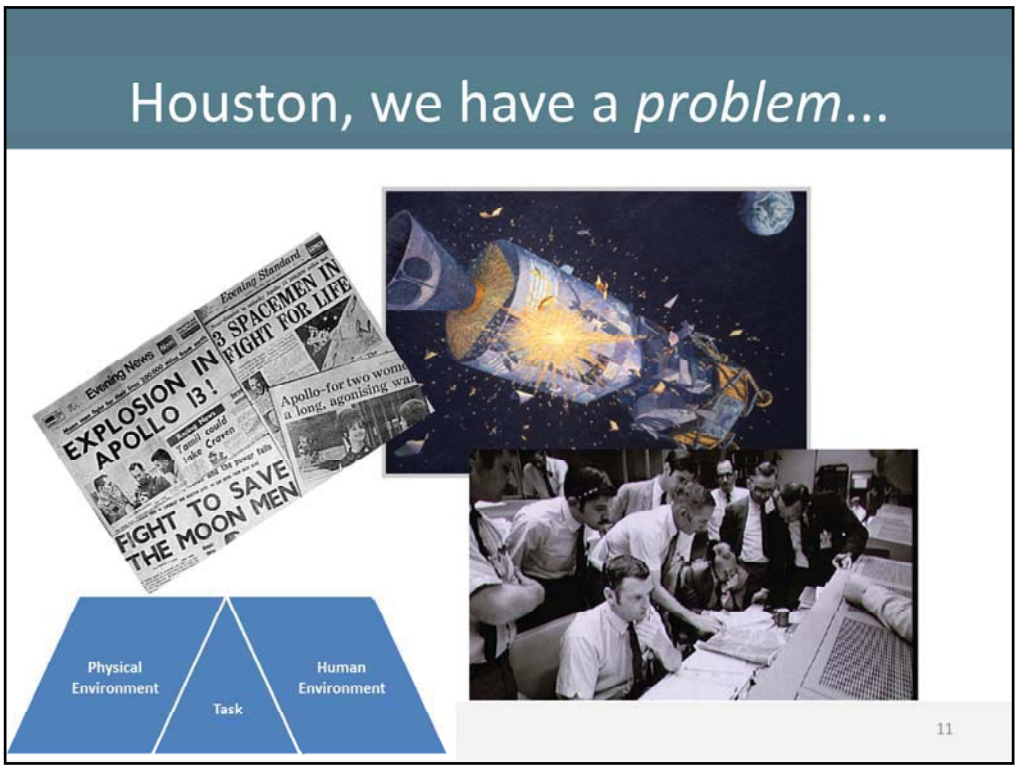
The diagram here describes the human factors framework. At the top is performance - the goal is good performance. Performance is influenced and shaped by both environmental factors and human factors.

Environmental factors are at the bottom tier. This level really defines the "situation" as you enter it – you enter a situation with a task in mind, and with a given physical and human environment. The physical environment can include the workspace and any physical aspect of this space. The human environment refers to yourself as well as others, and, spanning further outwards, the society and culture in which the situation exists.

You also enter the situation with individual capabilities and limitations (point to the middle level of the pyramid). Some capabilities and limitations are structured by the culture and society you function within, for example, when driving we adhere to "the rules of the road" – this convention is a factor that influences performance.

The effects of these factors can include distractions, interruptions. For example the design of a workspace might encourage others to use the same area as a through-way to another location resulting in regular traffic and distractions to the person working there. The effects could also be my own behaviours, for example, I might be stressed, frustrated or overwhelmed by my workload.

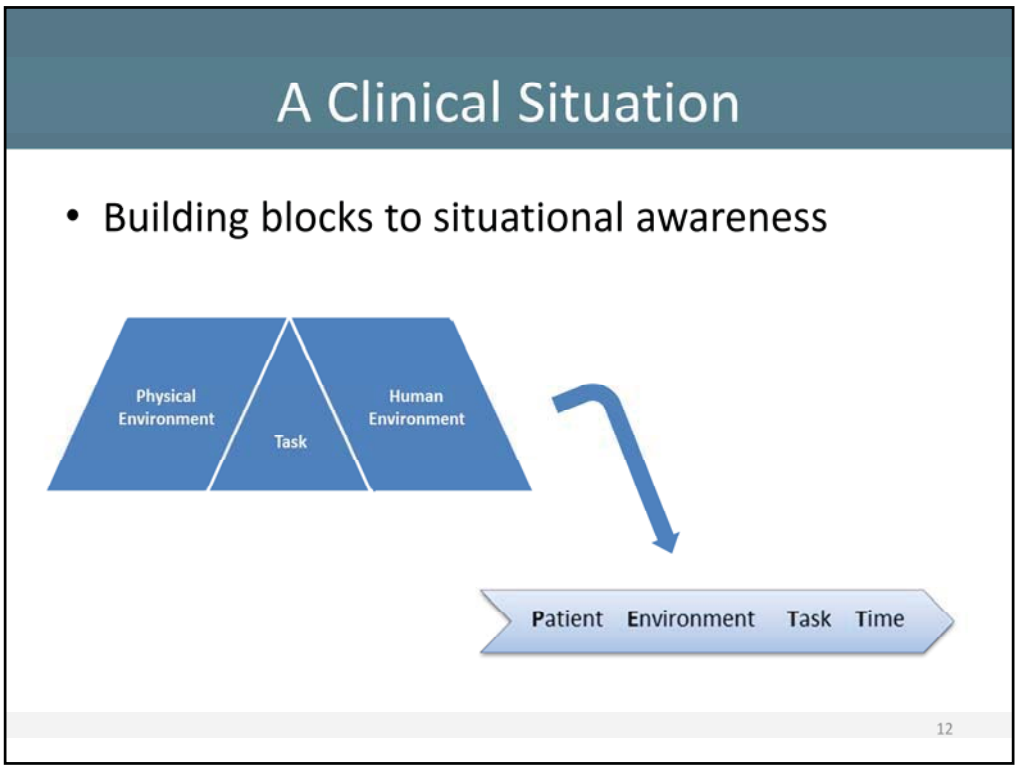
Where does situational awareness fit? Anywhere really. But perhaps it can be situated best in the bottom tier, because we can begin to build situational awareness based on the given environment, task, person, culture, etc. It's important to keep in mind that situational awareness is a dynamic process, constantly unfolding and changing.



The experience of Apollo 13 is an excellent example of situational awareness within a team under immense stress. In this case, everything was well rehearsed and seemed to be routine and then out of the blue came "Houston, we have a problem". The team had a new situation to manage: the oxygen tanks had exploded and other additional damage was incurred. A new task was presented to the team: find out what happened, decide how to manage and fix the damage and finally decide how the team will get home.

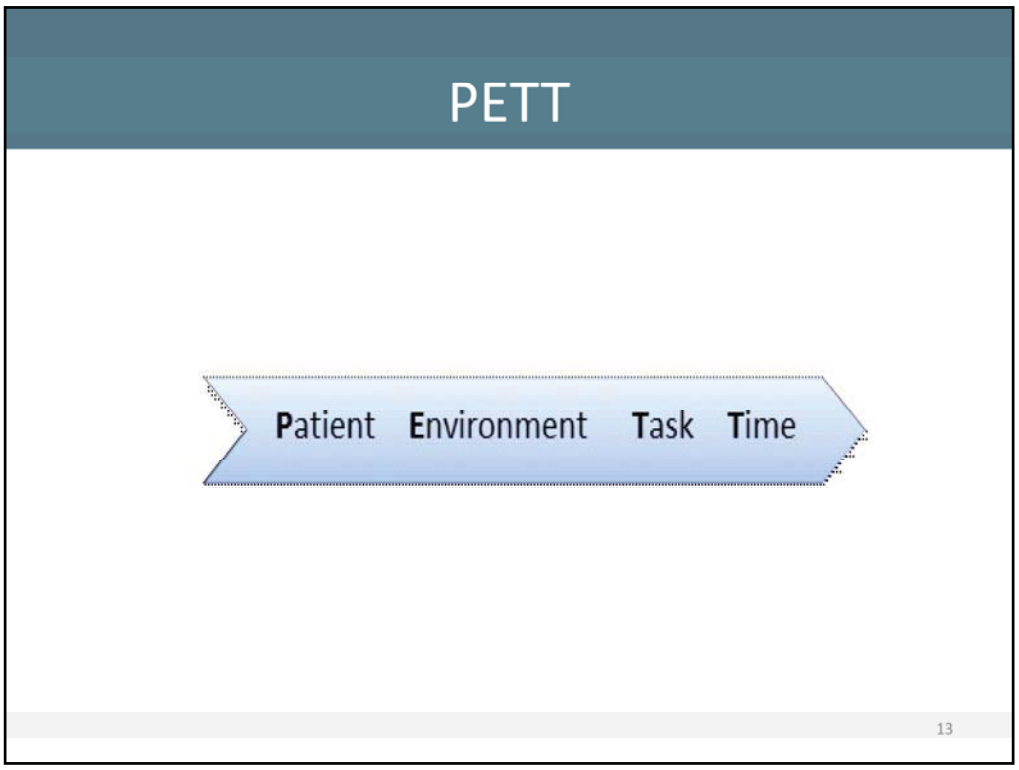
Using the bottom tier of our diagram we can identify some of the elements of the situation: the physical environment included damaged infrastructure, low oxygen, and high quality tools. The human environment included the team on board, their procedures and rules, and the "Houston" team at the control centre on earth.

These elements define the basic ingredients of a stressful, risky and life-threatening situation.

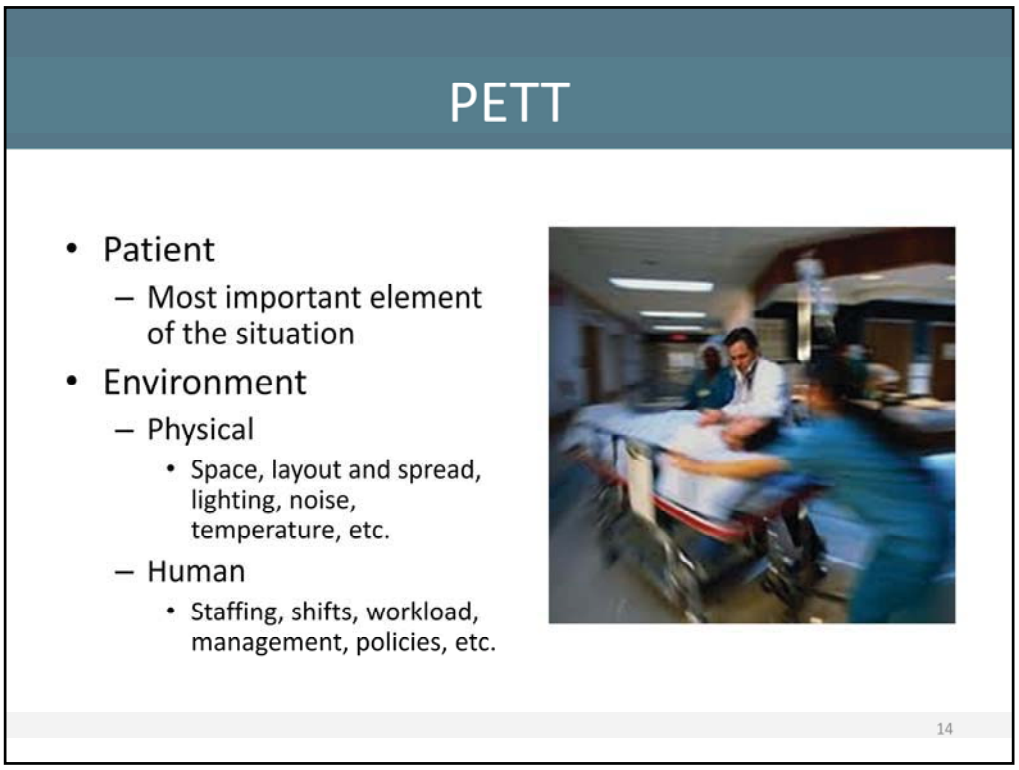


Now let's bring this idea of a stressful, risky and life-threatening situation into the clinical context.

Starting with the bottom tier of the human factors framework, what is typically in a clinical "situation"?

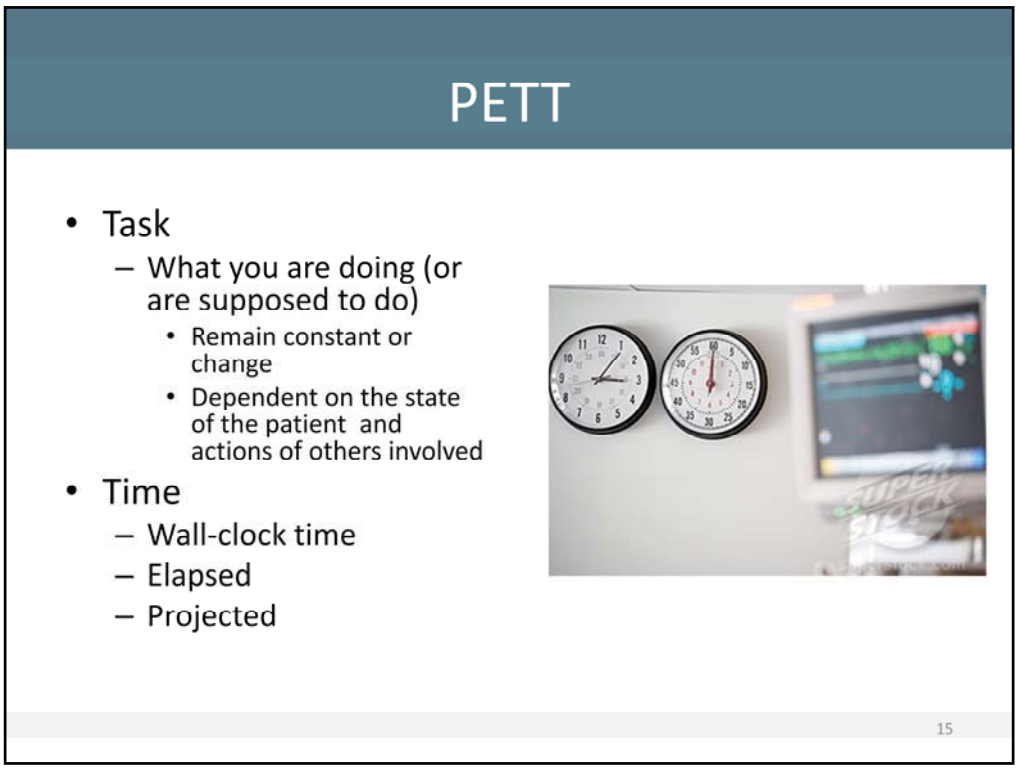


Patient, Environment, Task, and Time (PETT); these are the basic ingredients in the clinical situation.



The patient is the most important element of the situation, including the past, present and future (anticipating the future) condition of the patient.

Then we look to the physical and human environment. The physical environment is your workspace, equipment, the lighting, noise, temperature, etc. These things may cause distractions or interruptions. The human environment includes the people you work with such as your colleagues, your supervisor, the nurses, and includes your own skills, your training and qualifications, your emotional state. The human environment also includes the rules and procedures of your medical practice, and the hospital.

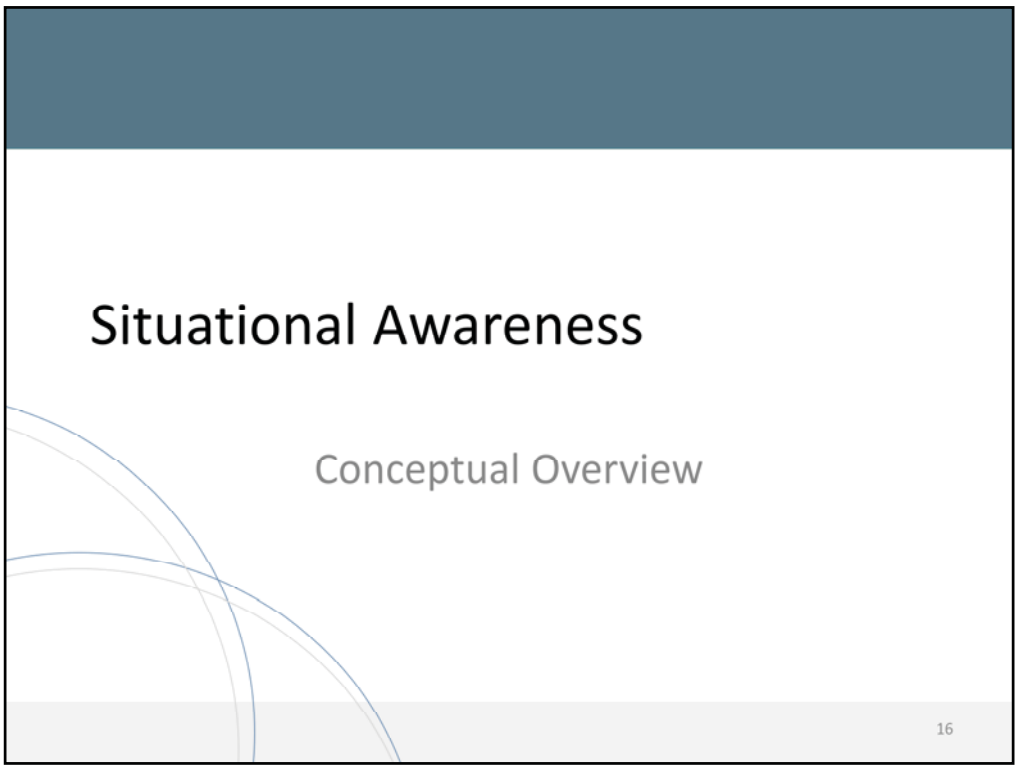


Then we look to the task. The primary task is to take care of the patient but what happens when an event occurs and creates a new task? There may be known procedures to address the new task but have you identified it as something different then the initial task?

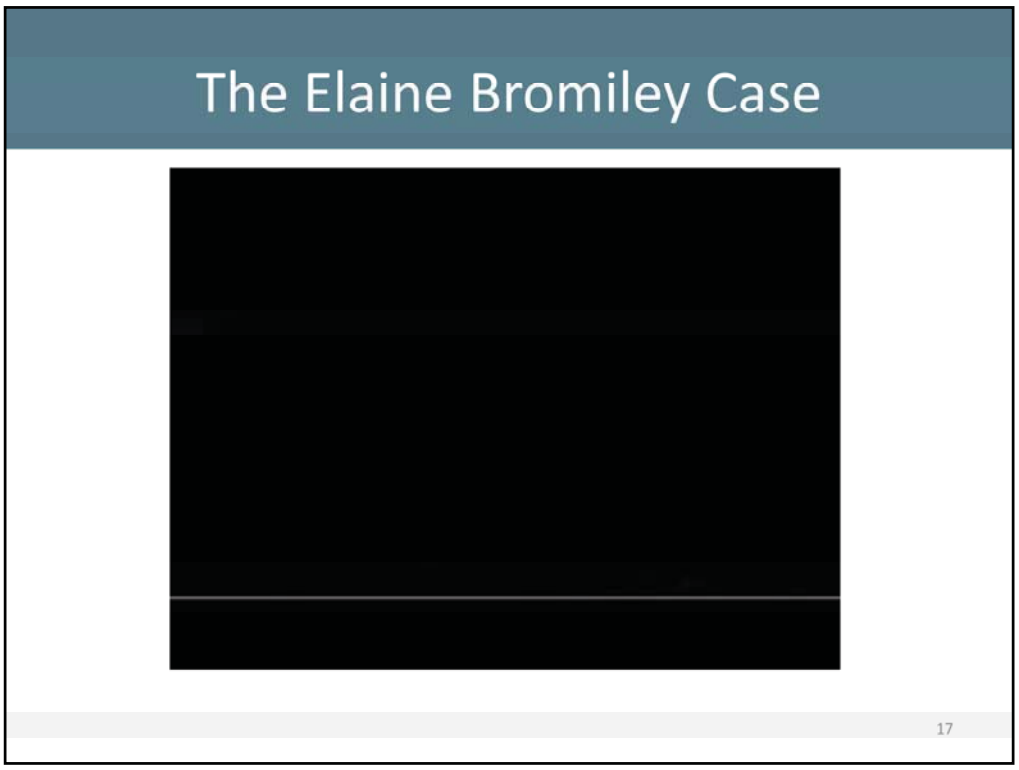
Despite procedures existing and a wealth of training and qualifications, “wrong patient, wrong procedure, wrong site” can happen to anyone as a result of a lack of awareness.

We also need to look at time. In the clinical context, elapsed time can be critical.

Does this make sense to everyone?

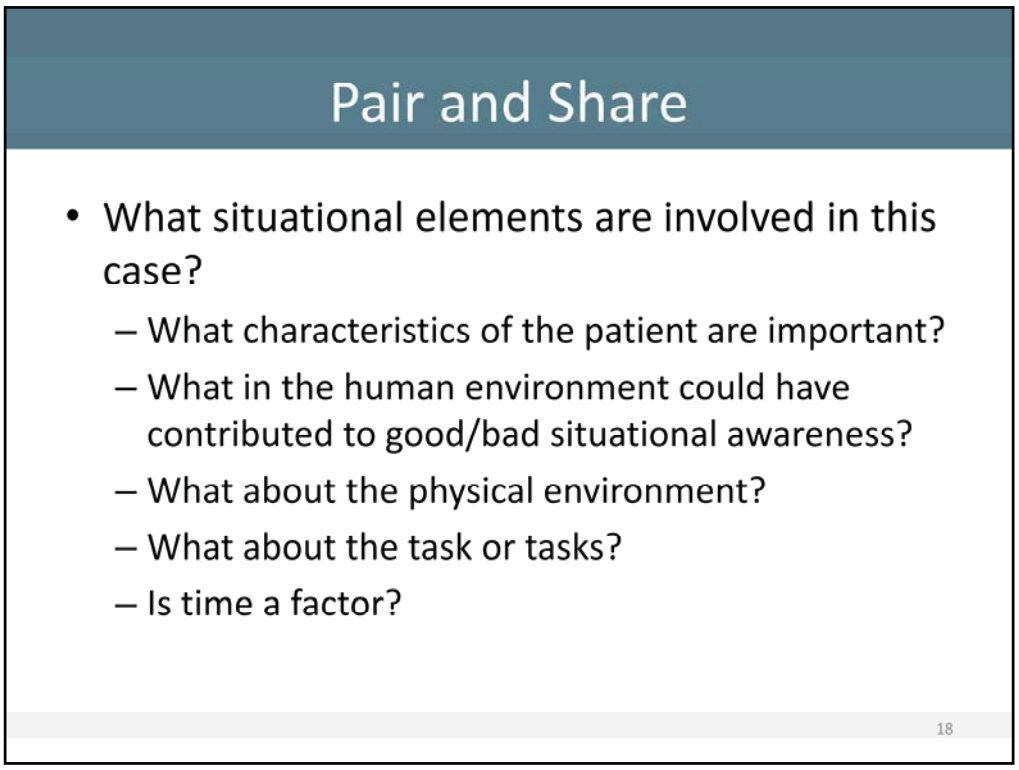


Now that we know the ingredients of a situation, let's discuss what it means to be aware of the situation



We're now going to bring in a clinical case to analyze situational awareness in the clinical context. Watch the video and then, as a group, read the "Case 5: Elaine Bromiley" case description in Chapter 9 of the training binder. While you watch the video and read the case think about our discussion about what situational awareness is. What is going on? What are the elements of the situation (task, physical environment, human environment)? What are the human factors? Do the physicians know what's going on? Afterwards I will ask you to identify these elements.

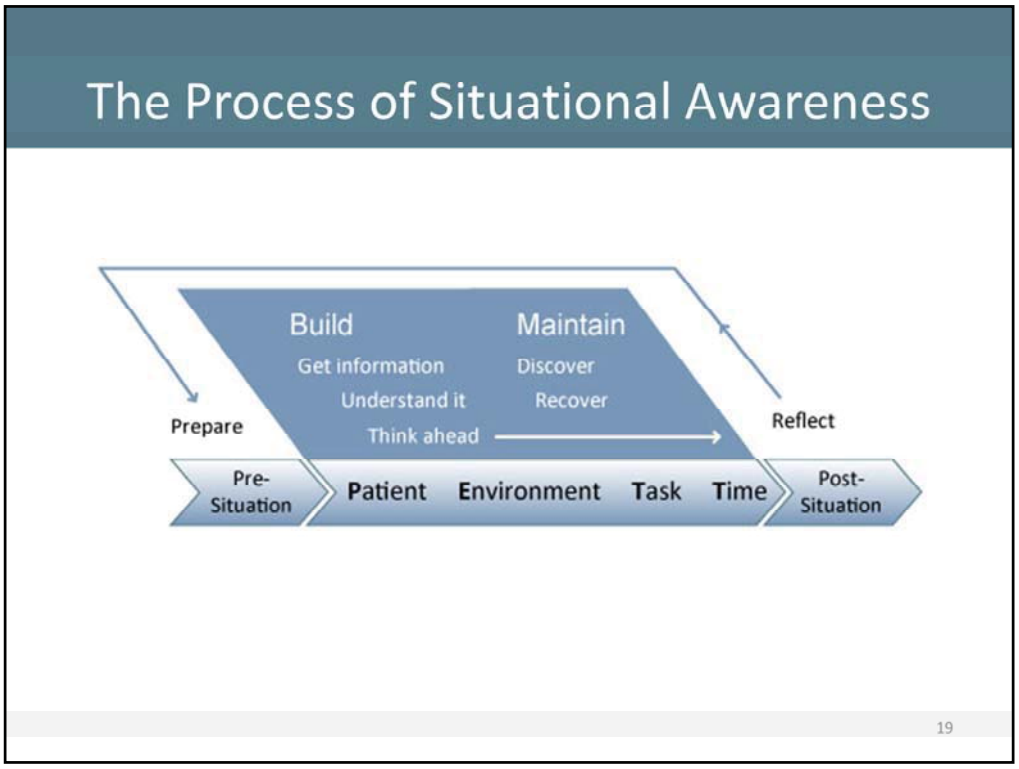
This is the Elaine Bromiley case entitled "Just a Routine Operation", the first clip is her husband describing the case and the events that occurred throughout her surgery.
(show the video)



What elements of a situation are involved in this case? Think back to our "PETT" discussion. Pair-up and discuss.
Is anyone already familiar with this case? If so please try to pair-up with someone less familiar.

Responses should include:
- **patient:** taking for granted the overall good health of the patient and not responding (in varied ways) to the critical state that she regressed to. Appeared to be an easy airway and therefore did not anticipate for difficulty, did not say "what if?" and move on to a new approach.
- **human environment:** being aware of all the different skills and the roles and responsibilities of all the team members. Perhaps an organizational hierarchy/the authority gradient of the hospital setting could have impeded the ability to try various options. Perhaps stressed or fatigued influenced response.
- **physical environment:** being aware of the resources available to the team. Perhaps there was mechanical issues, such as alarms turned off, etc.
- **task:** being aware of the task and identifying when a new task arises. This team failed to recognize the new task, failed to seek out options, and became fixated on one task.
- **time:** lack of awareness of time. Perhaps no one was delegated the responsibility of keeping an eye on the time. Perhaps because the patient was young and in good health they overestimated how much time they would have to complete the intubation.

Let's move on to a more thorough definition of situational awareness.



Now that we've gone over what situational awareness is, the question remains: how do we get to a good level of situational awareness?

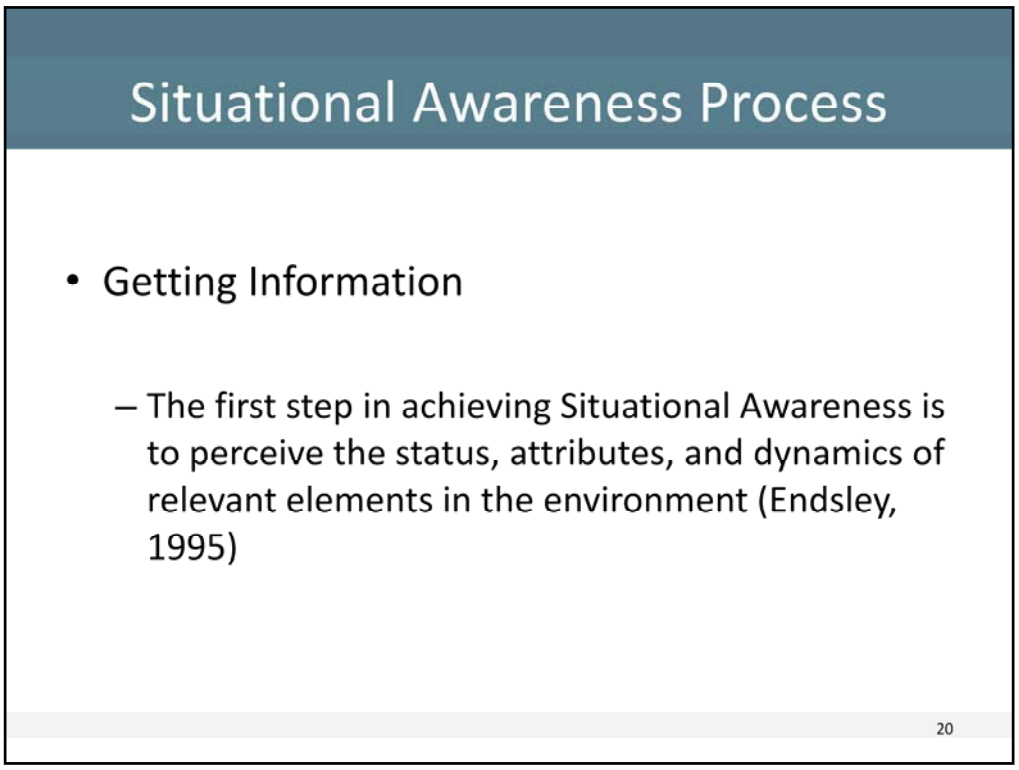
The process is centred around the situation itself, which in the clinical context we have defined as including four key elements: patient, environment, task, time.

The process is based on building and maintaining situational awareness. This is a continuous process starting "pre-situation" (the planning and briefing stage) and continuing through to the "post-situation" (the debrief and reflection stage).

Thinking back to the driving example: if the first stage in "building" situational awareness is getting information – this would equate to recognizing the stop sign. Next we need to understand the information – this would be comprehending that the stop sign means stop. The next logical step is thinking ahead - anticipating the location of the motorcycle when you pull out from the stop sign.

This building process applies to every aspect of the situation, getting information on the patient, on the environment, on the task, on the time, all at the same time. Additionally, these dimensions of a situation are dynamic, constantly changing so this process needs to be on-going. Because of the dynamic nature of the situation, it is critical to "maintain" situational awareness by discovering and recovering information and recognizing the changes that have occurred.

This is a process of understanding what has happened, what is happening and what is going to happen.



First step in the process of building situational awareness is **getting information** of the situation, this is very perceptual. “Perceive the status, attributes, and dynamics of relevant elements in the environment”. This gets tricky when we come to “relevant” elements, because there are many things going on around you this process focuses on parsing out what elements are helpful to your goal.

Medical Example

- Getting Information
  - Elements visually extracted from monitor
  - Heart Rate
  - Blood Pressure

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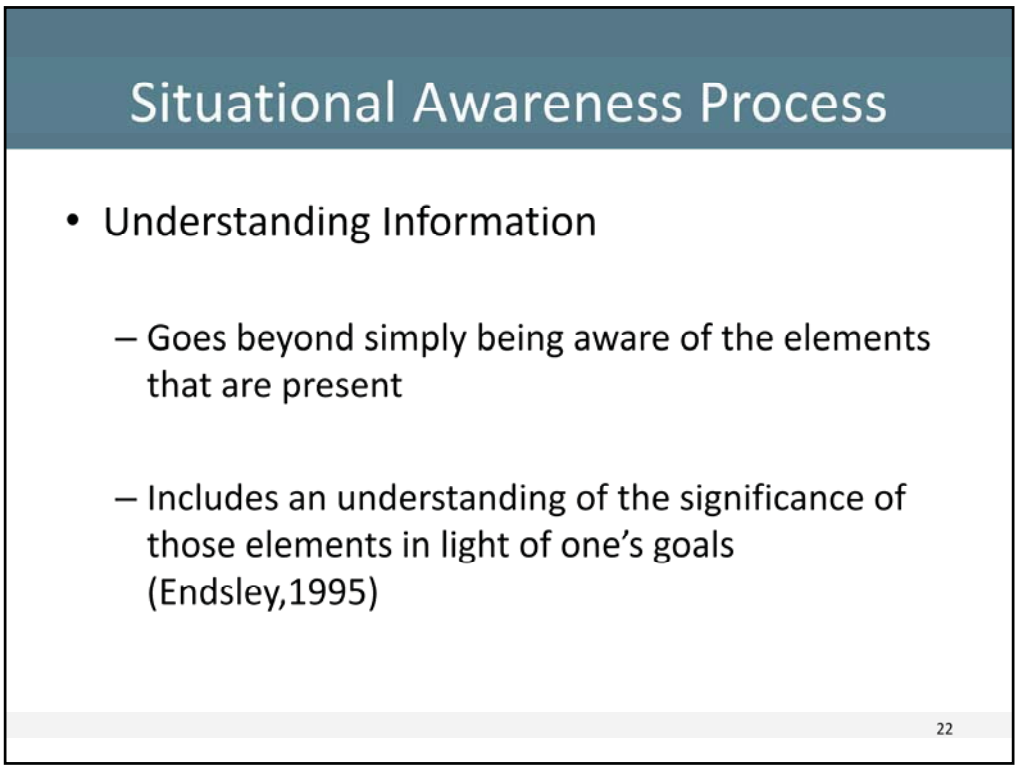
In the clinical setting this starts with getting information of the vital signs. There is a lot of information on this monitor, so you extract the most relevant information. For example, when you walk into the resuscitation area of your ED, you look up and extract the HR, BP and SaO2.

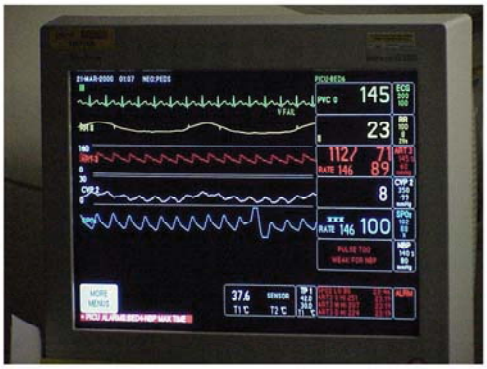
Extracting that information is the very first step of building situational awareness.



The second step is understanding the information, what are the implications of this information with respect to your goal? Relating back to the perceptual elements, this is understanding the significance of the element as related to your goal and understanding what they mean in the process.

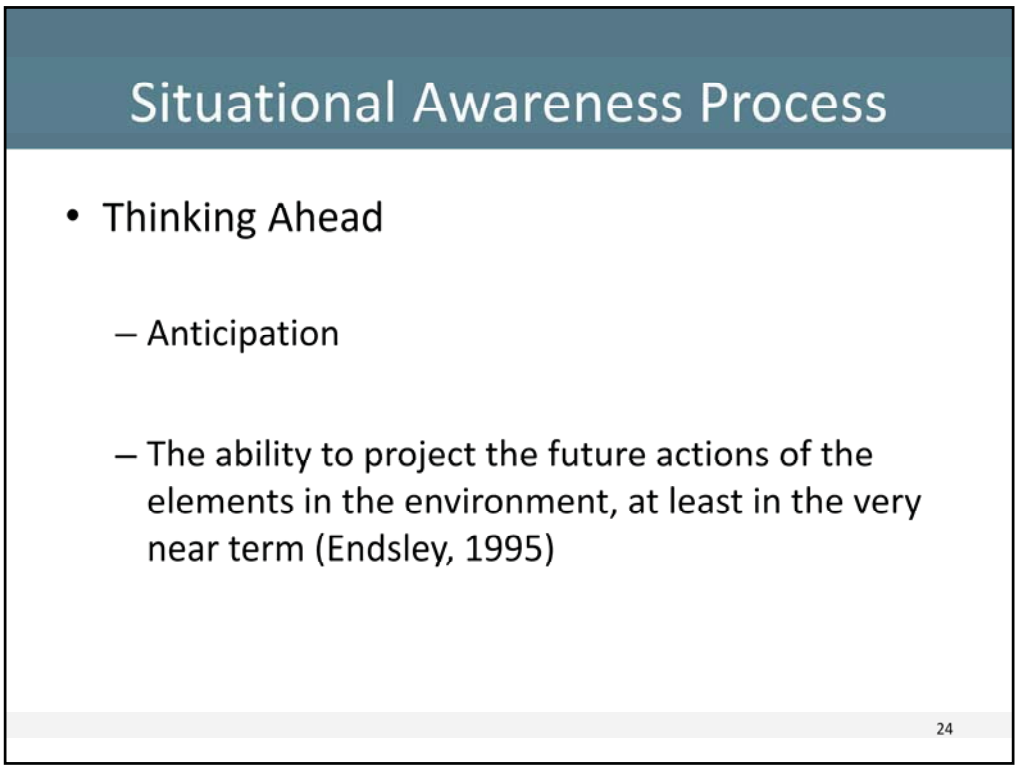
Medical Example

- Understanding of …..



23

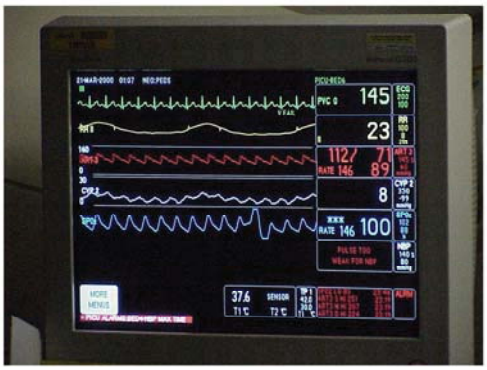
This stage puts the vital signs into context. For example, these vital signs may not be very significant for a child (depending on their age), but if you have an elderly trauma patient with these vitals then they suddenly have very significant meaning and will impact to how you proceed.



The last stage, which really defines experts from novices, is thinking ahead and anticipating what the perceptual elements mean and what they mean for the future based on the initial goal. In situational awareness literature this is called **projection**, the ability to project what the impact of your future actions will be. Adapting your thinking to always involve **projection** will allow you to constantly maintain your situational awareness.

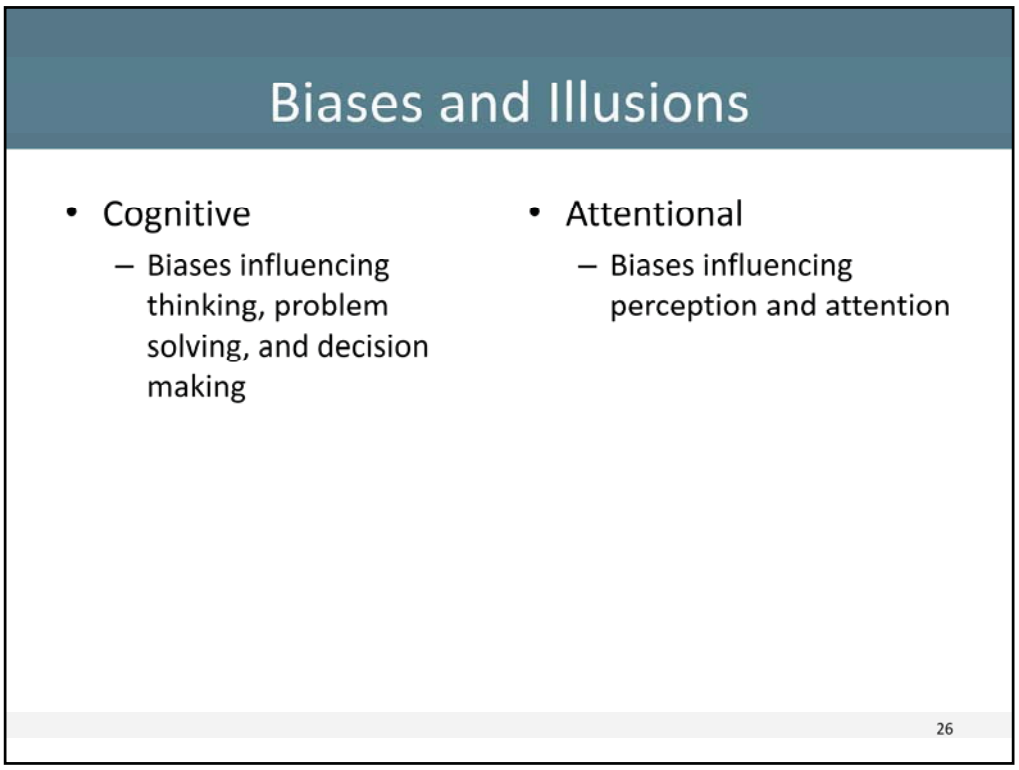
Medical Example

- Thinking ahead....



25

So we've seen that the vital signs indicate high heart rate, and low blood pressure. We've put the vitals into context: elderly trauma patient. The next step is to anticipate what's going to happen. I can anticipate that the patient may deteriorate if I don't intervene. The important thing is looking ahead and tying this to action, "what do I do next?" and, "what will the outcomes be if I do this...?"



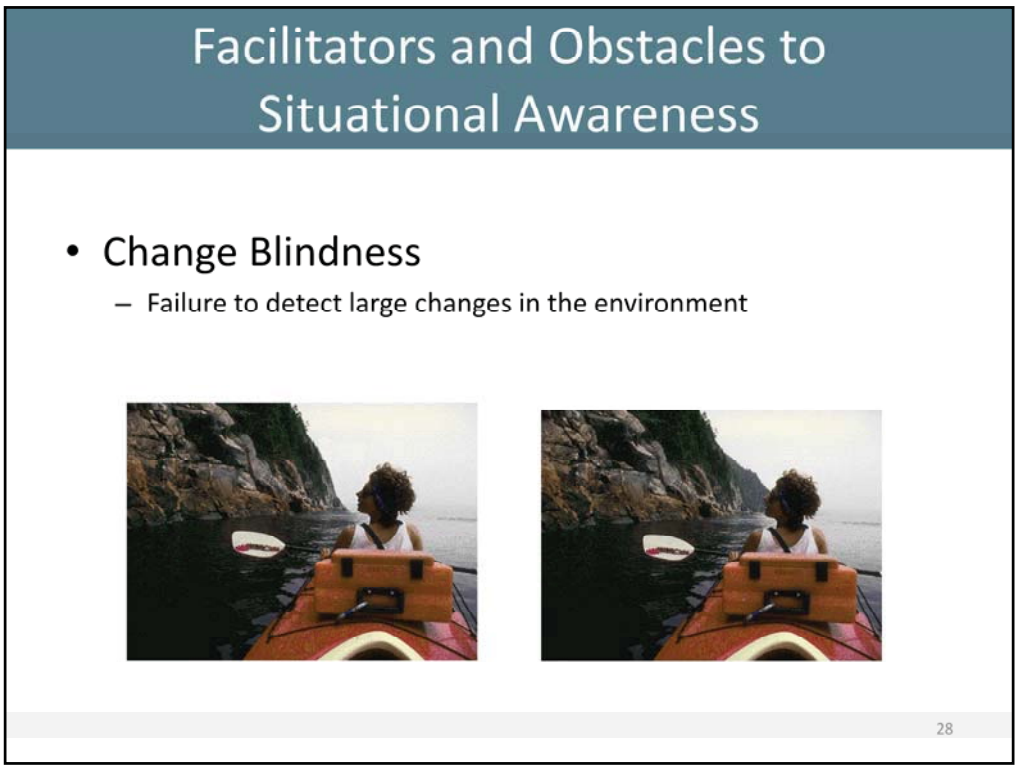
Next we are going to take a look at the two biases that influence our ability to make decisions and reach a certain level of situational awareness.

Cognitive biases are the biases that influence thinking, problem solving and decision making.

Attentional biases are biases that influence perception and attention, for example "looking and not seeing". We think that what we are seeing is what we are looking at but biases can have a strong influence what we see.

(awareness test video)

As is shown in this video, it is easy to miss something you're not looking for, particularly when you're focusing on a particular task. When you relate this to the Elaine Bromiley case, the physicians became so fixated on the task of intubation that the decreasing SATs went unnoticed.



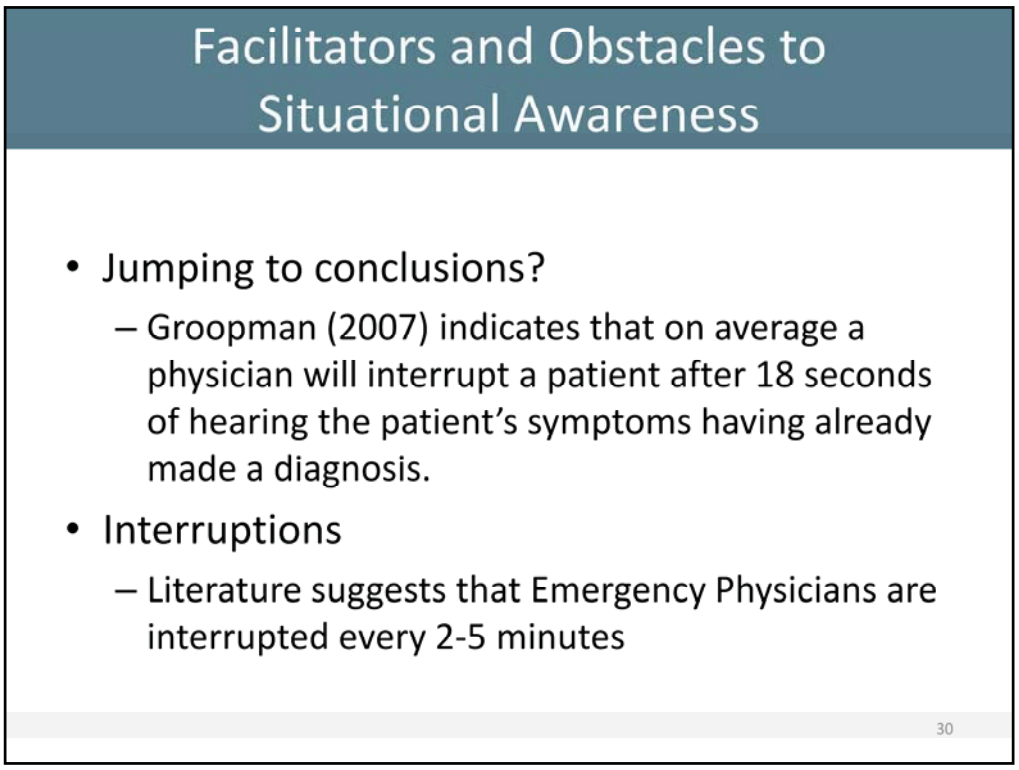
Take a look at this picture (click to show first – left - image)

Now take a look at this picture (click TWICE to show second – right – image and hide the first). Do you see any differences?

(click again to show the images side-by-side)

Another obstacle to situational awareness is change blindness. We think that we perceive everything and we think that we have a great memory, but the reality is it is easy to fail to detect large change because there is a limit to the amount of perceptual information that our brain can assimilate at one time. Our perceptual systems tend to eliminate things without us realizing it.

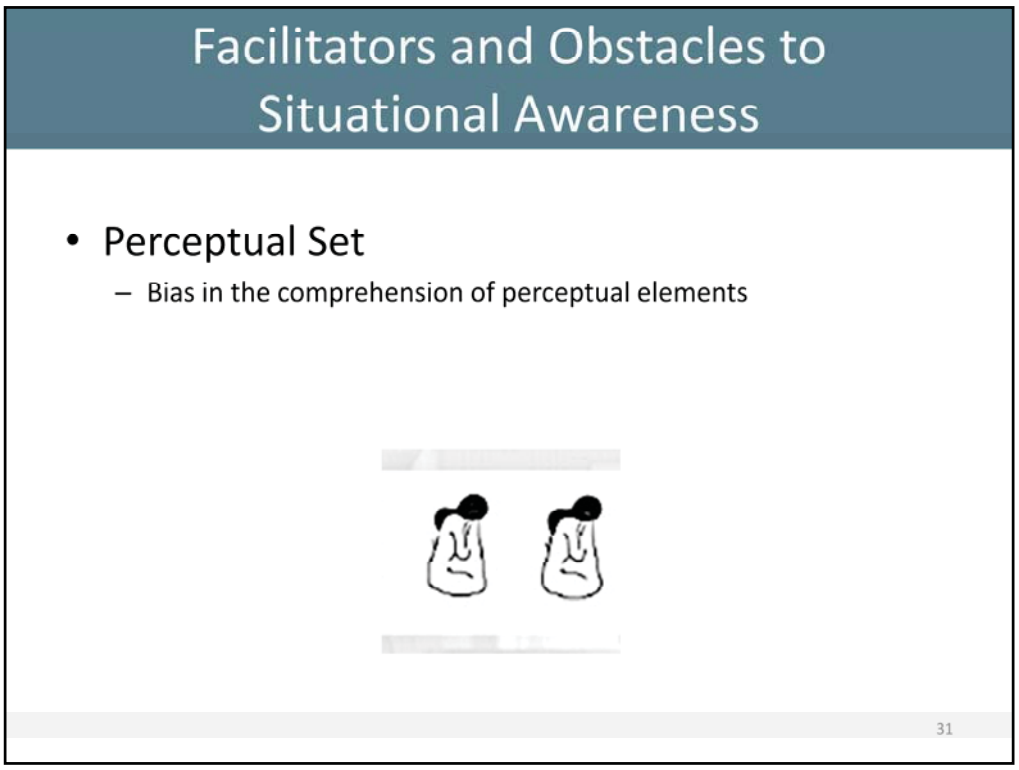
(change blindness video)
It is very easy to miss obvious changes in the environment, this is particularly important for dynamic context such as the clinical context where things are always changing.



Other obstacles to situational awareness is the tendency for physicians to make decisions and diagnoses quickly.

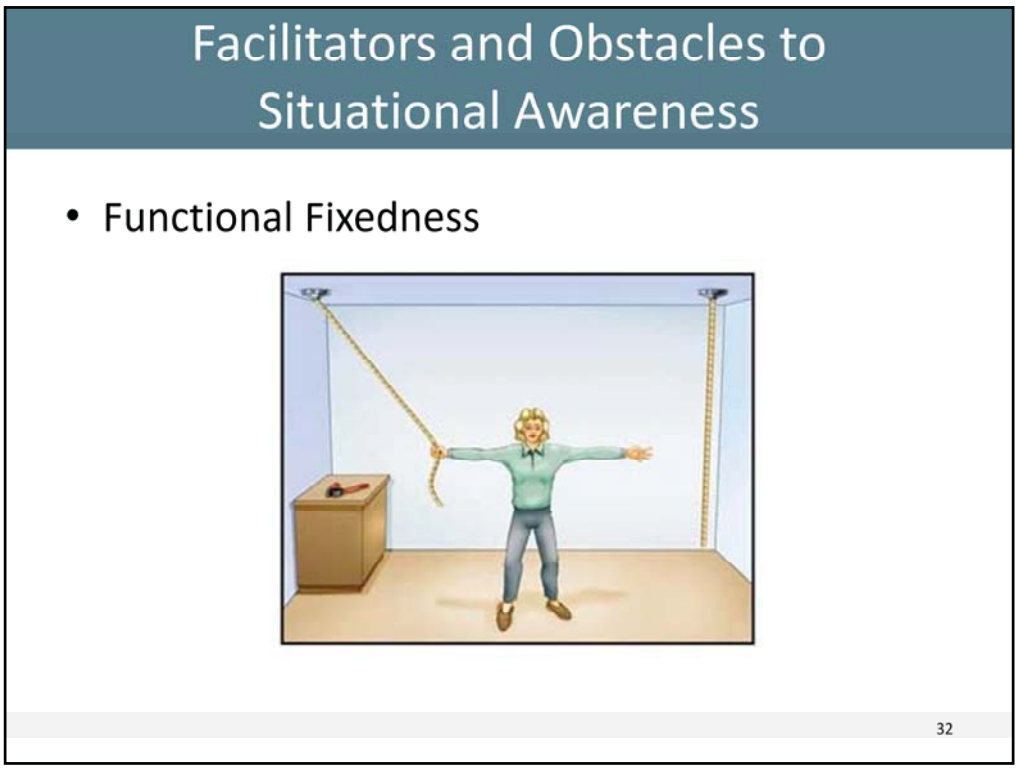
Interruptions also present an obstacle to situational awareness, as studies have shown us that physicians are constantly interrupted. Between the pre-interruption phase and the post-interruption phase, a lot can change. Research is telling us that we're not as good as we think we are in recovering information and evaluate the changes, especially in highly time sensitive and critical situations.

[Note: research on interruptions in the Emergency Department has come up with a range of timeframes, see Chisolm 2000, Rivera-Rodriguez 2010, and Jeanmonod 2010 (all three references can be found in the primer bibliography)]



Your perception, what you see, can be easily biased. Your perception of the middle figures here can be biased based on the other figures shown beforehand. (Show image to the left, then image on the right - you could see a man's face OR a woman's body based on which image you are shown first)

So when you walk into a situation your perception of what is going on can be biased based on what you see beforehand. For example in the Elaine Bromiley case new team members were introduced into the situation as it reached a critical point, but the strategy to secure the airway did not change. We can assume this is because of perceptual bias that inhibited the ability of the new team to critically think, for example perhaps the situation was framed by the surgeons as "routine" rather than "crisis".



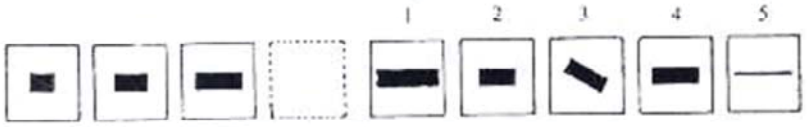
Functional fixedness is another obstacle to situational awareness and is particularly relevant to the Elaine Bromiley case...

The example we have here is a traditional psychology test. The task is to hold both ropes at the same time. You can let go of the rope at any point and you can use anything in the room to help with the task. Most people get fixated on using the pliers to grab the rope which ultimately does not work, and fail to see the other option, which is to use the pliers weight to swing the second rope to be close enough to grab. In this example the pliers have multiple uses, but many think that there is only one use. Functional fixation is overcome by stepping back and determining what resources are available and the many ways in which they can be used.

The lesson from this example is to look for other solutions, given the information that is available to you.

Facilitators and Obstacles to Situational Awareness

- Series Completion
  - What happens next?
  - Anticipating based on the logical understanding of



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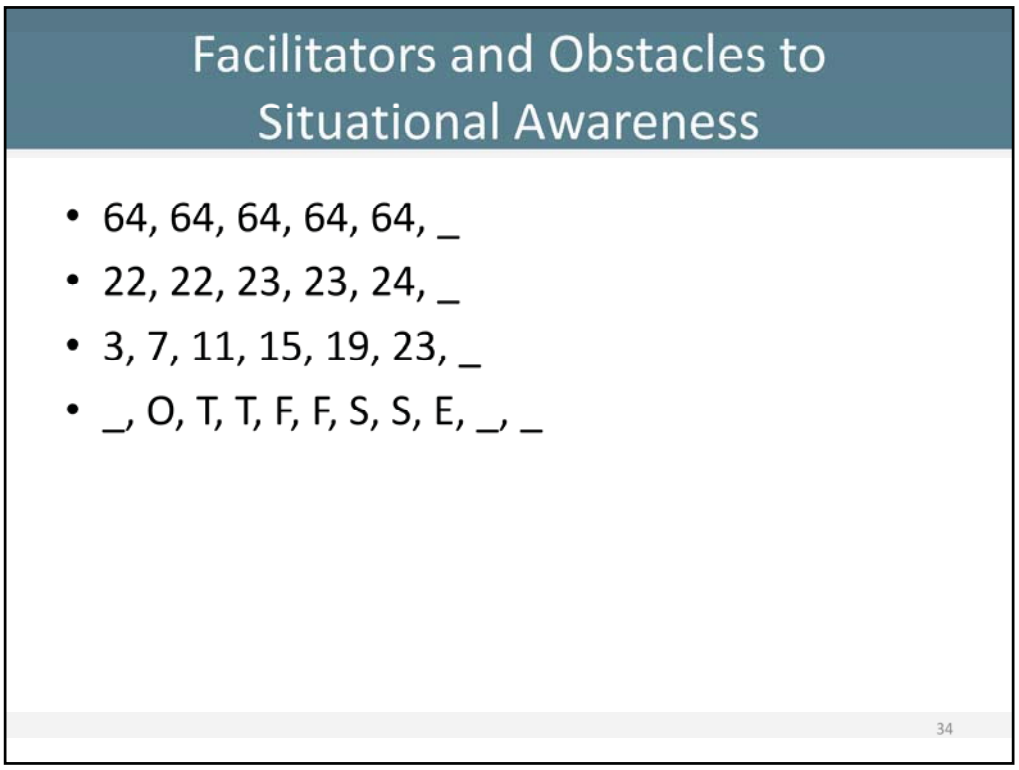
Series completion refers to the biases that influence logical understanding.



Who can tell me what the missing letters are in the last bullet point?
(Answer: Z, N and T for zero, nine and ten, the first letter of numbers 0 to 10)

These series completion exercises show the problem of being "stuck" in a given way to look at things. This is similar to being stuck in the same way of solving a problem without trying to look for more information or other ways to solve the problem.

Time for a Break…

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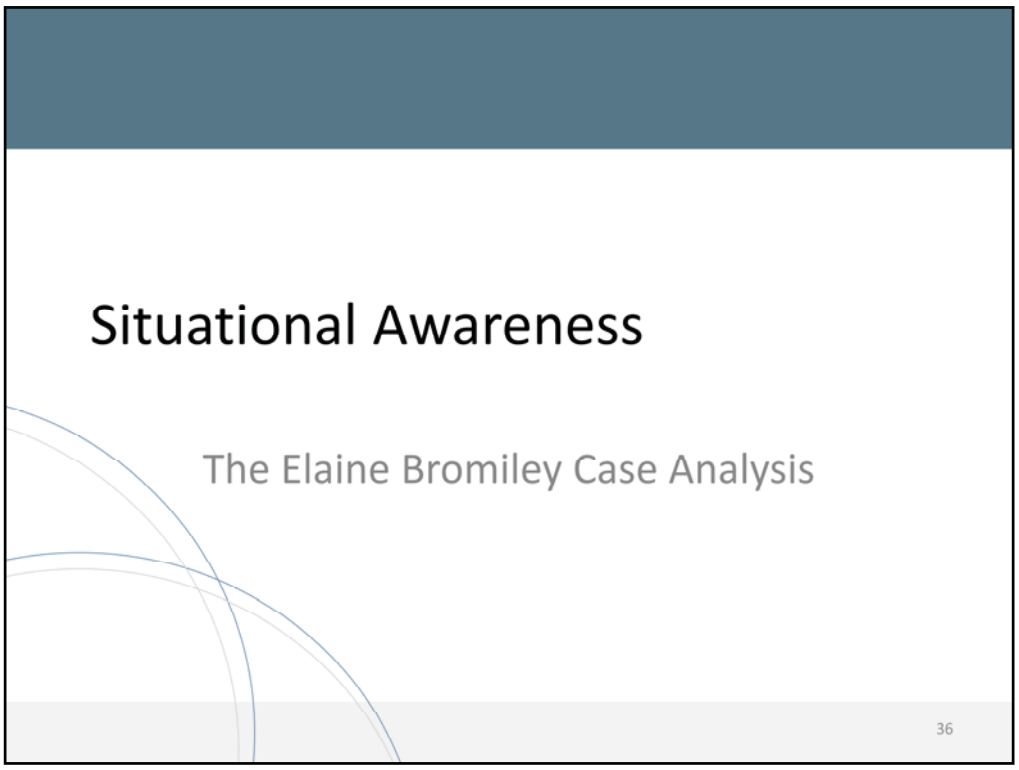
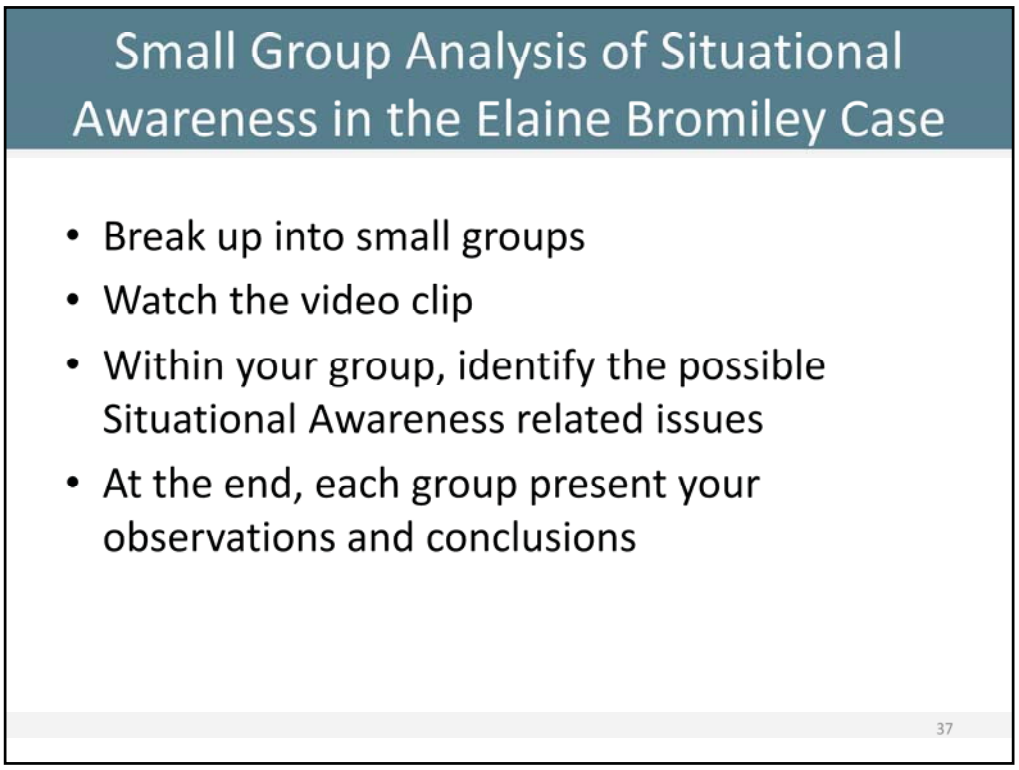
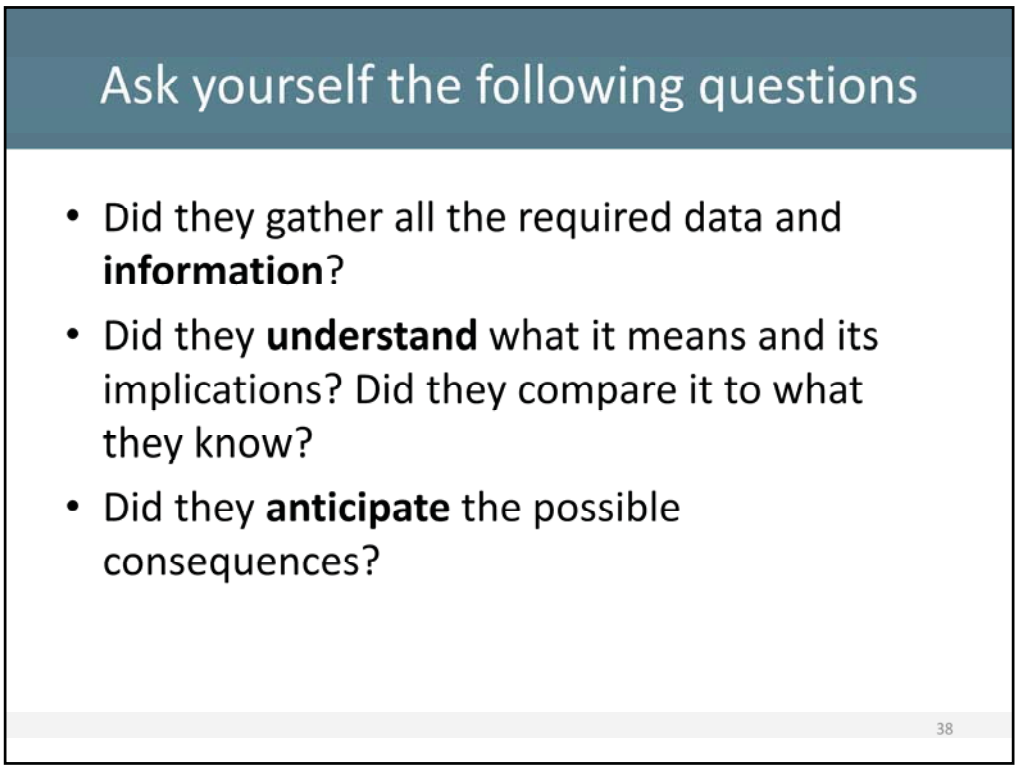

Situational Awareness
The Elaine Bromiley Case Analysis
36



Now we'd like to apply our understanding of situational awareness to the Elaine Bromiley case.

Breaking up into small groups, we will show clips from the case followed by a discussion with your small group and then we will discuss as a larger group. As you watch, try to put yourself into the shoes of this team and think about what was building good situational awareness and what was interfering with situational awareness.



Three basic questions should be applied to each stage:

1) Did they have all the information?
2) Do you think they understood the information?
3) Does it look like they were thinking ahead, or anticipating what could happen?

The Elaine Bromiley Case: Part 1

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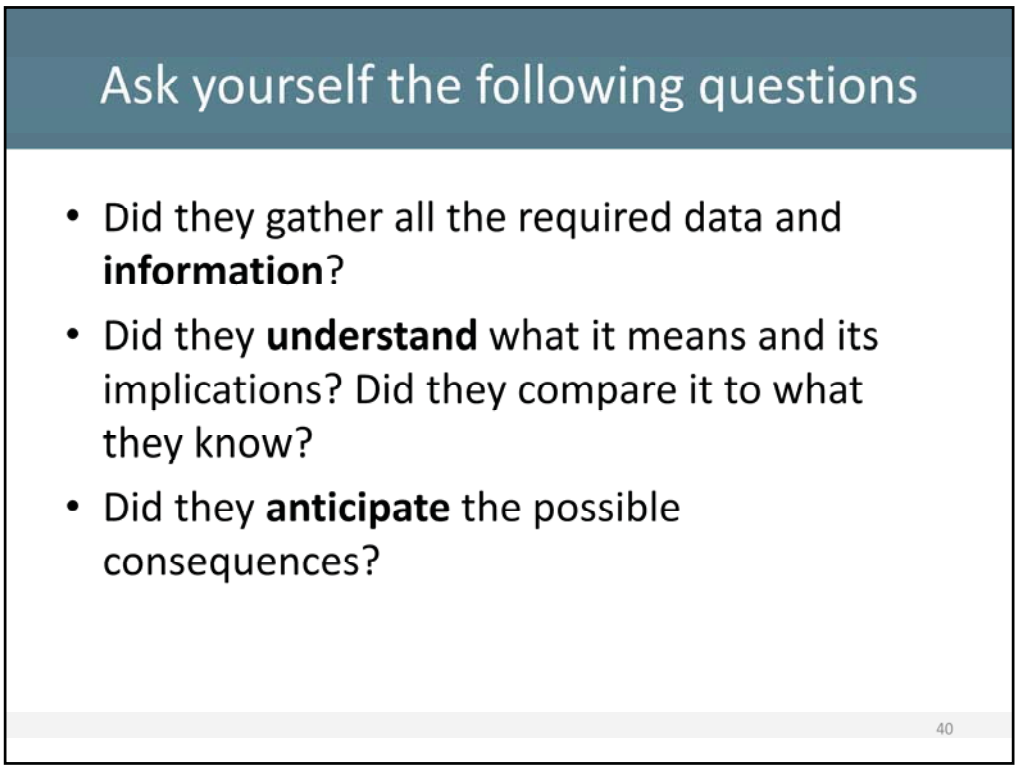

(post this slide while the groups work on the questions)

Small group discussion – results should include:
1) Did they have the information?
- There was a pre-op assessment (anticipate - looking for potential problems in a pre-op assessment);
- Monitors are on the patient.
- the physicians noticed sats were low.
- they determined that the LMA didn't fit, found that there was muscle tension and administered drugs.
- the physicians noticed over time she was visibly blue.
2) Did they understand the implications of the problem they were encountering?
- They understood that the LMA wasn't working, a solution was proposed and verbalized to the team that the LMA is not working "I'm going to tilt the head back", in response to the low sat.
3) Did they anticipate?
- They also didn't anticipate that they may not be able to bag her otherwise they wouldn't have given the relaxant.
- There was no indication of anticipating what's available if LMA isn't fitting, what resources are available if LMA doesn't work.

The Elaine Bromiley Case: Part 2

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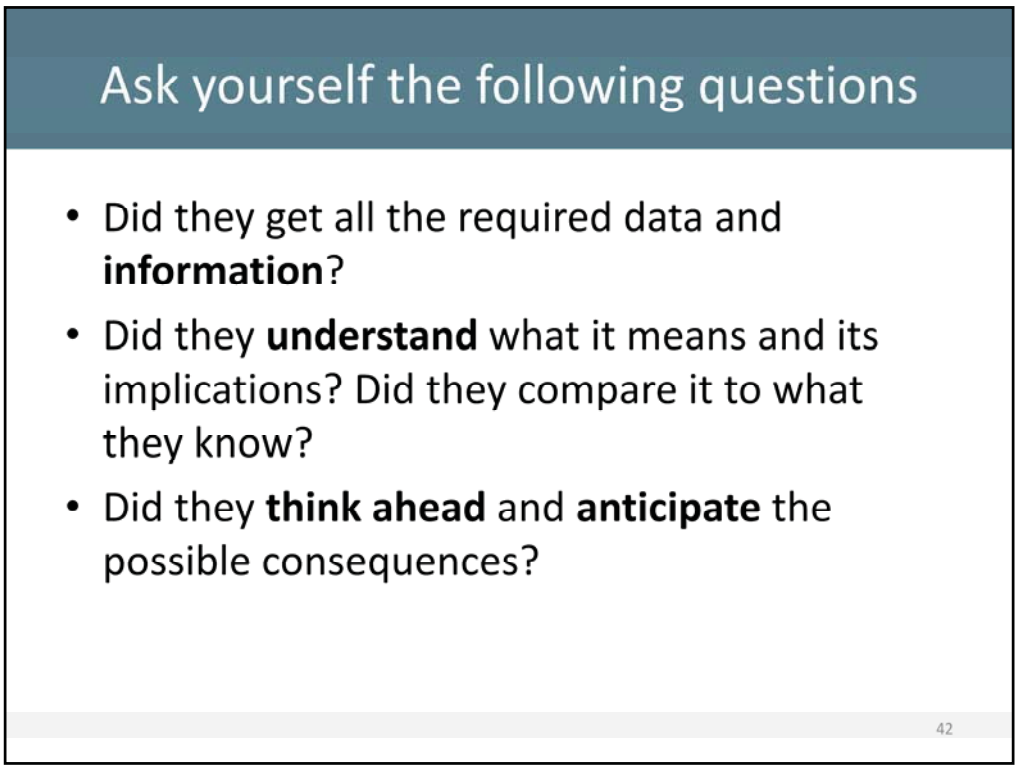
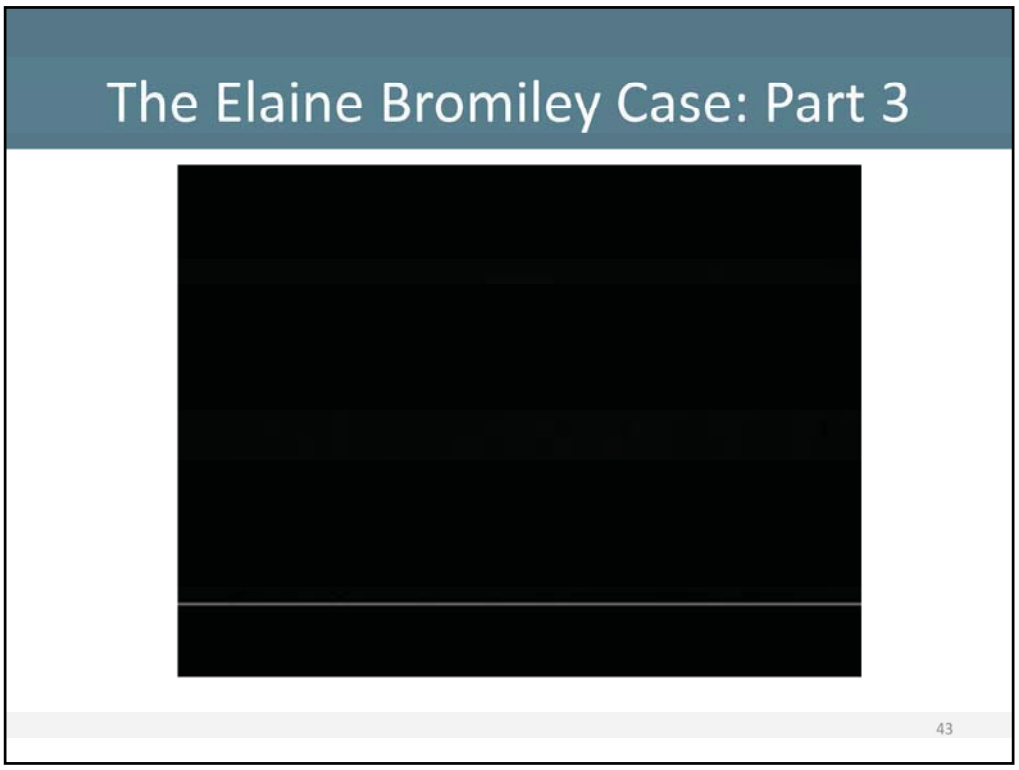
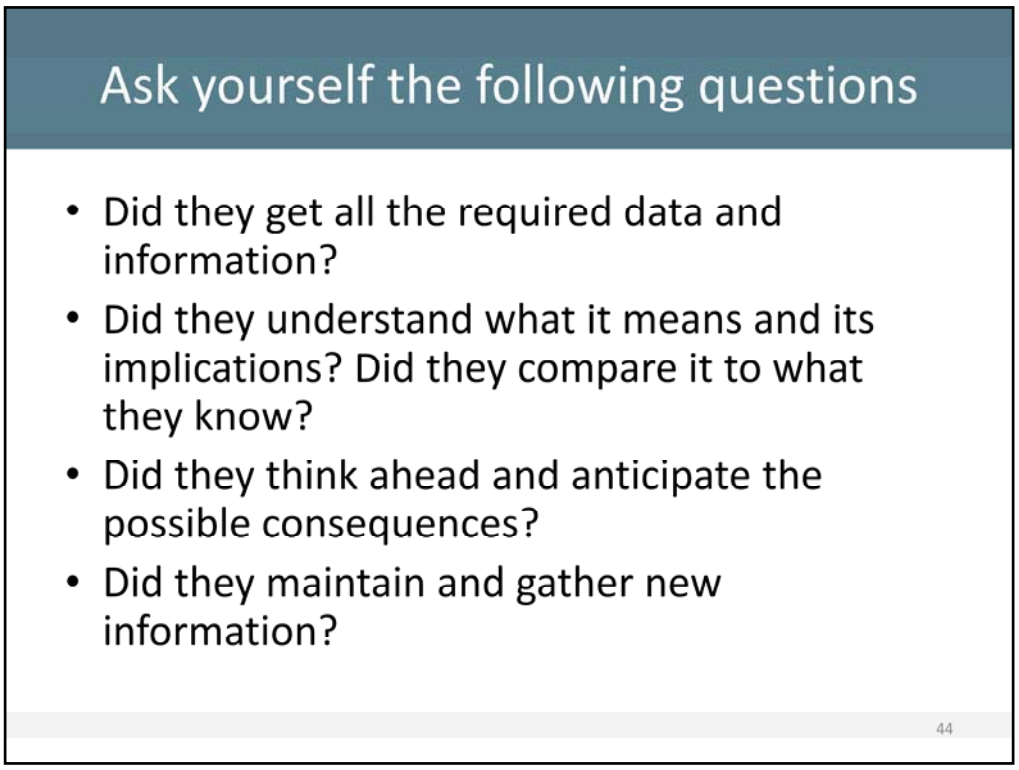


Small group discussion – responses may include:
1) Did they get all the information?
- What's new: sats are 40, and heart rate is lowering,
- What's new: several anesthesiologists, surgeons and nurses show up in response to a call for help.
- We don't know if she's bag-able; Are the anesthesiologists doing anything to optimize?
- What is the time? How can you be aware of time? By delegating the responsibility to some one such as the individual charting could remind the team of the time every minute. This led the anesthesiologists to focus on the procedure not the clock.
- We don't know if the time has been communicated to the new team members.
- We don't know if there was a leader that delegated responsibilities to the new team.
2) Did they understand?
- Did the anesthesiologist understand the importance of ventilating the patient and increasing oxygen reserve?
- Did the anesthesiologist think of asking for the difficult airway cart?
- Priority seems to be off, the anesthesiologists are still focusing on step A, when really this is a code blue situation. They are fixated on the routine and fail to recognize the situation has turned from routine to crisis.
- When the team calls for help, it can be assumed that the severity of situation is understood. When the fresh anesthesiologists and surgeons showed up, it should have been clear that a surgical airway was needed. Despite this acknowledgement of crisis, everyone is co-opted into the same solution (even though as a responder their job is to do critical thinking), perhaps this was because the situation was not framed as a worst-case-scenario situation and this biased the action and thinking of the responders (communication breakdown)
- "Anchoring" is occurring.
3) Did they anticipate?
- The team held off from calling for assistance, but eventually did call.
- Are they picking up the gravity of the situation? No.
- The original team and the new team both failed to anticipate the actions of maintaining their course of intubation.

Is this good situational awareness?
(discussion)
-The anesthesiologists are fixated on the situation as an easy procedure on a healthy, young patient, and fail to recognize the implications of the sats being at 40 and failed to recognize that the approach needs to be changed
-**This is called "anchoring", being stuck in the original situation, not responding to the changing dynamics and new information**.

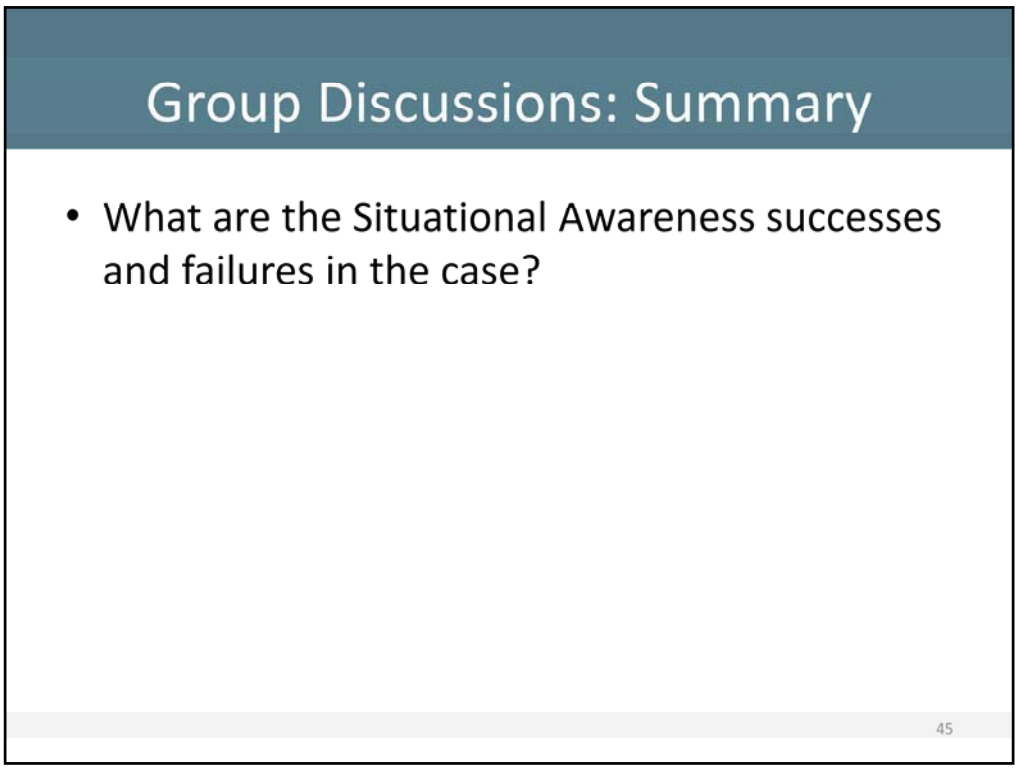

The Elaine Bromiley Case: Part 3
43



Small group discussion

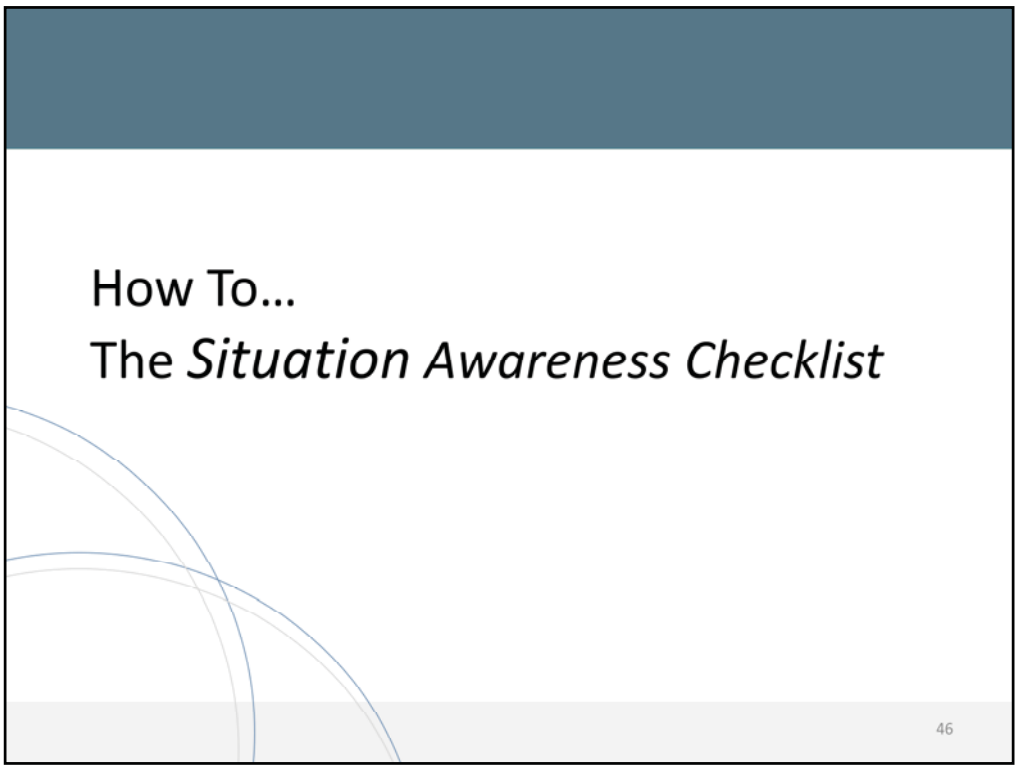
1) Did they have all the information?
2) Do you think they understood the information?
3) Does it look like they were thinking ahead, or anticipating what could happen?

The question remains: Why is this happening to a skilled and experienced team?

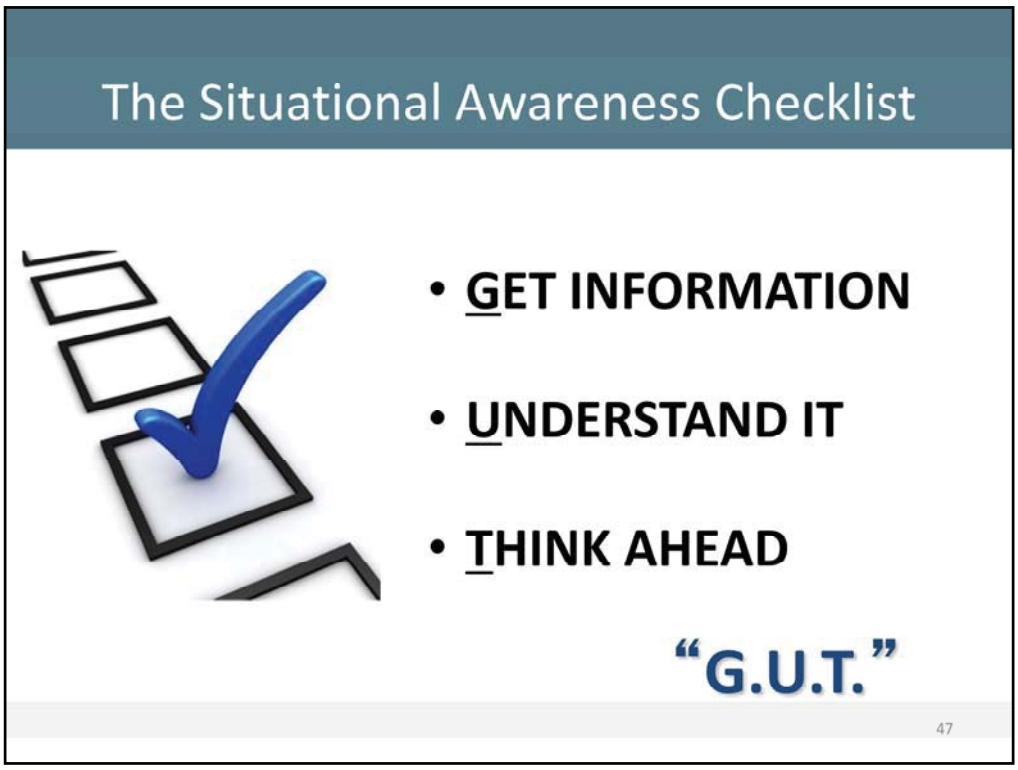


In retrospective analysis it is easy to point the finger and claim “incompetence”, but the reality is that this can happen to anyone. Why?

How was the team successful/unsuccessful in building and maintaining situational awareness?
(Discussion on the situational awareness successes and failures in the case.)
Successes include:
- Identified that the LMA did not fit and made adjustments accordingly
- Called for help indicating an awareness of the severity of the situation
- etc…
Failures include:
- Lost track of time
- The new team did not offer critical thinking
- Poor communication between attending and responding teams
- etc…



Next we'd like to present a practical take-away to bring situational awareness to your daily practice; the Situational Awareness Checklist.



The checklist uses the same steps that we've analyzed the Elaine Bromiley case with:
1)Get information
2)Understand it
3)Think ahead

[N.B. This checklist should be provided as a handout at the beginning of the course]

Getting information includes scanning and searching, remaining watchful, paying attention and communication. The main message here is to be active in acquiring information. Don't wait for information to come to you. Expect the unexpected.

Communication is particularly important, it is not only a means of acquiring information or conveying information, it also leads to understanding the information better, which is the next step in the checklist.

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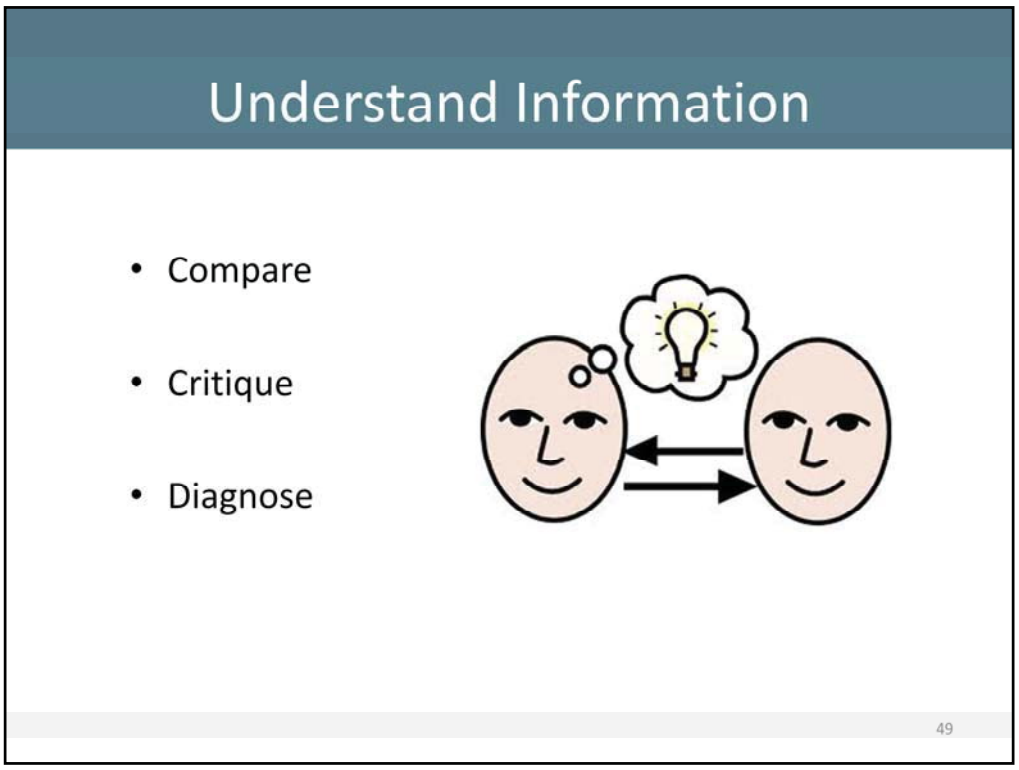
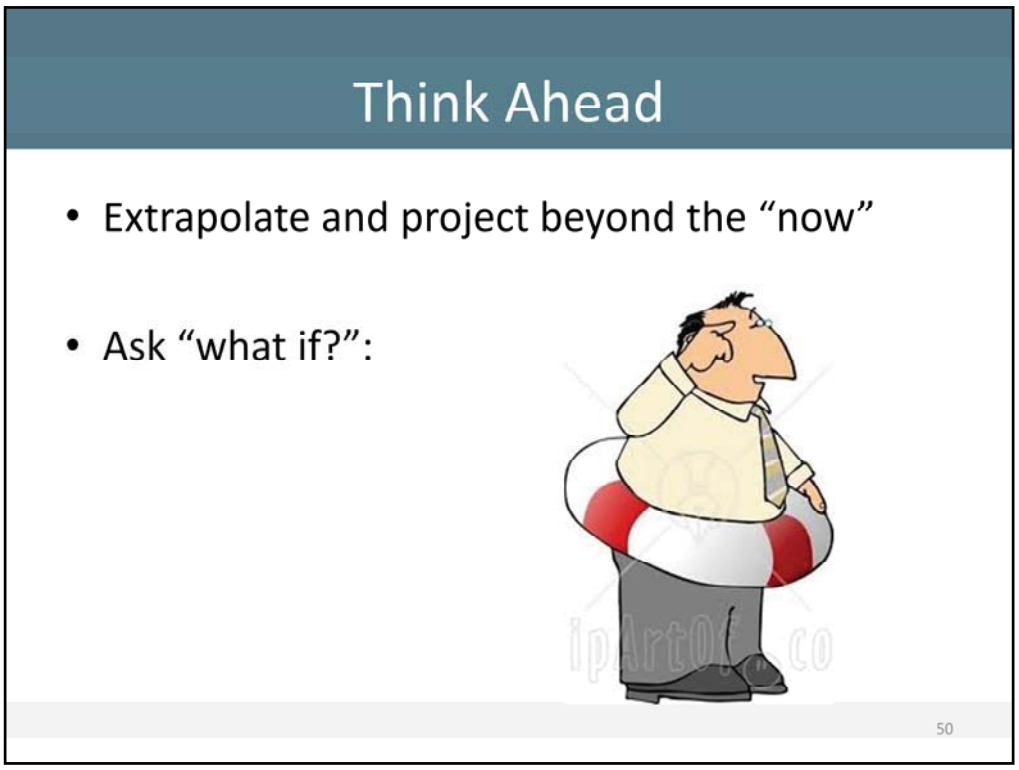


In beginning to understand the information, compare the situation to other situations and experiences, however don't get stuck in a comparison of one case. Always apply critical thinking to see what other options are available. Ask yourself, "Did I take anything for granted?" Then finally diagnose the situation and start thinking ahead.



Thinking ahead means asking "If this persists, what will it look like in one minute? …in two minutes?" and asking "What if?"

Thinking about options and thinking ahead creates the bridge from making decisions to acting upon it.

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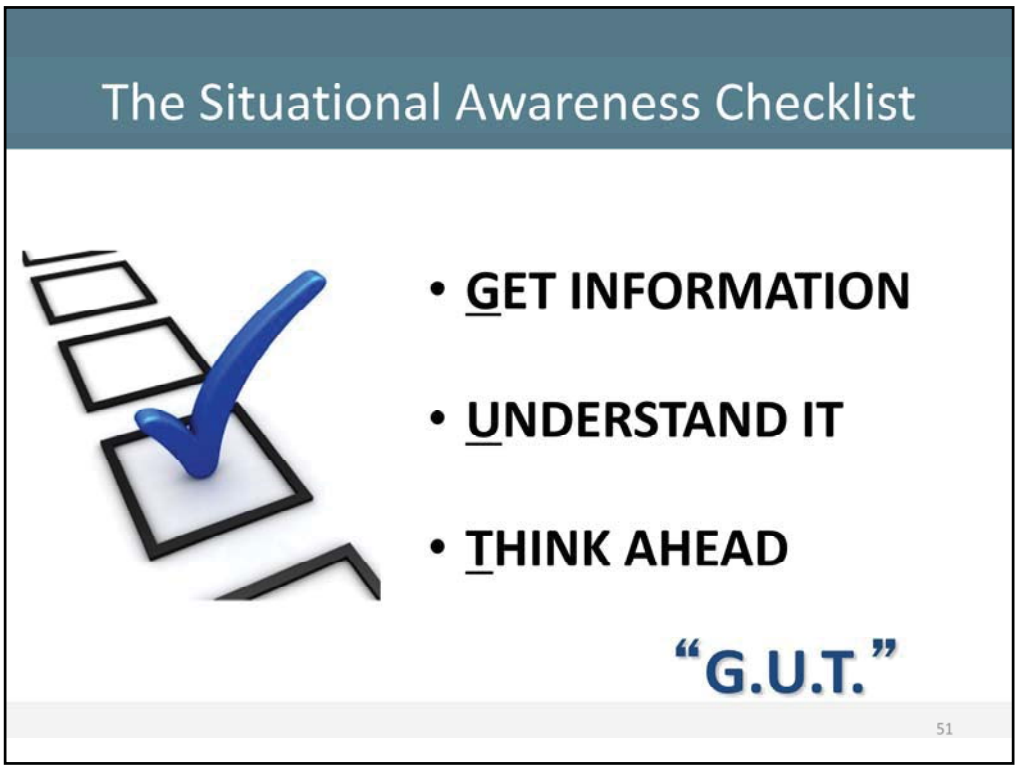

The checklist uses the same steps that we've analyzed the Elaine Bromiley case with:
1) Get information
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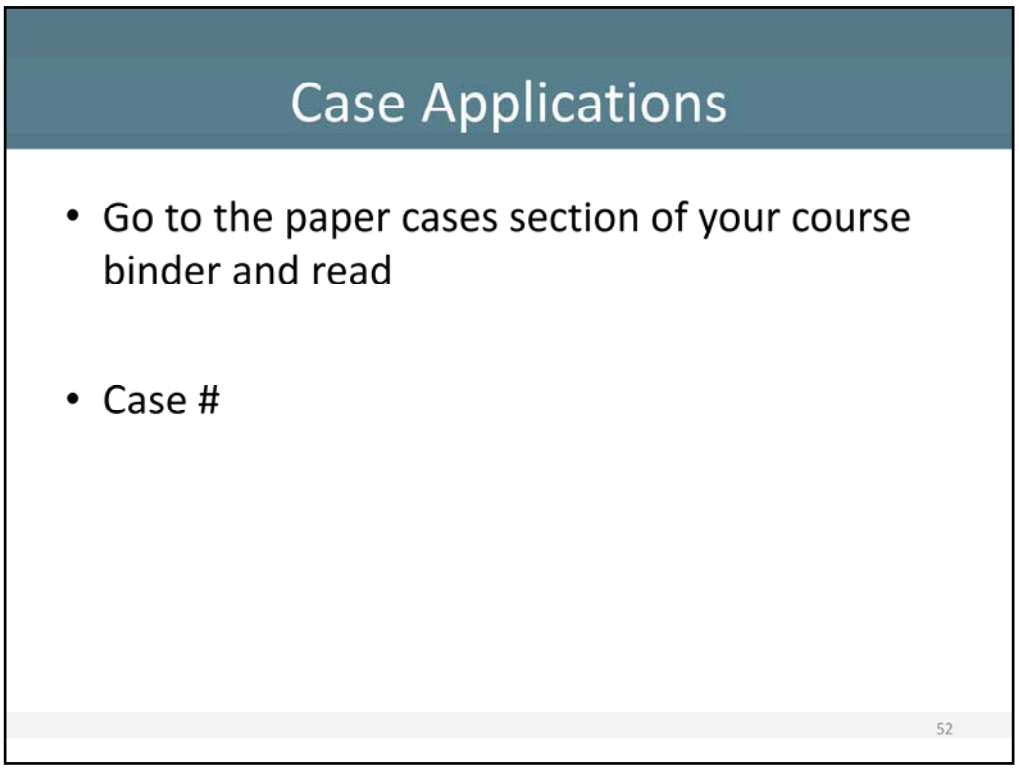
[N.B. This checklist should be provided as a handout at the beginning of the course]



Instructions for instructors:

Familiarize yourself with the cases and case analysis in the Case Studies section of the binder

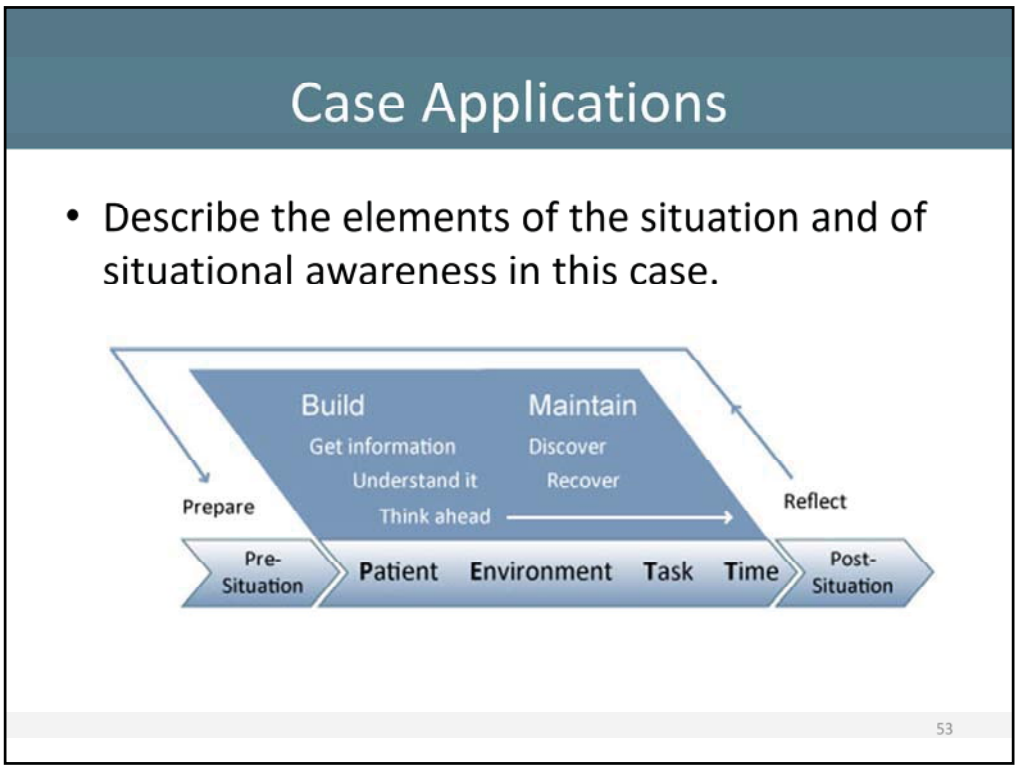
Direct participants to read one of Cases 2 through 5 in the cases studies section of the course binder. Then work through the case with them using the lessons and tools presented earlier in the presentation.

You should have time for two case examples. Proceed with the case analysis as follows:

-For the first case, ask participants to identify the elements of the situation (PETT)
-Then ask them how they would prepare for the surgery or other task required of the situation?
-In the group discussion, ask participants to walk through the SA Checklist for this case.

-For the second case, ask participants to use PETT and the SA Checklist to work through the case analysis
-In the discussion direct participant's attention to critical thinking as a key component of achieving optimal situational awareness.

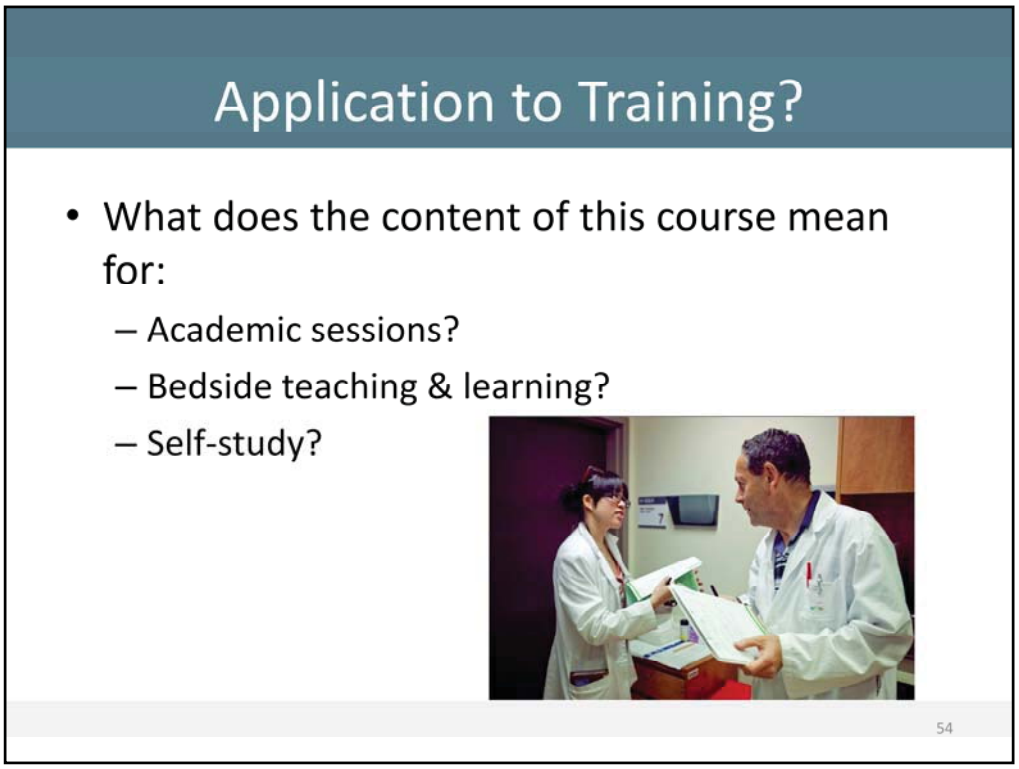
-If you have time, use a third case to focus on cognitive and attentional biases implied in the case write-up.



1: Describe the elements of the situation (PETT)

2: Use the SA Checklist to analyse the successes and failures in this case (Get information, Understand it, Think ahead)

3: Can you identify cognitive or attentional biases in this case?

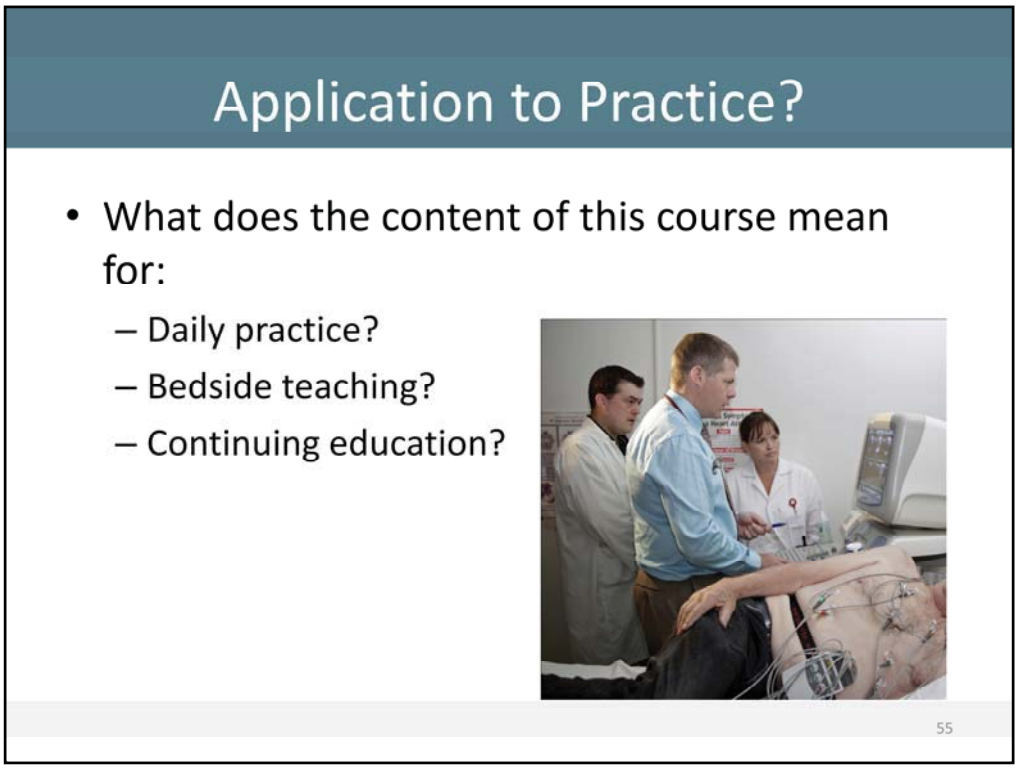


If your audience is primarily educators:
Does anyone currently teach this or have this incorporated into a curricula? How did you do it?
Is anyone using these concepts in simulation exercises?

If your audience is primarily physicians-in-training:
How can we incorporate this situational awareness content into your academic sessions? Bedside? Your own learning?
What are your ideas?
(Group discussion)

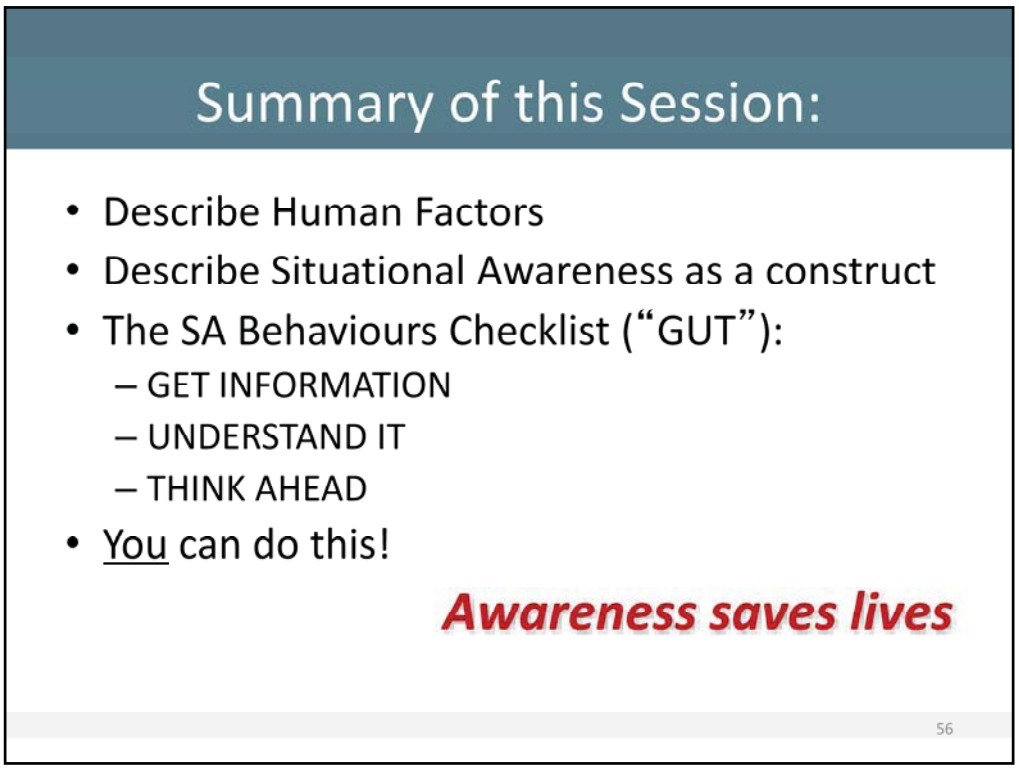
Discussion items might include:
- Being conscious of dynamics outside of medicine such as environmental factors like overcrowding, stress, fatigue, etc.
- As a resident, taking the opportunity to step back and assess the situation
- Use retrospective analysis for your own experience and identify how you built and maintained situational awareness.

Ideas on how to teach:
- Case based learning for medical students
- Simulation scenarios for ACLS, PALS or ATLS or other critical care scenarios – discussion of SA concepts and evaluating degree of SA
- Workshops for staff
- Bedside teaching; e.g. preparing for trauma – discussion of timekeeper, roles, communication, how to get data, thinking aloud



How can your situational awareness training be included in your daily practice? How would you teach this to someone else? How can this be included in your own continuing education?
Any ideas?
(Group discussion)

Discussion items may include:
- Discussing the case as it's going on with residents and students, for example, "notice that the BP is this.. How would you respond if this happened…"
- Thinking out loud
- As an attending physician you are responsible for the entire Emergency cohort - at the beginning of the shift take a walk around and check everything out, feel out the level of situational awarness.
- Step in and intervene when you see something that might lead to an adverse outcome.



The objectives of this session were to describe human factors and define situational awareness in the context of the human factors framework and medical practice.

What we would like you to take with you after this course is the SA checklist – give it a try, apply this when you are at the bedside, preparing for a case or in the OR.

As we all know and can see from many of the cases shared during this session: Awareness saves lives

Acknowledgements

- Funding

- Collaborating organizations

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THE OTTAWA HOSPITAL
L'HÔPITAL D'OTTAWA

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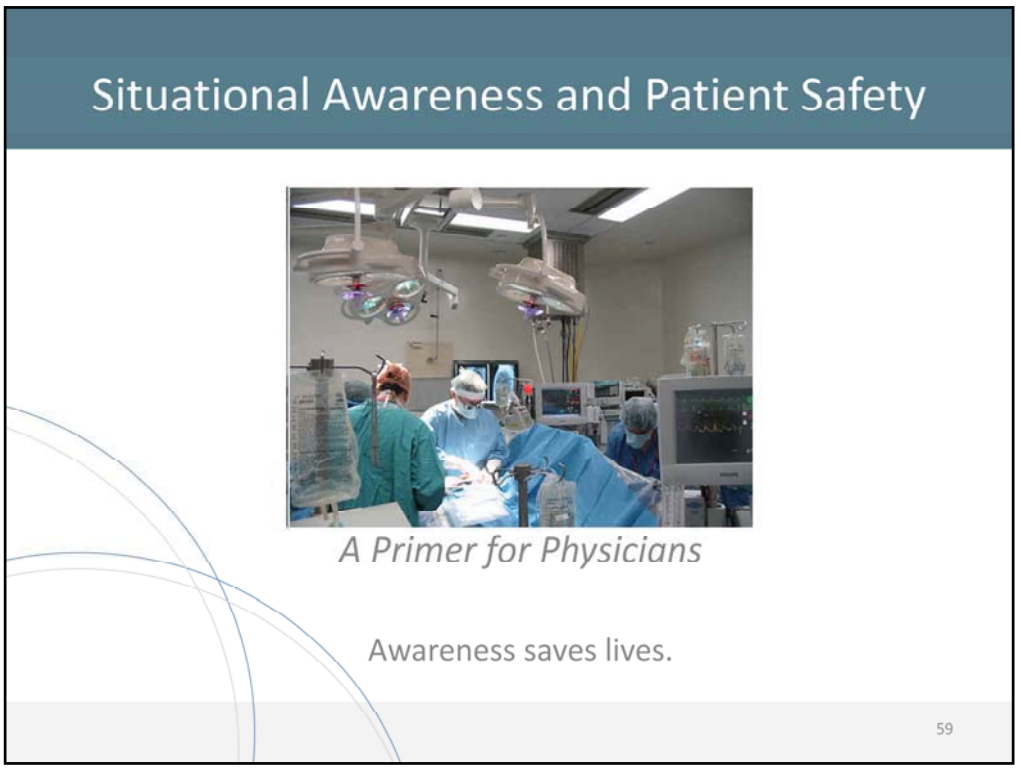
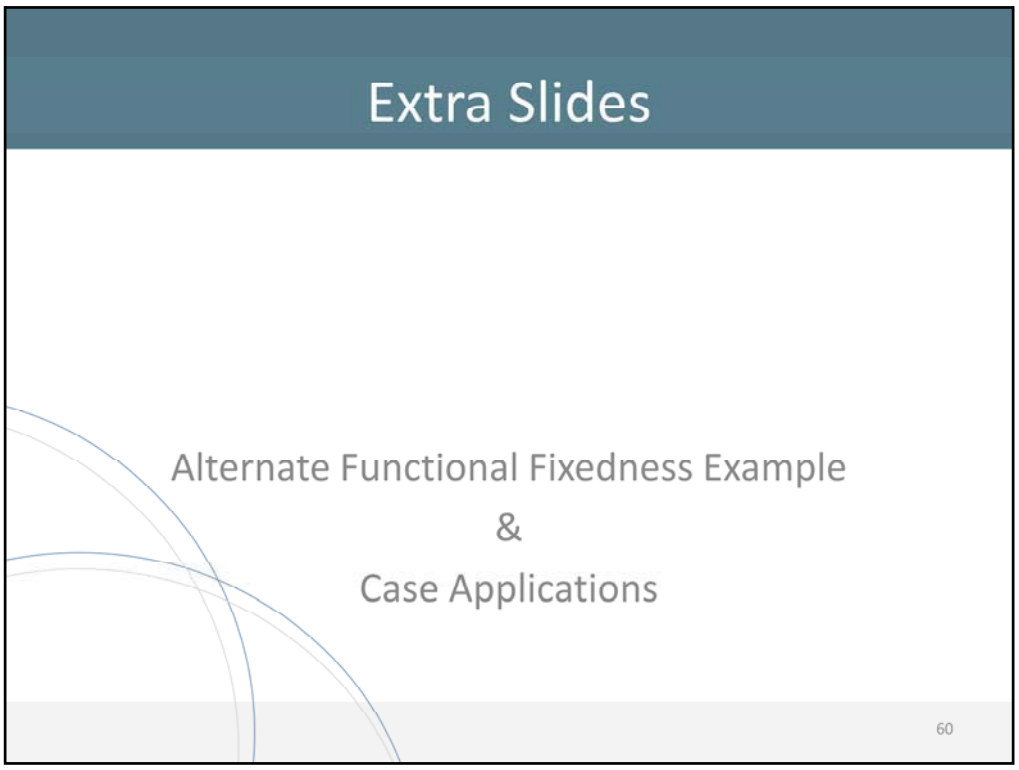


[This is the last slide – please direct participants to the SA Primer for further reading and study.]


Extra Slides
Alternate Functional Fixedness Example
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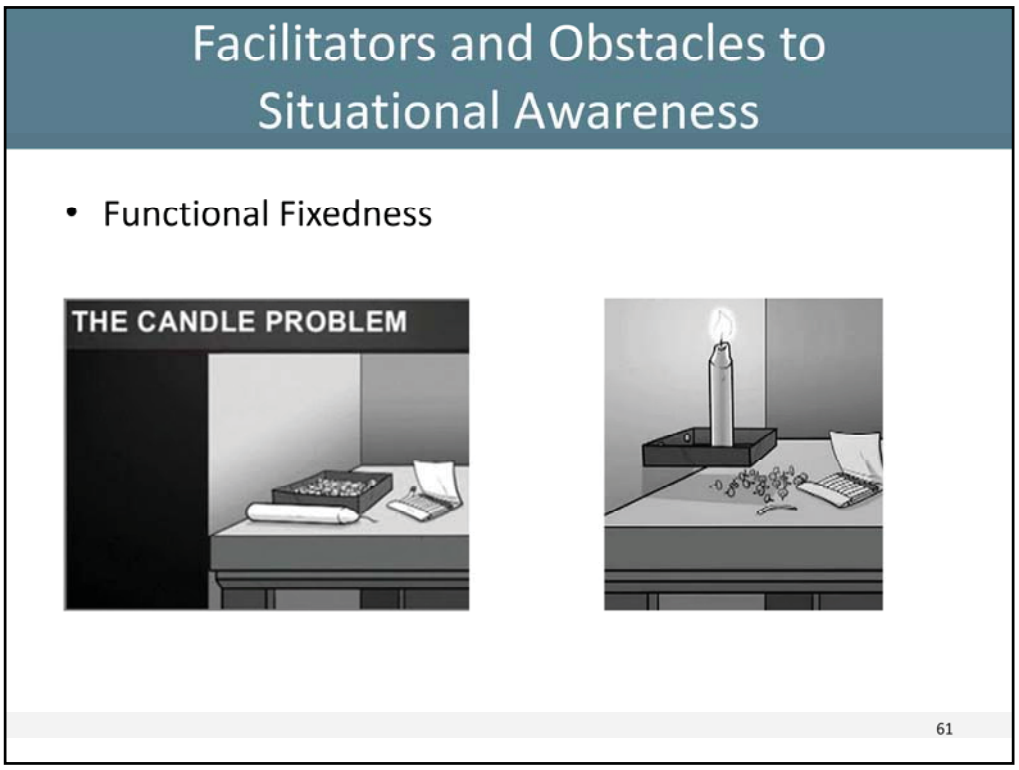


Functional fixedness is another obstacle to situation is particularly relevant to the Elaine Bromiley case...

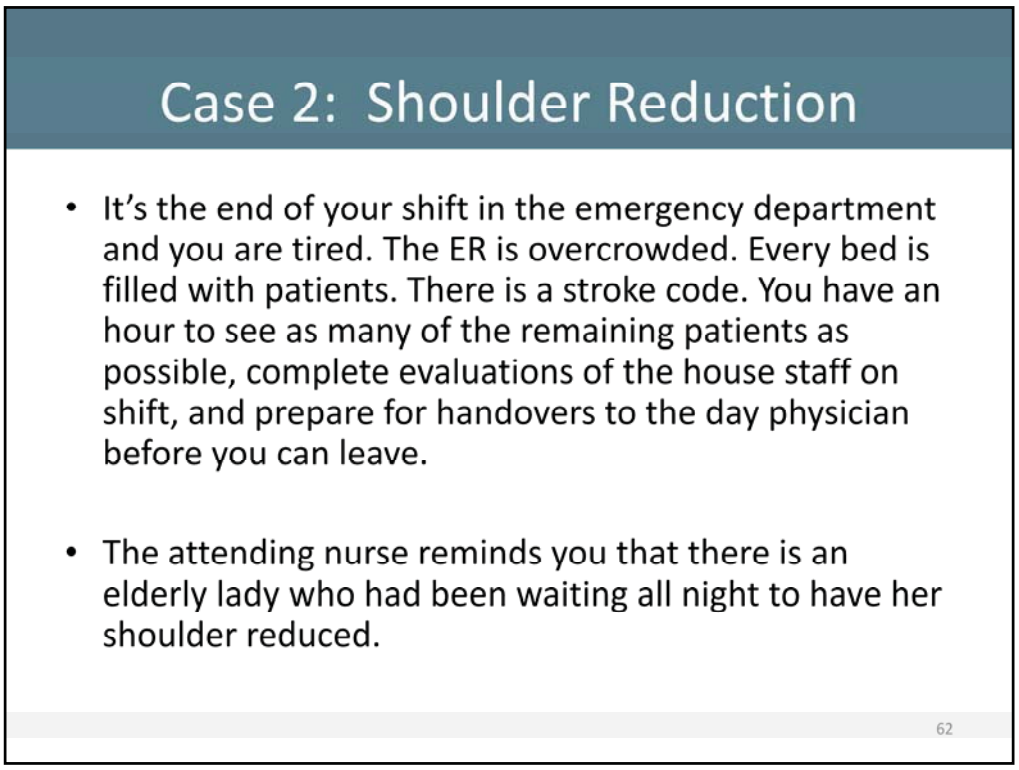
The example we have here is a traditional psychology test. How would you attach the candle to the wall so that it does not drip onto the table below?

(wait a minute, ask for suggestions from the audience, then click to show the second image)

In a classic experiment demonstrating functional fixedness, Duncker (1945) gave participants a candle, a box of thumbtacks, and a book of matches, and asked them to attach the candle to the wall so that it did not drip onto the table below. Duncker found that participants tried to attach the candle directly to the wall with the tacks, or to glue it to the wall by melting it. Very few of them thought of using the inside of the box as a candle-holder and tacking this to the wall. In Duncker's terms the participants were "fixated" on the box's normal function of holding thumbtacks and could not re-conceptualize it in a manner that allowed them to solve the problem. For instance, participants presented with an empty tack box were two times more likely to solve the problem than those presented with the tack box used as a container (Adamson 1952).

Alternate images below from http://edlieze.blogspot.com/2010/09/i-need-to-make-confession-at-outset.html

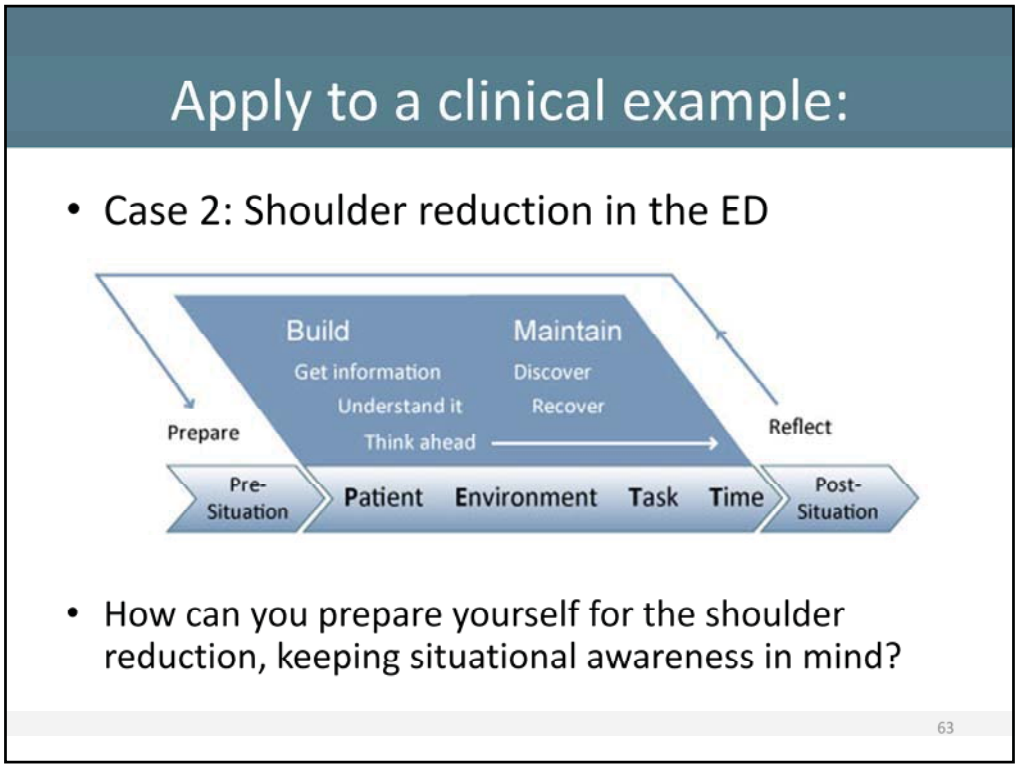
The lesson from this example is to look for other solutions, given the information that is availabl e to you.



Here is a clinical example that we can apply the situational awareness concepts to.

It's the end of your shift in the emergency department and you are tired. The ER is overcrowded. Every bed is filled with patients. There is a stroke code. You have 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 you can leave.

The attending nurse reminds you that there is an elderly lady who had been waiting all night to have her shoulder reduced.

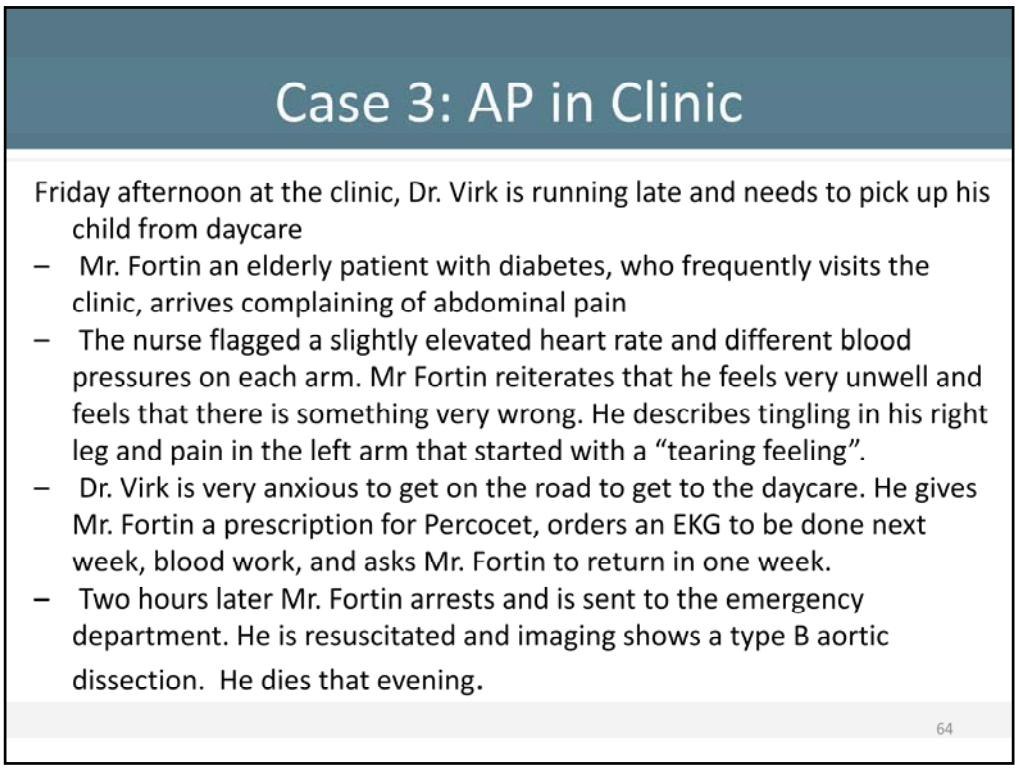


How can you prepare mentally and physically for this shoulder reduction, keeping situational awareness in mind?
(Group Discussion)

Going into this procedure you should be thinking this is a potentially dangerous situation – shoulder reduction is a particularly difficult procedure, you'll be performing sedation which is a risky procedure, you're fatigued, you're on tight timing pressure, the patient is old, the environment is busy, etc. - all of theses are red flags.

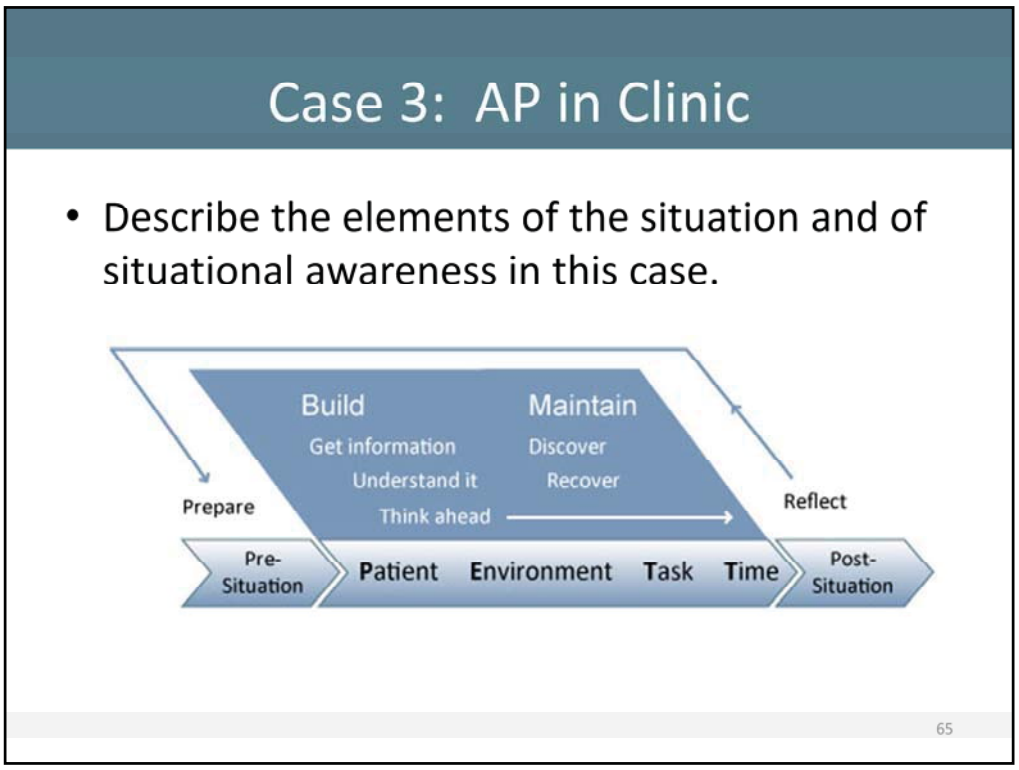
Patient: elderly patient, comorbidities?, hasn't been able to get a bed, has she eaten?
Environment: Physical: busy, overcrowded ER
Human: you are tired, the RT is tired
Task: shoulder reduction (a particularly difficult procedure), you'll be performing sedation which is a risky procedure,
Time: time pressure because of handover, the patient has been waiting all night for the shoulder reduction

It's easy to cut corners: airway assessment, has she eaten?, doing the procedure without RT



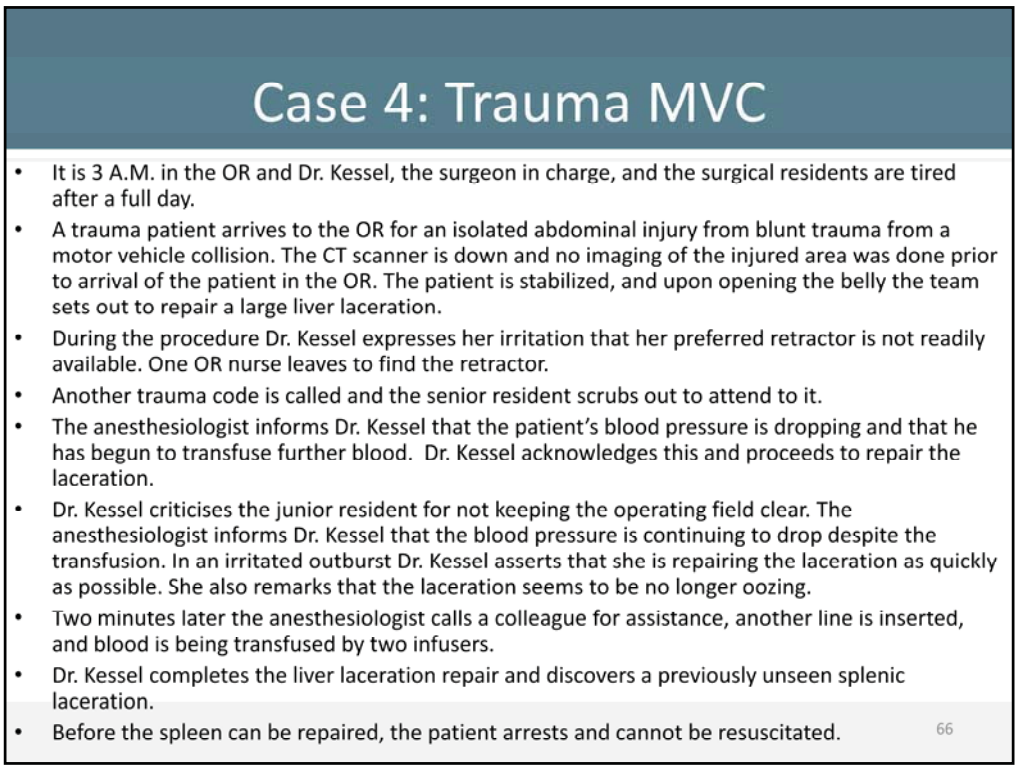
(read the case aloud)

Friday afternoon at the clinic, Dr. Virk is running late and needs to pick up his child from daycare
– Mr. Fortin an elderly patient with diabetes, who frequently visits the clinic, arrives complaining of abdominal pain
– The nurse flagged a slightly elevated heart rate and different blood pressures on each arm. Mr Fortin reiterates that he feels very unwell and feels that there is something very wrong. He describes tingling in his right leg and pain in the left arm that started with a "tearing feeling".
– Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.
– Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

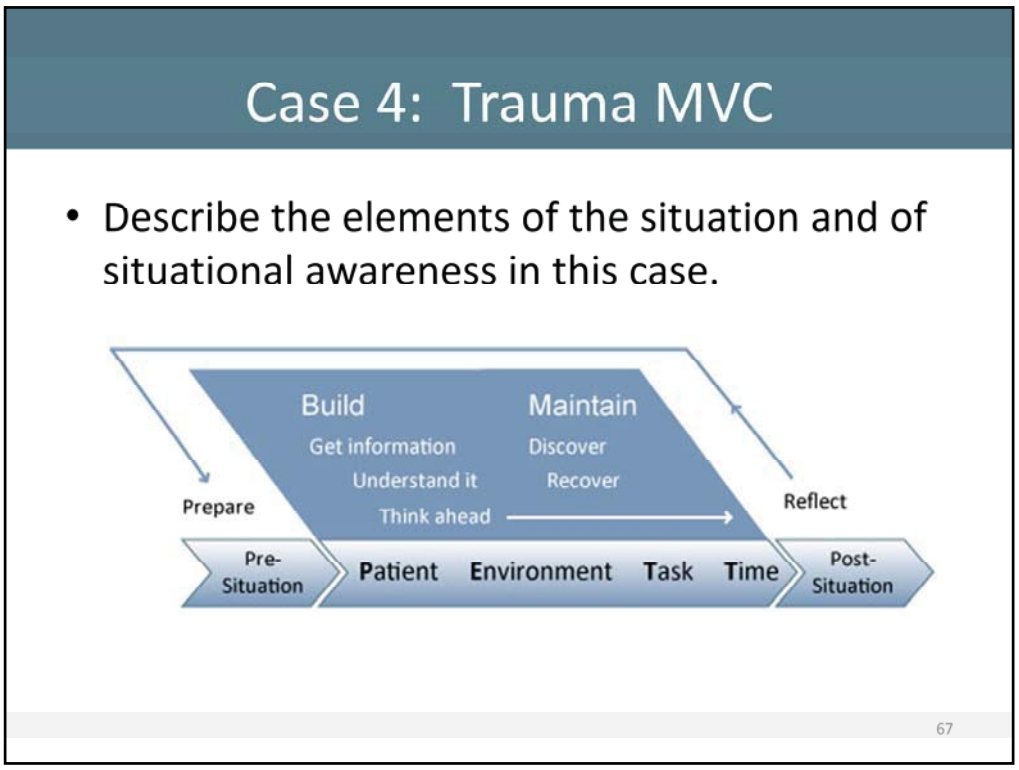


Describe the elements of the situation.
(Discussion should include a description of PETT – Patient, Environment, Task, Time)

Using the Situational Awareness checklist, did Dr. Virk (1) get information, (2) understand it, and (3) think ahead?

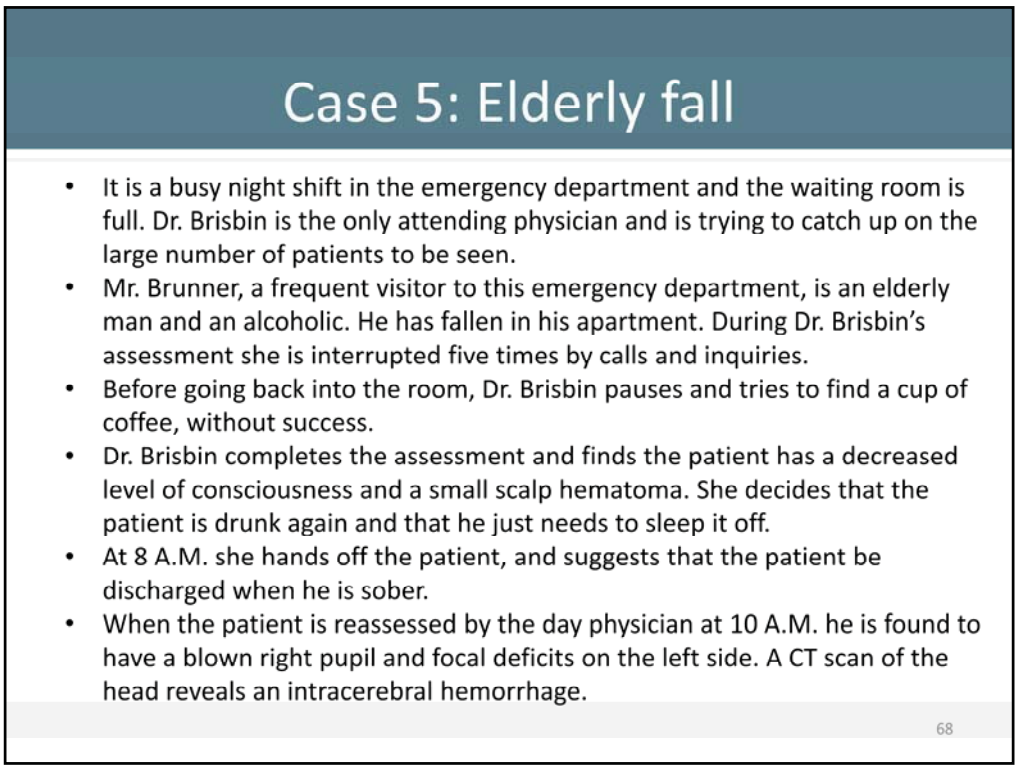


•It is 3 A.M. in the operating room and Dr. Kessel the surgeon, in charge, and the surgical residents are tired after a full day in the OR.
•A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.
•During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.
•Another trauma code is called and the senior resident scrubs out to attend to it.
•The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood. Dr. Kessel acknowledges this and proceeds to repair the laceration.
•Dr. Kessel criticises the junior resident for not keeping the operating field clear. The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion. In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.
•Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two infusers.
•Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration.
•Before the spleen can be repaired, the patient arrests and cannot be resuscitated.

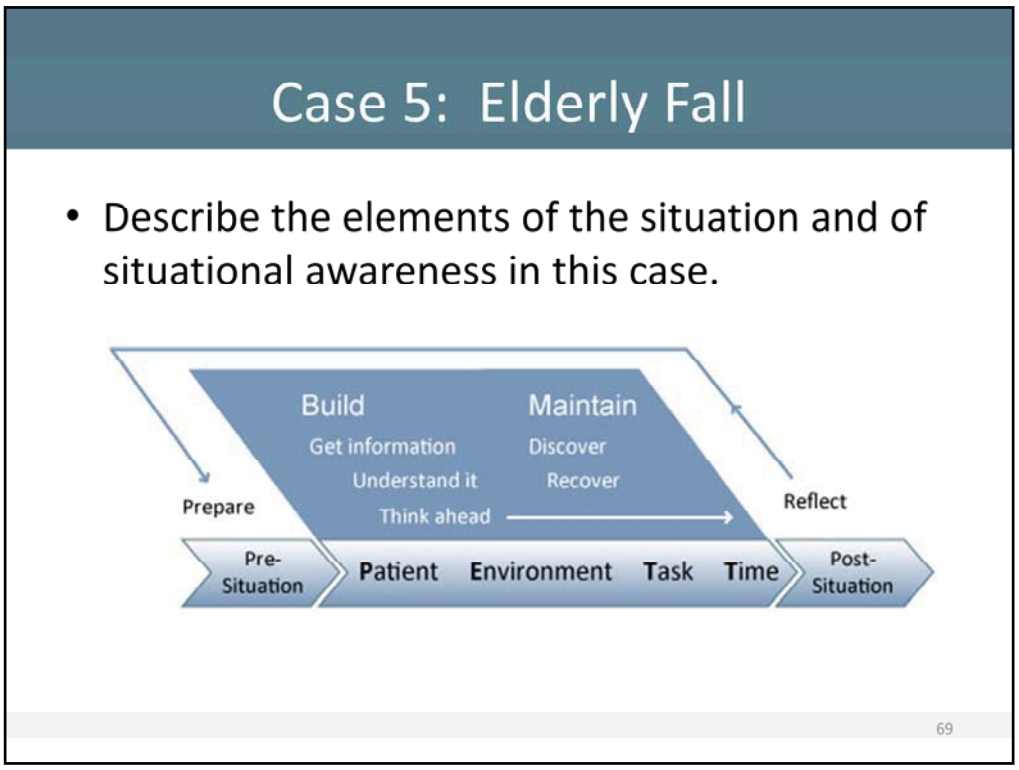


Describe the elements of the situation here.
(Discussion should include a description of PETT – Patient, Environment, Task, Time)

Using the Situational Awareness checklist, did Dr. Kessel (1) get information, (2) understand it, and (3) think ahead?



•It is a busy night shift in the emergency department. Dr. Brisbin is working as the only attending physician and trying to catch up on the large number of patients to be seen, and the waiting room is full.
•Mr. Brunner, a frequent visitor to this emergency department, is an elderly man and an alcoholic. He has fallen in his apartment. During Dr. Brisbin's assessment she is interrupted five times by calls and inquiries.
•Before going back into the room, Dr. Brisbin pauses and tries to find a cup of coffee, without success.
•Dr. Brisbin completes the assessment and finds the patient has a decreased level of consciousness and a small scalp hematoma. She decides that the patient is drunk again and that he just needs to sleep it off.
•At 8 A.M. she hands off the patient to her colleague coming in on the day shift, and suggests that the patient be discharged when he is sober.
•When the patient is reassessed by the day physician at 10 A.M. he is found to have a blown right pupil and focal deficits on the left side. A CT scan of the head reveals an intracerebral hemorrhage.



Describe the elements of the situation.
(Discussion should include a description of PETT – Patient, Environment, Task, Time)

Using the Situational Awareness checklist, did Dr. Brisbin (1) get information, (2) understand it, and (3) think ahead?

Chapter 5

Instructional Supplement for Workshop Participants

Contents

About This Instructional Supplement

The objectives of this Instructional Supplement are to:

1. Support the material provided in the Situational Awareness Primer and in-class lessons by:
   a. Reviewing key concepts
   b. Providing practical examples illustrating key concepts
2. Provide independent learning exercises to test your understanding of key concepts

To meet these objectives, the sections within this Instructional Supplement are ordered according to the presentation of information in the Situational Awareness Primer that appears earlier in this learning package.

Each section follows this instructional pattern: a **review of key concepts**, followed by an **example** illustrating how to conduct situational awareness assessment and maintenance activities; **"test your knowledge"** questions and/or skill testing exercises titled: **now you try**. In addition, as you work through this Instructional Supplement, you will notice a number of **Tips** and **Notes** that provide additional support and ideas for how to establish and maintain situational awareness in your practice.

Throughout this Instructional Supplement you will be asked to use elements of Case 1 from the case studies section of this learning package. This is designed to give you hands-on practice and assess your understanding of key concepts. Thus, as you develop your understanding of situational awareness theory and process, you will be able to apply your understanding to a specific case.

At the end of this Instructional Supplement you will have the opportunity to perform a comprehensive analysis of a new case integrating all of the knowledge and skills developed throughout this learning package.

What Do You Know About Situational Awareness?

Review of key concepts

The purpose of this initial section is to get you thinking intuitively about situational awareness. The Situational Awareness Primer associated with this learning package opens with the following statement:

> *Many adverse medical events are associated with so-called "human factors" in Healthcare settings. Situational awareness is a key component of human factors and refers to a person's perception and understanding of the dynamic information that is present in their environment. Essentially it is the process of integrating relevant information from the environment into a concise picture based on which all decision making and action take place.*

Example

Let's review the following short case excerpt to get us thinking about things that happen in clinical circumstances:

> *During an emergency C-section, the anesthesiology team has difficulty intubating 29-year-old Laura Small. Amidst acrimonious debate between the surgeon anxious to begin the procedure and the anesthesiologist struggling to get Ms. Small's airway secured, the baby is delivered. The mother's uterus is noted as blue, and her vital signs rapidly deteriorate... After a 12-hour shift and no lunch, Martina Pellos, an obstetrics nurse who is assisting in the emergency, is directed to rapidly administer vitamin K to the baby. Nurse Pellos reaches for an ampule of vitamin K from the set of bins at the side of the room holding several medications commonly used in the delivery suite. After injecting the medication, she notices that she has inadvertently given the baby methylergonovine (Methergine - a potent vasoconstrictor).*

What are some of the factors in this case description that could influence decision-making and performance?

1. There is acrimonious debate between the surgeon and the anesthesiologist. Could this have impacted their focus on the patient, their awareness of what was going on around them, or their ability to make clear-headed decisions regarding the course of action? How does the human or organizational environment impact performance?
2. Nurse Pellos is at the end of her shift and has not eaten. It is very likely she is suffering from physical fatigue. How could this affect her performance?
3. Also, the placement or labeling of bins holding medications could have been such that they "encouraged" or made it easy to inadvertently pick up the wrong drug. What was the physical design of this equipment? Were all the bins open, making it easy to reach for one vial and grab another? Are the vials similar in size and or colour?

So far, we have identified three factors that could have influenced performance: acrimonious debate; fatigue; and equipment design.

Now you try

Think back to a case from your own experience, or something you heard or read about, where a seemingly routine case went wrong. Use the space provided below to write out a description of what happened. Then, ask yourself if there was a lack of situational awareness by any member of the medical team at any point in this case? Did this contribute or could it have contributed to an adverse outcome? If so, how? At this point you may not be sure if situational awareness was really a key factor, but there may be other things that contributed to the less-than-ideal outcome, for example: fatigue, lack of communication, availability of tools, equipment or expertise, etc. Based on your intuitive understanding of the case, identify factors that you believe could have contributed to the outcome.

Your case description: _____

Based on your intuitive understanding of this case, identify any loss of situational-awareness and how it could have affected decision-making or contributed to the adverse outcome: _____

Can you identify any other factors that may have contributed to the loss of situational awareness or adverse outcome?

Understanding the Human Factors Framework

Review of key concepts

Recall from the Situational Awareness Primer that "Human Factors" (HF):

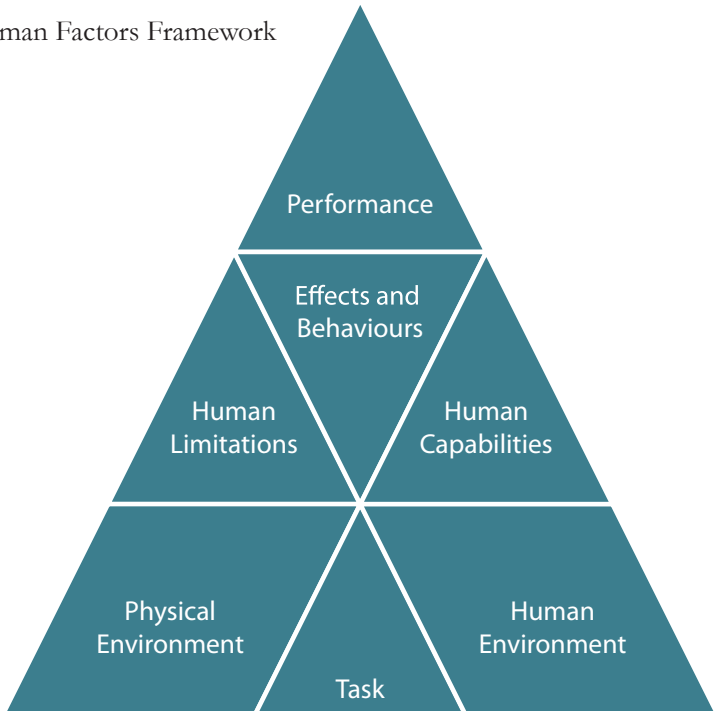
- Is a discipline addressing human behaviour, abilities, limitations, and relationship to the work environment (physical, organizational, cultural);
- Applies to the design and evaluation of safer and more effective tools, machines, systems, tasks, jobs, and environments; and
- Is recognized by The Royal College of Physicians and Surgeons of Canada, and the Canadian Patient Safety Institute as a Core Safety Competency (2008).

The **Human Factors Framework** depicts the interactions between human, environmental and task characteristics that illustrate how these types of factors can influence human behaviour and performance. This framework should help you understand what's in a "situation" and what factors can play a role in influencing situational awareness.

Do you remember each of the components of the HF Framework and how they contribute to human performance?

As a reminder, take a look at the Human Factors Framework in Figure 1 below.

Figure 1
The Human Factors Framework



Each of the components of the framework represents a family of factors that can positively or negatively influence performance.

Test your knowledge

Use your understanding of the Human Factors Framework to answer the questions below. If you get stuck, go back to the Situational Awareness Primer.

Q1. Why are the environmental factors presented on the bottom of the pyramid?

_____

_____

Q2. Fill in the blanks in the following statement:

The components of the HF framework "act together in an _____ fashion to produce effects and behaviours such as distractions, _____, _____, _____, stress, etc".

Q3. Where is situational awareness placed within the human factors framework, and why?

_____

_____

_____

_____

Example case analysis (part 1)

Read the case description below. Note this is Case 1 in the Paper Cases section of this course package.

It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous incidents.

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.

Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

Tip

When you try to assess what could be the possible influencing factors in a given situation, work your way up from the bottom tier of the framework to the top. In other words, start by asking yourself: What is going on in the environment? Then go up the framework to the middle tier, and ask: How could these environmental conditions interact with human capabilities or limitations? What would be the results of such circumstances?

Now, let's work through the case step by step and identify potential influencing factors from the human factors framework.

Case excerpt	Analysis
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	• The fact that Dr. Virk is "running late" suggests elevated **workload**. This is a characteristic of the work environment, or organizational environment and falls into the Human Environment component of the HF framework. • The fact that he feels he "has to leave immediately to pick his child up" is a possible internal **distraction** – because he may be preoccupied with something other than the task at hand. This feeling may also lead to **stress**. Both distractions and stress are factors related to human limitations

Now you try (case analysis part 1)

Now you try analyzing the next section of the case, extracted below. Remember that factors identified previously could carry-over and continue to influence performance or decision-making as the situation evolves.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous incidents.

Tip

Underline the information in the case that you think is important or might suggest a potential influencing factor in the mix.

[Use this space to enter your answer]

Example case analysis (part 2)

As the case evolves, we can see other potentially influencing factors in the situation:

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.

- As is obvious from the language used in the case description, the calls are **interruptions** which can affect Dr. Virk's focus on the task because it is hard to keep so many different things in your mind at the same time – this is a characteristic of the environment that interacts with human limitations: these interruptions increase **workload**

Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".

- Again, all factors carry over from above and could continue to influence Dr. Virk's decision-making
- The fact that Dr. Virk ignores the nurse's flag of vital signs could suggest a possible **authority gradient**: an organizational or vocational cultural factor that hinders communication between staff members in different positions – this is considered part of the human environment

Now you try (case analysis part 2)

Now you try identifying factors in the last part of the case description;

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

[Use this space to enter your answer]

What is a "Situation"?

Review of key concepts

Recall from the Situational Awareness Primer, that a situation is "a set of environmental conditions and system states with which the participant is interacting that can be characterized uniquely by a set of information, knowledge and response options" (Pew, 2000).

When you participate in a situation, the fundamental elements of the situation will become your building blocks for situation assessment and awareness.

The fundamental elements of a clinical situation include:

- the **Patient**
- the physical and human **Environment**,
- the **Task** itself and
- how all of these change over **Time**

Note that all these situational elements are at the base of the human factors framework. Though "time" does not have an explicit placeholder in the framework, it is implicit in the task, and it can impact the other elements.

Test your knowledge

How much do you remember from the Situational Awareness Primer? Test your knowledge by answering the following questions:

Q1. Fill in the blanks:

The _____ is likely the most important element of the situation in medical practice.

Q2. Using your own personal practice experience, provide an example of static patient information and one example of dynamic patient information that change over time. Explain why this distinction is important.

Static: _____

Dynamic: _____

Explanation: _____
_____
_____

Q3. Describe the two kinds of environment that need to be considered, including examples of what you might find/consider part of each.

1._____
_____
2._____
_____

Now, keeping these points in mind, let's take a look at how we can use the PETT elements to systematically understand a clinical situation.

Example case analysis

First, read the case description below:

During an emergency C-section, the anesthesiology team has difficulty intubating 29-year-old Laura Small. Amidst acrimonious debate between the surgeon, anxious to begin the procedure, and the anesthesiologist, struggling to get Ms. Small's airway secured, the baby is delivered. The mother's uterus is noted as blue, and her vital signs rapidly deteriorate. A Code Blue is called and CPR begun. Still waiting for the airway backup team, an obstetrician attempts a tracheostomy. After defibrillation and medication restore a normal sinus rhythm, it is estimated that Ms. Small was anoxic for at least 10 minutes.

Tip

Use the PETT acronym to remind you of the fundamental elements of a situation and what to look for when faced with a situation.

Now let's look for all of the Patient information in this case.

Situation elements in this example	
Patient	**Static information:** patient age and name (29-year-old Laura Small) **Dynamic information:** Initial - Pregnant and giving birth, appears to have a compromised airway and requires intubation. Mid-way - Baby is delivered and uterus is noted blue, vital signs rapidly deteriorate Final - Normal sinus rhythm is restored after she was anoxic for at least 10 minutes
Environment	**Physical environment:** little information is presented in this situation but the room is likely full of people **Human environment**: there is an anesthesiology team, there is acrimonious debate between the surgeon and anesthesiologist… that may suggest interpersonal or organizational aspects that should be considered, an airway team is called… but does not arrive immediately, and there is an obstetrician.
Task	**Primary task:** Emergency C-section **Associated tasks:** monitoring vital signs **Secondary tasks:** securing the airway, intubation, calling Code Blue, CPR, tracheostomy, defibrillation, medication administration
Time	**Start:** unknown **Elapsed time** between recognition of the need to intubate and restoration of sinus rhythm: unknown, greater than 10 minutes

Now you try doing a PETT analysis for case 1

Recall the case with Mr. Fortin that was presented earlier in this instructional supplement (OR, Turn to Case 1 in the Paper Cases section of your binder). Read the case again and then perform a PETT analysis on the situation using the blank PETT table below.

Spend 10 minutes on this activity.

Tip

As you read through the case, highlight or underline all of the information you think is important for this analysis, then put it in the table below.

Situation elements	
Patient	**Static information:** **Dynamic information:** Initial - Mid-way - Final -
Environment	**Physical environment:** **Human environment**:
Task	**Primary task:** **Associated tasks:** **Secondary tasks:**
Time	**Start:** **Present:** **Elapsed time**

Now you have established a certain level of understanding with respect to the situation presented in this case. Essentially, you have developed a certain level of "awareness" with respect to the situation that is presented.

Situational Awareness – A General Definition

Review of key concepts

Recall from your earlier reading that "situational awareness" is…

- Knowing what is going on around you
- Includes having team awareness,
- The ability to detect, integrate and interpret data gathered from the environment, and
- Your ability to remain aware of everything that is happening and to integrate this awareness into what you are doing at the moment

In other words, "situational awareness" is both a process of assessing a situation and the resulting knowledge or awareness of that situation.

Test your knowledge

Based on your reading and/or participation in the face-to-face course, answer the following knowledge testing questions. Use the space below to record your answers.

Spend 10 minutes on this activity.

When you are done, check your knowledge by looking at the answers located at the end of this section.

Q1. Define "good" situational awareness

Q2. What can happen if you are not "aware"?

Q3. Does Situational Awareness cause behaviour?

Q4. Does good Situational Awareness always lead to good performance?

Q5. Write down an example from your practice, something you witnessed or heard about where a lack of situational awareness affected the performance of a medical procedure or diagnosis.

Situational Awareness – Why is it so Important?

Review of key concepts

Why is situational awareness so important in medicine? One of the examples given in the Situational Awareness Primer highlights that errors of wrong site surgery, wrong drug, wrong dose or wrong patient, can often be relate to a lack of situational awareness. Misperception of a patient's situation can lead to erroneous decision-making and potentially serious adverse events.

Research shows that situational awareness is:

- One of the most essential non-technical skills for the achievement of safe clinical practice
- Especially critical when changes in the patient's condition have to be responded to promptly

Situational awareness is also negatively impacted by a number of factors that are common in healthcare, including: interruption, distraction, fatigue, stress, etc. This makes medical professionals particularly prone to loss of situational awareness.

Test your knowledge

Q1. Write down an example from your own practice of a loss of situational awareness – even if it was only momentary and you recovered quickly from it.

_____

_____

Q2. What factors contributed to this loss of situational awareness?

_____

_____

Q3. Using the above example, or another hypothetical example, explain how a loss of situational awareness could affect your ability to appropriately diagnose or treat a patient?

_____

_____

Situational Awareness – A Bit of Research and Theory

Review of key concepts

Situational awareness is considered central to safe and effective decision making in many domains. The theory of situational awareness is frequently used to explain how and why decision makers are able to assimilate information in complex tasks in a way that allows them to "know what is going on" and make critical decisions.

Recall that the three levels, or activities required to build and maintain situational awareness are perception, or getting the information; comprehension, or understanding the information; and projection, or thinking ahead.

Note

An annotated bibliography is included at the end of this learning package. Look to the reference cited there for additional information and more detail on the theory behind situational awareness in healthcare and other safety critical domains.

Test your knowledge

Q1. In what safety critical industry did situational awareness first originate? _____

Q2. What is the difference between situation assessment and situational awareness?

_____

_____

Q3. Define "team situational awareness". _____

_____

_____

Q4. Of the three levels of situation assessment, which one is most important for building and maintaining team situational awareness? Why? _____

_____

_____

Q5. Write down an example of good situational awareness from your own practice. When you do this, break it down into the three activities: perception, comprehension, and projection. How did this help you make the right decision?

Perception (getting the information) _____

_____

Comprehension (understanding it) _____

_____

Projection (thinking ahead) _____

_____

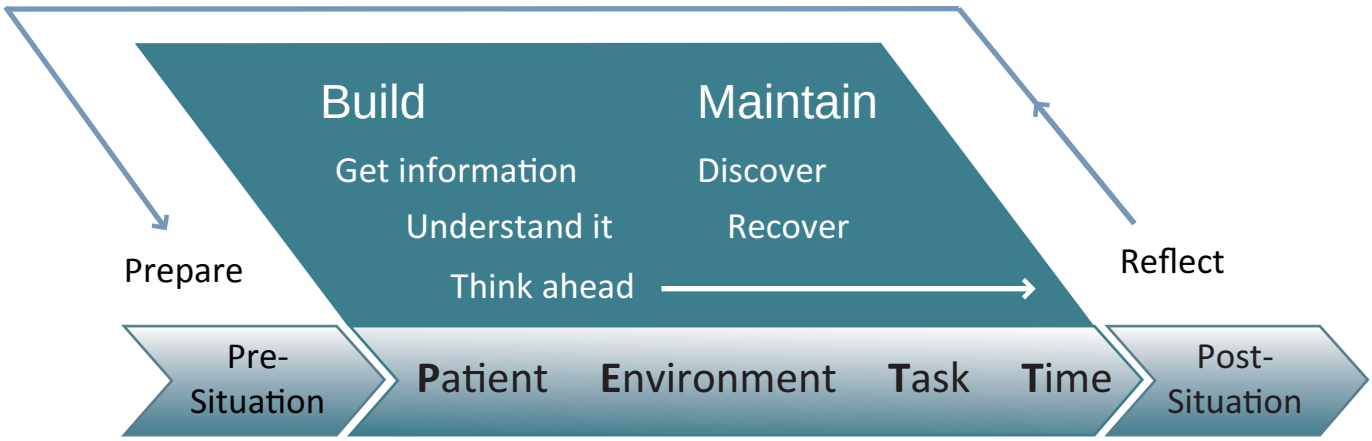
_____

The Process of Situational Assessment and Awareness

Review of key concepts

Recall from the Primer, that situational assessment and awareness as a process and a state of knowledge needs to be as dynamic as the safety critical situation that is being assessed.

Figure 2
the Process of Situational Awareness and Assessment



Situation assessment starts in the pre-situation phase, and then the situation unfolds with building and maintaining situational awareness. Continuously thinking ahead allows for complete understanding and building a bridge to decision making. When the situation is over, you have the opportunity to reflect – on your own or as a team. This reflection or debrief helps solidify knowledge and understanding for use in future pre-situation preparation.

Test your knowledge

Answer each of the following questions based on the case we read before, with Mr. Fortin (Case 1 in the paper cases section of this binder).

Q1. Explain how you would build situational assessment for this case.

Q2. Once you had established initial situational assessment, how would you maintain it as the situation evolved? In your answer, be specific about the type of information that you would be looking for and how often you would go about getting it.

Q3. The last component of situational awareness is thinking ahead to complete the understanding of the situation and help you make decisions. Identify where in the case Dr. Virk failed to think ahead and consequently made decisions that were not in the patient's best interest. If he had been thinking ahead, what other decisions do you think would reasonably have been made?

The Elements of Situational Awareness

Recall there are three main elements of the process of situational awareness:

- Getting information
- Understanding information
- Thinking ahead

Getting the information

A review of key concepts

To ensure you get the information you need, you should:

- **Scan and search**, i.e. be proactive in getting information
- **Pay attention** to what is going on around you
- **Remain watchful** and expect the unexpected
- **Communicate** the information and your understanding with your team and peers

Tip

Remember that some information is static, i.e. it will not change over time, and other information is dynamic. The dynamic information is such that you need to continually check-in on the information source to catch new information as it becomes available. This is where the "scan and search" strategy comes in handy.

Test your knowledge

Q1. Think of two examples of passive information acquisition that you perform in clinical work. Write them down below:

1. _____

2. _____

Q2. Think of two examples of active information gathering, where you had to make a special effort to get important information regarding your patient or task. Write them down below:

1. _____

2. _____

Example PETT Analysis for Getting the Information

Think back to Case 1, with Dr. Virk and Mr. Fortin, and recall the PETT tables we generated earlier. We are now going to extend the tables and identify all of the sources, delivery methods and the nature of the information provided to Dr. Virk in the scenario.

		Get the information		
Situation Elements		Nature	Delivery	Sources
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **Final:** cardiac arrest, aortic dissection and death	**Static:** Background info. **Dynamic:** patient status over the course of the scenario	**Passive:** nurse report **Active:** patient complaints	The nurse The patient
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road.	Static	Active/Passive	**Self:** Familiarity with the clinic
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin. **Associated task:** Orders tests. **Secondary:** picking up child from daycare, various interruptions/distractions.		Passive and active	The nurse, the patient
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time to cardiac arrest:** 2 hours	Dynamic	Passive	The patient, the nurse.

Now you try

Now take a look at Case 2 in the paper cases section of this learning package. Use the table below to guide your own assessment of the situation elements and the information sources, delivery mechanisms and nature as we have done above.

		Get the information		
Situation Elements		Nature	Delivery	Sources
Patient				
Environment				
Task				
Time				

Understanding the Information

A review of key concepts

We know the next step after getting the information is developing an understanding of it: What does this mean for the patient, for me, or my team? Recall from the Primer that there are a couple of tricks to sorting through this information and turning it into understanding:

- **Compare** the information you gather to what you know and what you expect
- **Critique** the information; check information accuracy, completeness, source and relevance. As you get new information, cross-reference it with what you already know and assess conflicts and contradictions.
- **Diagnose** by asking what this information means and why it may (or not) have happened.

For example, in the case of Mr. Fortin with Dr Virk, we can see that though Dr. Virk received the information from the nurse that Mr. Fortin's blood pressure was high and different on each arm, Dr. Virk presupposed the outcome (nothing serious is wrong) based on historical visits. There was no apparent diagnosis of the information itself to determine – on the spot – what these symptoms mean and what could be causing them. Instead, Dr. Virk puts off the diagnosis by prescribing additional testing at a later date.

Example PETT Analysis for Understanding the Information

Here is a PETT analysis for Dr. Virk's understanding of the information in this scenario.

		Understand the information		
Situation Elements		Compare	Critique	Diagnose
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **End:** cardiac arrest, aortic dissection and death	Based on a comparison of current and past vital signs, the nurse flags an elevated BP and different pressures on each arm. Based on past visits, Dr. Virk concludes the case is not urgent.	Seems that no critical thinking was done by Dr. Virk to assess the possible cause of the elevated BP, non-symetrical BP and associated arm/leg pain.	It is clear after-the-fact what the cause of the symptoms were.

Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes **Mid-way:** Dr. Virk is interrupted by three calls during the consultation.The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road	The medical tasks appear to be routine. Dr. Virk ignores the red flags provided by the nurse. The secondary task of picking up his child from daycare, may not be routine.	No critical thinking about the implication of the environmental elements on the internal state of the physician.	
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions/distractions	The medical tasks appear to be routine. Dr. Virk ignores the red flags provided by the nurse. The secondary task of picking up his child from daycare, may not be routine.		
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours			Seems like Dr. Virk considered the possibility that something was wrong, but failed to link the symptoms with immediate danger.

Now you try

Work through the same exercise using information presented in Case 2 and the blank table below

		Understand the information		
Situation Elements		Compare	Critique	Diagnose
Patient				
Environment				
Task				
Time				

Thinking Ahead

A review of key points

Let's assume you have collected all of the information, evaluated it and understand the situation – now what do you do? Think ahead: where could this lead? What are the possible outcomes of the action you have decided to take? Recall from the Primer that thinking ahead is taking all of the information gathered and understood and using it to extrapolate the status of the situation in the near and extended future.

Example PETT analysis for thinking ahead

The following is a PETT analysis example for Case 1 for thinking ahead:

		Think Ahead	
	Situation Elements	**Extrapolation**	**"What if?"**
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **Final:** cardiac arrest, aortic dissection and death	There could possibly have been an extrapolation by the nurse calling Dr. Virk in to see this patient.	The nurse may have been thinking about a potential diagnosis or what could happen – which is why she flagged Mr. Fortin's vitals.
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road	Not clear if extrapolation was done with respect to repeated interruptions and their impact on Dr. Virk's attention to Mr. Fortin's case.	
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions, distractions	No extrapolation on the impact of the interruptions on Dr. Virk's primary task of diagnosing the patient.	Perhaps some "what if" analysis was done with respect to Dr. Virk being late to pick up his child, but this is a distraction from Mr. Fortin's case.
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours	No extrapolation by Dr. Virk of the possible progression of the symptoms over time.	No "what if" was done with respect to the possible need for a more immediate diagnosis.

Now you try

Now you try using Case 2 and the blank PETT table below.

		Think Ahead	
Situation Elements		Extrapolation	"What if?"
Patient			
Environment			
Task			
Time			

Maintaining Situational Awareness Over Time

A review of key concepts

As we have seen in a number of the cases reviewed thus far, clinical situations are dynamic and unexpected events, environmental or task factors can be introduced in a way that might turn a routine case into something quite unexpected. Thus once you have built a comprehensive picture of the situation, you need keep this in mind and work to maintain it. This means continued information gathering and understanding to ensure you do not lose the situational awareness you have consciously built.

Test your knowledge

Use the space provided to answer the questions below. Each of these questions is based on the information presented in the Situational Awareness Primer and your own understanding of that information.

Q1. The key activities for maintaining situational awareness can be described as "discover and recover". In practice, what could you do to achieve this? Describe the actions you would take.

Q2. Provide an example from your own practice (if possible) of a time when you felt you had lost situational awareness. How did you discover that you had lost situational awareness? What did you do to recover in this case? Knowing what you do now, from the Situational Awareness Primer, would you change anything, e.g. take different or additional actions, to recover in that same situation?

Q3. Based on your understanding of the factors that can influence situational awareness, identify one type of influencing factor and describe how it could contribute to a loss of situational awareness and what you could do to prevent this loss.

Possible Obstacles to Adequate Situational Awareness

Review of key concepts

Human information processing has limited cognitive resources and a tremendous quantity of information to parse through. Heuristics are the collection of experienced based techniques that we use to help us make decisions, such as rules of thumb, intuition or common sense. Heuristics can help, but also hinder good judgment by biasing the physician. For example, hearing one patient's description of their symptoms might lead you to jump to a conclusion based on recent experience with a patient exhibiting the same symptoms – without verifying the symptoms against other patient characteristics, this could lead to a dangerous assumption.

Recall from the Primer that there are two main types of biases: cognitive and attentional.

Cognitive biases influence thinking, problem solving and decision making. Here are some examples:

- Anchoring occurs when there is a fixation on the initial assessment, making it unlikely that the initial assessment will be reassessed and updated with new information
- Confirmation bias is the tendency to look for evidence that confirms or matches the current situation or decision.

Attentional biases influence perception and attention, in other words, how you perceive information and what you pay attention to in the environment. Here are some examples:

- Tunneling is when your attention narrows to the exclusion of other potentially critical information
- Other 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

Example case analysis for biases

Using your understanding of cognitive and attentional biases, take a look at those that were identified in our case with Dr. Virk. Instead of breaking the case into situational elements, as we have done in previous exercises, we are going to go back to the initial text and look at events step by step.

Case 1 Family Medicine Clinic	Biases
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr Virk thinks it is likely benign in nature, as with previous visits.	Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be **anchoring** on the "nothing is seriously wrong" conclusions of previous visits by this patient.
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	Carry over from above

Case 1 Family Medicine Clinic	Biases
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	Carry over from above
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.	Carry over from above. Influencing factors lead to **tunneling** which becomes an obstacle for the adequate comprehension and thinking ahead activities. These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.	

Now you try

Now, using the blank table below, do the same analysis of biases for Case 2. We have already put the case description into the table for you.

Case 2 Trauma MVC	Biases
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.	
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.	
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.	
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.	
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.	
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.	
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.	
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.	

Case 2 Trauma MVC	Biases
Dr. Kessel acknowledges this and proceeds to repair the laceration.	
Dr. Kessel criticises the junior resident for not keeping the operating field clear.	
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.	
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.	
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.	
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.	

Putting it all Together

Throughout this instructional supplement we have been looking repeatedly at the case of Dr. Virk and Mr. Fortin where a serious vascular problem went unnoticed. You learned how to identify key elements of the situation and conduct a PETT analysis (Patient, Environment, Task, Time) as well as how to identify potentially influencing factors based on human capabilities and limitations. We also discussed and practiced the three cyclical stages of situation assessment, and practiced identifying cognitive and attentional biases that can hinder the building and maintaining of situational awareness. Now, let's put it all together for a complete case analysis. Take a look at the table on the next page showing a complete analysis for Case 1. You will notice that the analysis for the stages of situation assessment: getting the information, understanding it and thinking ahead, has been compressed from what we practiced earlier. Here we only present the conclusions from that detailed analysis.

Practical Takeaways

Congratulations! You have completed the instructional supplement. Look to the Situational Awareness Primer for a situational awareness checklist that you can use as reminders of the key lessons reviewed here.

Example full-case analysis

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	**Workload** Possible internal **distraction** stemming from the need to leave immediately Possible **stress**		Dr. Virk appears to be aware of the time.		
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. *Dr Virk thinks it is likely benign in nature, as with previous visits.*	**Workload, distraction** and possible **stress** carried over from above. Additional **workload** imposed by the complexity of the case (i.e. an elderly patient with diabetes and abdominal pain could have a long list of diagnoses).	Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be **anchoring** on the "nothing is seriously wrong" conclusions of previous visits by this patient.	Patient brings a complaint; patient's history is reviewed.	At this time it is not clear what the comprehension is, but it is implied that Dr.Virk might compare the present symptoms to those reported in previous visits, all of which resulted in nothing, or no more than, minor complications related to diabetes..	It is not clear if any thinking ahead was done

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	Interruption Increased **workload** Increased likelihood for cognitive biases	Carry over from above	A lot of other information, unrelated to this particular patient is introduced and the physician's focus is taken away from the task at hand.	Dr. Virk understands that each of these calls require his immediate attention. The potential of a serious health problem with Mr. Fortin is not understood	There is no thinking about Mr.Fortin at this time.
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	**Carry over from above** Possible **authority gradient** (i.e. organizational or vocational cultural factor that hinders communication between staff members in different positions)	Carry over from above	Additional information is gathered about the patient's condition Dr. Virk does not perceive the "red flags" that are being presented by both the nurse and the patient	This new information is compared to the complaints presented on previous visits. The nurse recognizes that vitals are there are some concerning abnormalities in the vital signs	The nurse flags elevated vitals because she predicts the Dr. needs this information. It is also likely that she predicts an ominous diagnosis, but does not share this directly.

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week	**Anxiety suggests stress** **Distraction caused by workload**	Carry over from above. Influencing factors lead to **tunneling** which becomes an obstacle for the adequate comprehension and thinking ahead activities. These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.	Dr. Virk makes a connection between the symptoms presented and possible cardiac problem. He does not see any immediate danger and prescribes the patient medication and testing rather than a more immediate referral to the ED	He does not think ahead to the potential severity of the situation and a decision is made based on a biased comprehension of the situation	There is no thinking about Mr. Fortin at this time.
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening			The diagnosis could have been discovered earlier with improved communication, between the nurse and the doctor; attention to and comprehension of the red flags; and insight into the nature of interruptions, their timing and impact on one's likelihood to make cognitive errors.		

Now you try

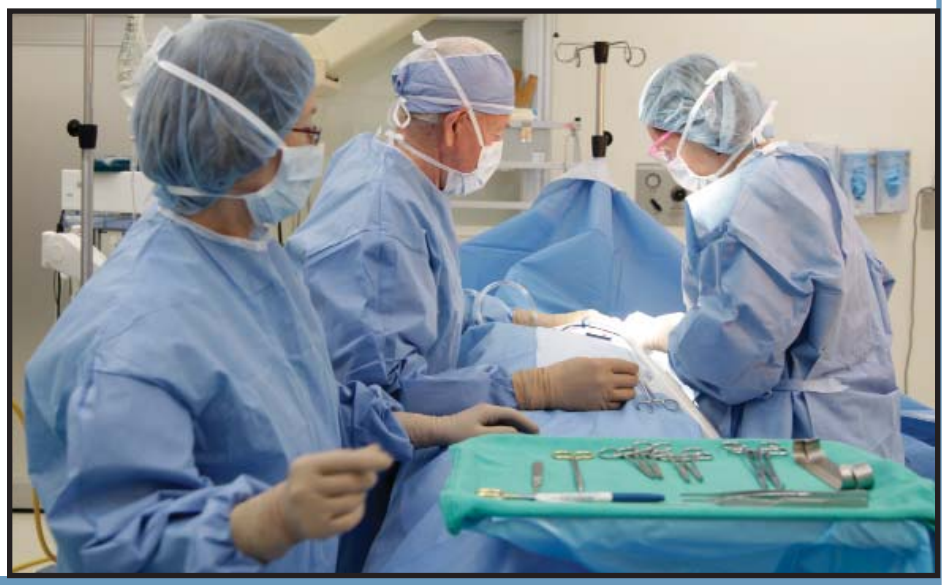
Now you have a chance to put all of the skills you have learned together to analyze a completely new case.
Complete the following table for Case 2.

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.					
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.					
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.					
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.					

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.					
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.					
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.					
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.					
Dr. Kessel acknowledges this and proceeds to repair the laceration.					
Dr. Kessel criticises the junior resident for not keeping the operating field clear.					
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.					

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.					
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.					
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.					

Chapter 6



Instructional Supplement for Instructors

Contents

About This Instructional Supplement

The objectives of this Instructional Supplement are to:

1. Support the material provided in the Situational Awareness Primer and in-class lessons by:
   a. Reviewing key concepts
   b. Providing practical examples illustrating key concepts
2. Provide independent learning exercises to test your understanding of key concepts
3. Provide detailed answers to the independent learning exercises so you can check your understanding and identify and rectify gaps in learning
4. Provide teaching tips to support instructors in training activities

In order to meet these objectives, the sections within this Instructional Supplement are ordered according to the presentation of information in the Situational Awareness Primer that appears earlier in this learning package.

Each section follows an instructional pattern: a **review of key concepts,** followed by an **example** illustrating how to conduct situational awareness assessment and maintenance activities; **"test your knowledge"** questions and/or skill testing exercises titled: **now you try**; and **discussion questions** for instructors using this material in an educational environment or teaching context. In addition, as you work through this Instructional Supplement, you will notice a number of **Tips** and **Notes** that provide additional support and ideas for how to establish and maintain situational awareness in your practice.

Throughout this you will be asked to use elements of Case 1 from the case studies section of this learning package to have a hands-on practice and assess your understanding of concepts. Thus, as you develop your understanding of situational awareness theory and process, you will be able to apply your understanding to a specific case.

At the end of this Instructional Supplement you will have the opportunity to perform a comprehensive analysis of a new case integrating all of the knowledge and skills developed throughout this.

What Do You Know About Situational Awareness?

Review of key concepts

The purpose of this initial section is to get you thinking intuitively about situational awareness. The situational awareness primer associated with this independent learning opens with the following statement:

Many adverse medical events are associated with so-called "human factors" in Healthcare settings. Situational awareness is a key component of human factors and refers to a person's perception and understanding of the dynamic information that is present in their environment. Essentially it is the process of integrating relevant information from the environment into a concise picture based on which all decision making and action take place.

Example

Let's review the following short case excerpt to get us thinking about things that happen in clinical circumstances:

> *During an emergency C-section, the anesthesiology team has difficulty intubating 29-year-old Laura Small. Amidst acrimonious debate between the surgeon anxious to begin the procedure and the anesthesiologist struggling to get Ms. Small's airway secured, the baby is delivered. The mother's uterus is noted as blue, and her vital signs rapidly deteriorate... After a 12-hour shift and no lunch, Martina Pellos, an obstetrics nurse who is assisting in the emergency, is directed to rapidly administer vitamin K to the baby. Nurse Pellos reaches for an ampule of vitamin K from the set of bins at the side of the room holding several medications commonly used in the delivery suite. After injecting the medication, she notices that she has inadvertently given the baby methylergonovine (Methorgine - a potent vasoconstrictor)*

What are some of the factors in this case description that could influence the eventual decision-making and performance?

1. There is acrimonious debate between the surgeon and the anesthesiologist. Could this have impacted their focus on the patient, their awareness of what was going on around them, or their ability to make clear-headed decisions regarding the course of action? How does the human or organizational environment impact performance?
2. Nurse Pellos is at the end of her shift and has not eaten. It is very likely she is suffering from physical fatigue. How could this affect her performance?
3. Also, the placement or labeling of bins holding medications could have been such that they "encouraged" or made it easy for a mistake like this to happen. What was the physical design like for this piece of equipment? Were all the bins open, making it easy to reach for one and grab another? Are the vials similar in size and or colour?

So far, we have identified three factors that could have influenced performance: acrimonious debate; fatigue; and equipment design.

Now you try

Think back to a case from your own experience, or something you heard or read about, where a seemingly routine case went wrong. Use the space provided below to write out a description of what happened. Then, ask yourself if there was a lack of situational awareness by any member of the medical team at any point in this case? Did this contribute or could it have contributed to an adverse outcome? If so, how? At this point you may not be sure if situational awareness was really a key factor, but there may be other things that contributed to the less-than-ideal outcome, for example: fatigue, lack of communication, availability of tools, equipment or expertise, etc. Based on your intuitive understanding of the case, identify factors that you believe could have contributed to the outcome.

Your case description: _____

With your intuitive understanding, identify any loss of situational-awareness and how it could have affected decision-making or contributed to the adverse outcome: _____

Can you identify any other factors that may have contributed to the loss of situational awareness or adverse outcome?

Discussion questions

Use this activity as an opportunity to share experience and lead into a discussion identifying potential contributing factors. For example: ask participants how fatigue may have impacted perception of critical information, awareness or decision-making in their case examples. Try to pinpoint factors that could have contributed to any loss of situational awareness identified by participants. This should lead the group easily into the next topic in the human factors framework.

Answers to "Now you try" questions

A wide variety of case examples are acceptable; there is no correct or incorrect answer. It is most important that you try to identify factors that could impact decision-making and performance. Here we are trying to get you to express your own intuitive definition of situational awareness. The objective is for you to start thinking critically about elements of the internal or external environment that may ultimately impact decision-making and performance.

Understanding the Human Factors Framework

Review of key concepts

Recall from the Situational Awareness Primer that "Human Factors" (HF):

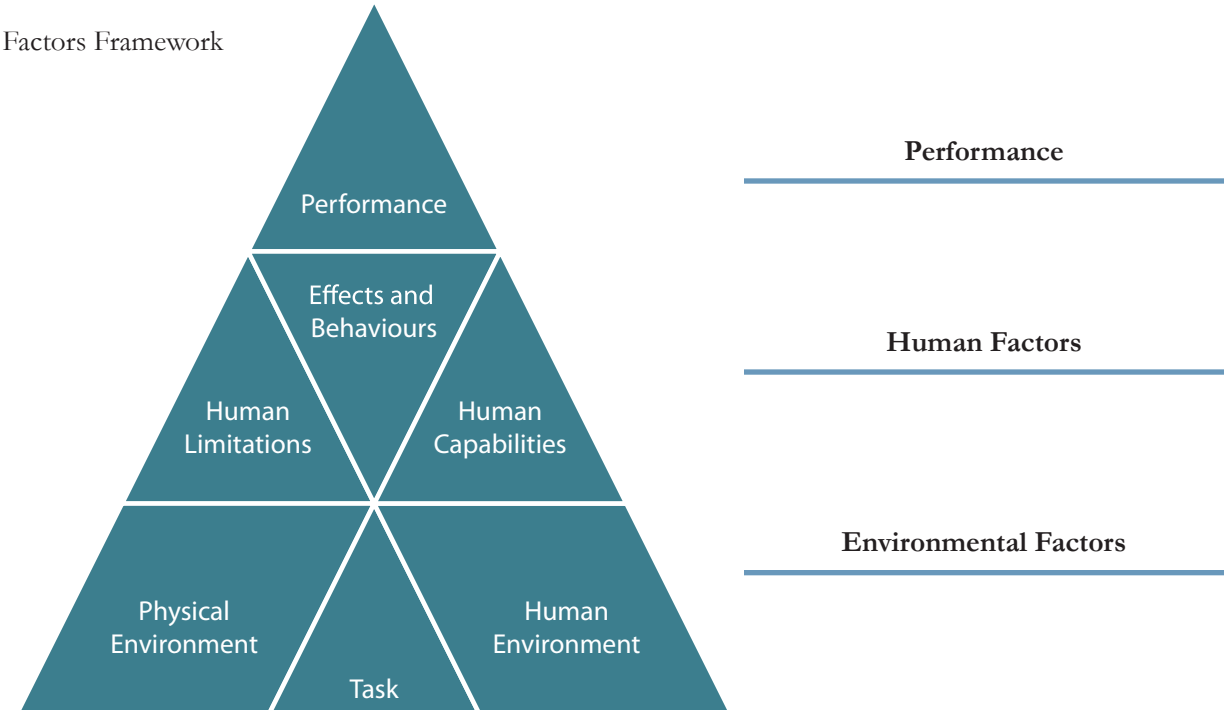
- Is a discipline addressing human behaviour, abilities, limitations, and relationship to the work environment (physical, organizational, cultural);
- Applies to the design and evaluation of safer and more effective tools, machines, systems, tasks, jobs, and environments; and
- Is recognized by The Royal College of Physicians and Surgeons of Canada, and the Canadian Patient Safety Institute as a Core Safety Competency (2008).

The **Human Factors Framework** depicts the interactions between human, environmental and task characteristics that illustrate how these types of factors can influence human behaviour and performance. This framework should help you understand what's in a situation and what factors can play a role in influencing situational awareness.

Do you remember each of the components of the HF Framework and how they contribute to human performance?

As a reminder, see the Human Factors Framework in Figure 1.

Figure 1
The Human Factors Framework



Each of the components of the framework represents a family of factors that can positively or negatively influence performance.

Test your knowledge

Use your understanding of the human factors framework to answer the questions below. If you get stuck, go back to the Situational Awareness Primer. Answers to these questions are provided at the end of this section.

Q1. Why are the environmental factors presented on the bottom of the pyramid?

_____

_____

Q2. Fill in the blanks in the following statement:

The components of the HF framework "act together in an _____ fashion to produce effects and behaviours such as distractions, _____, _____, _____, stress, etc".

Q3. Where is situational awareness placed within the human factors framework, and why?

_____

_____

_____

Example case analysis (part 1)

Now, read the case description below. Note this is Case 1 in the Paper Cases section of this course package.

It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous incidents.

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.

Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

Tip

When you try to assess what could be the possible influencing factors in a given situation, work your way up from the bottom tier of the framework to the top. In other words, start by asking yourself: What is going on in the environment? Then go up the framework to the middle tier, and ask: How could these environmental conditions interact with human capabilities or limitations? What would be the results of such circumstances?

Now, let's work through the case step by step and identify potential influencing factors from the human factors framework.

Case excerpt	Analysis
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	• The fact that Dr. Virk is "running late" suggests elevated **workload**. This is a characteristic of the work environment, or organizational environment and falls into the Human Environment component of the HF framework • The fact that he feels he "has to leave immediately to pick his child up" is a possible internal **distraction** – because he may be preoccupied with something other than the task at hand. This feeling may also lead to **stress**. Both distractions and stress are factors related to human limitations

Now you try (case analysis part 1)

Now you try analyzing the next section of the case, extracted below. Remember that factors identified previously could carry-over and continue to influence performance or decision-making as the situation evolves.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous incidents.

[Use this space to enter your answer]

Tip

Underline the information in the case that you think is important or might suggest a potential influencing factor in the mix.

Example case analysis (part 2)

As the case evolves, we can see other potentially influencing factors in the situation:

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	• As is obvious from the language used in the case description, the calls are **interruptions** which can affect Dr. Virk's focus on the task because it is hard to keep so many different things in your mind at the same time – this is a characteristic of the environment that interacts with human limitations: these interruptions increase **workload**
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	• Again, all factors carry over from above and could continue to influence Dr. Virk's decision-making • The fact that Dr. Virk ignores the nurse's flag of vital signs could suggest a possible **authority gradient**: an organizational or vocational cultural factor that hinders communication between staff members in different positions – this is considered part of the human environment

Now you try (case analysis part 2)

Now you try identifying factors in the last part of the case description…

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

[Use this space to enter your answer]

Discussion questions

Building on the lessons from this section of the Situational Awareness Primer and the exercises in this Instructional Supplement, you could lead a discussion with the group on one or more of the following:

- How do environmental factors and human capabilities and limitations interact to help or hinder performance? Can anyone think of an example, or explain again in their own words the examples provided above?
- Why is workload a concern? What can you do to mitigate the effects of elevated workload?
- Have you ever worked in an environment where there was a noticeable authority gradient, perhaps a strict hierarchy that discouraged questioning between team members in different vocations? How did this impact performance or patient care? Does anyone have an example to share? What do you think could be done to improve communication in this type of environment?

Alternately, suggest a link to the situational awareness concept. Discuss how these factors can influence knowing or not knowing what is going on in the situation described in the case.

Answers to knowledge-testing question

Q1. The physical and human environments in which a task is being performed are the basic elements of a situation, this is why they are at the bottom of the pyramid. Human capabilities and limitations are applied within this "situation" in an effort to achieve the task. Thus the human capabilities and limitations are applied on top of the physical and human environment that is already in place.

Q2. The components of the HF framework act together in an interdependent fashion to produce effects and behaviours such as distractions, interruptions, fatigue, workload, stress, etc.

Q3. Situational Awareness fits within the Effects and Behaviours block of the framework because it is often a product of the physical and human environment you work in, and your own capabilities and limitations when working in that environment.

Answers to the case analysis

Part 1:

- Workload, distraction and possible stress carried over from section above – in other words, these factors can continue to impact situational assessment and awareness unless they are adequately addressed or otherwise eliminated. For example, if Dr. Virk's wife called and said she could pick up the child from daycare, then all of a sudden the cognitive workload, distraction and any possible rushing or stress associated with that task would disappear.
- Additional workload imposed by the complexity of the case (i.e. an elderly patient with diabetes and abdominal pain could have a long list of diagnoses)

Part 2:

- Anxiety suggests stress
- The secondary task of getting to the daycare is a distraction and results in added mental workload

What is a "Situation"?

Review of key concepts

Recall from the Situational Awareness Primer, that a situation is "a set of environmental conditions and system states with which the participant is interacting that can be characterized uniquely by a set of information, knowledge and response options" (Pew, 2000).

When you participate in a situation, the fundamental elements of the situation will become your building blocks for situation assessment and awareness.

The fundamental elements of a clinical situation include:

- the **Patient**
- the physical and human **Environment**,
- the **Task** itself and
- how all of these change over **Time**

Note that all these situational elements are at the base of the human factors framework. Though "time" does not have an explicit placeholder in the framework, it is implicit in the task, and it can impact the other elements.

Test your knowledge

How much do you remember from the Situational Awareness Primer? Test your knowledge by answering the following questions:

Q1. Fill in the blanks:

The _____ is likely the most important element of the situation in medical practice.

Q2. Using your own personal practice experience, provide an example of static patient information and one example of dynamic patient information that change over time. Explain why this distinction is important.

Static: _____

Dynamic: _____

Explanation: _____
_____
_____

Q3. Describe the two kinds of environment that need to be considered, including examples of what you might find/consider part of each.

1. _____
_____

2. _____
_____

Now, keeping these points in mind, let's take a look at how we can use the PETT elements to systematically understand a clinical situation.

Example case analysis

First, read the case description below:

During an emergency C-section, the anesthesiology team has difficulty intubating 29-year-old Laura Small. Amidst acrimonious debate between the surgeon, anxious to begin the procedure, and the anesthesiologist, struggling to get Ms. Small's airway secured, the baby is delivered. The mother's uterus is noted as blue, and her vital signs rapidly deteriorate. A Code Blue is called and CPR begun. Still waiting for the airway backup team, an obstetrician attempts a tracheostomy. After defibrillation and medication restore a normal sinus rhythm, it is estimated that Ms. Small was anoxic for at least 10 minutes.

Tip

Use the PETT acronym to remind you of the fundamental elements of a situation and what to look for when faced with a situation.

Now let's look for all of the Patient information in this case.

Situation elements in this example

Patient	**Static information:** patient age and name (29-year-old Laura Small) **Dynamic information:** Initial - Pregnant and giving birth, appears to have a compromised airway and requires intubation. Mid-way - Baby is delivered and uterus is noted blue, vital signs rapidly deteriorate Final - Normal sinus rhythm is restored after she was anoxic for at least 10 minutes
Environment	**Physical environment:** little information is presented in this situation but the room is likely full of people **Human environment**: there is an anesthesiology team, there is acrimonious debate between the surgeon and anesthesiologist… that may suggest interpersonal or organizational aspects that should be considered, an airway team is called… but does not arrive immediately, and there is an obstetrician.
Task	**Primary task:** Emergency C-section **Associated tasks:** monitoring vital signs **Secondary tasks:** securing the airway, intubation, calling Code Blue, CPR, tracheostomy, defibrillation, medication administration
Time	**Start:** unknown **Elapsed time** between recognition of the need to intubate and restoration of sinus rhythm: unknown, greater than 10 minutes

Now you try doing a PETT analysis for case 1

Recall the case with Mr. Fortin that was presented earlier in this instructional supplement (OR, Turn to Case 1 in the Paper Cases section of your binder). Read the case again and then perform a PETT analysis on the situation using the blank PETT table below.

Spend 10 minutes on this activity.

Tip

Underline the information in the case that you think is important or might suggest a potential influencing factor in the mix.

Situation elements	
Patient	**Static information:** **Dynamic information:** Initial - Mid-way - Final -
Environment	**Physical environment:** **Human environment**:
Task	**Primary task:** **Associated tasks:** **Secondary tasks:**
Time	**Start:** **Present:** **Elapsed time**

Now you have established a certain level of understanding with respect to the situation presented in this case. Essentially, you have developed a certain level of "awareness" with respect to the situation that is presented.

Check your answers on the next page to see how much of the situation you captured!

Discussion question

Consider the following discussion question: What kind of secondary tasks regularly threaten situation assessment or awareness in your work environment? This can be a small or large group exercise – ask participants to collect a list of secondary tasks that could interfere with focus on the main task. Identify why or how these secondary tasks interfere with situational awareness. Then ask participants to identify what could be done to mitigate the impact of these secondary tasks. You can also link this to the concept of workload.

Answers to knowledge testing questions

Q1. Patient.

Q2. Examples of static patient information could include: name, age, allergies, or any confirmed aspect of medical history.
Examples of dynamic patient information could include: vital signs, patient status (stable, unstable, critical, etc.).
Explanation of why this is important: Each type of information implies a different way of ensuring you have the info. Static, does not require constant monitoring and attention, in contrast to dynamic info that requires one to scan and monitor and attend all the time. A lack of awareness of how dynamic information is changing over time could result in an important change going unnoticed. In the worst case, this change could be life threatening and if it goes unnoticed result in serious harm or death.

Q3. (1) The physical environment, including equipment, space and tools, and
(2) The human environment, including the medical team, and other people, that may enter or leave the situation as it progresses, as well as the social and cultural climate in the team or organization in which everyone is interacting.

Answer for Case 1 PETT analysis

Situation elements	
Patient	Static information: Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before Dynamic information: Initial – abdominal pain, elevated HR, different blood pressures on each arm Mid-way – feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling Final – aortic dissection, cardiac arrest and death
Environment	It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms Dr. Virk is anxious to get on the road
Task	Primary task: Information collection, diagnosis and treatment of Mr. Fortin Associated tasks: orders tests Secondary tasks: picking up child from daycare, various interruptions,/distractions
Time	Start: unknown Present: Friday afternoon, Dr. Virk is running late Elapsed time to cardiac arrest: 2 hours

Situational Awareness – A General Definition

Review of key concepts

Recall from your earlier reading that "situational awareness" is…

- Knowing what is going on around you
- Includes having team awareness
- The ability to detect, integrate and interpret data gathered from the environment, and
- Your ability to remain aware of everything that is happening and to integrate this awareness into what you are doing at the moment

In other words, "situational awareness" is both a process of assessing a situation and the resulting knowledge or awareness of that situation.

Test your knowledge

Based on your reading and/or participation in the face-to-face course, answer the following knowledge testing questions. Use the space below to record your answers.

Spend 10 minutes on this activity.

When you are done, check your knowledge by looking at the answers located at the end of this section.

Q1. Define "good" situational awareness

Q2. What can happen if you are not "aware"?

Q3. Does Situational Awareness cause behaviour?

Q4. Does good Situational Awareness always lead to good performance?

Q5. Write down an example from your practice, something you witnessed or heard about where a lack of situational awareness affected the performance of a medical procedure or diagnosis.

Discussion questions

- Question 3 and 4 of the short answer questions could also serve as group discussion questions. If participants are working through the Instructional Supplement, ask them to share their answers.
- Examples collected from question 5 above could be a good source of information related to patient safety. Consider asking staff/participants to submit their experiences for anonymous posting. There could be valuable lessons here that others could learn from.

Answers to knowledge testing questions

Q1. Good situational awareness would be when you are aware of what is going on in a certain medical situation, are able to perceive change, understand the impact of all elements of the situation, and integrate that information into your decision making.

.

Q2. Many things, including: critical information or a change in patient status can go unnoticed. This could lead to an incorrect diagnosis or delay to correct diagnosis. You may also succumb to one of the cognitive biases identified later in the Primer, for example you could be so focused on a task or aspect of the case (tunneling) that you become oblivious to the surrounding environment and may not hear a warning from one of your colleagues, or see how your own actions are affecting other elements of the situation. Furthermore, if you are not "aware", you will be less able to think ahead, plan future actions, or foresee the implications that the current situation could have on the future state of the patient condition.

Q3. Not necessarily. One's awareness of the situation can affect behaviour. Behaviour can also be impacted by other factors (such as knowledge, skill, fatigue, interruption, etc.) that can help or hinder Situational Awareness.

Q4. Good or poor performance could result from good or poor Situational Awareness. Situational Awareness can also be improved by better performance or degraded by poor performance that is influenced by other factors. See page 36 in the Situational Awareness Primer.

Q5. [Your answer should illustrate that you understand Situational Awareness; identify the loss of SA; and how it impacted decision-making or performance.]

Situational Awareness – Why is it so Important?

Review of key concepts

Why is situational awareness so important in medicine? One of the examples given in the Situational Awareness Primer highlights that errors of wrong site surgery, wrong drug, wrong dose or wrong patient, can often be related to a lack of situational awareness. Misperception of a patient's situation can lead to erroneous decision-making and potentially serious adverse events.

Research shows that situational awareness is:

- One of the most essential non-technical skills for the achievement of safe clinical practice
- Especially critical when changes in the patient's condition have to be responded to promptly

Situational awareness is also negatively impacted by a number of factors that are common in healthcare, including: interruption, distraction, fatigue, stress, etc. This makes medical professionals particularly prone to loss of situational awareness.

Test your knowledge

Q1. Write down an example from your own practice of a loss of situational awareness – even if it was only momentary and you recovered quickly from it.

_____

_____

Q2. What factors contributed to this loss of situational awareness?

_____

_____

Q3. Using the above example, or another hypothetical example, explain how a loss of situational awareness could affect your ability to appropriately diagnose or treat a patient?

_____

_____

Discussion questions

- Recall the Elaine Bromiley case that was part of the presentation slide set and is also outlined in the Situational Awareness Primer. The inquiry report suggested that loss of situational awareness was one of the key causes for the case outcome. Do you agree?
- Sometimes a loss of situational awareness contributes to poor decision-making. Other times, the required information was simply not available and no one could reasonably be expected to obtain a full picture of the situation. Discuss the difference between these two possibilities using clinical examples.

Answer the knowledge testing questions

Q1. [Your answer should demonstrate an event where you either missed information, or misinterpreted information e.g. misdiagnosis of a patient, delay in treatment, wrong drug, wrong site procedure, you were conducting rounds and mistook one patient for another….etc.]

Q2. [Distraction? Interruption? Fatigue? Stress? Workload? Organization/cultural factors? Lack of communication? Team dynamics? etc… One or more of these factors could contribute to loss of situational awareness]

Q3. Recall the answer to question 2 in the previous section: A loss of situational awareness could lead to an incorrect diagnosis or delay to correct diagnosis. You may also succumb to one of the cognitive biases identified later in the Primer, for example you could be so focused on a task or aspect of the case (tunneling) that you become oblivious to the surrounding environment and may not hear a warning from one of your colleagues, or see how your own actions are affecting other elements of the situation. Furthermore, if you are not "aware", you will be less able to think ahead, plan future actions, or foresee the implications that the current situation could have on the future state of the patient condition.

Situational Awareness – A Bit of Research and Theory

Review of key concepts

Situational awareness is considered central to safe and effective decision making in many domains. The theory of situational awareness is frequently used to explain how and why decision makers are able to assimilate information in complex tasks in a way that allows them to "know what is going on" and make critical decisions.

Recall that the three levels, or activities required to build and maintain situational awareness are perception, or getting the information; comprehension, or understanding the information; and projection, or thinking ahead.

Note

An annotated bibliography is included at the end of this learning package. Look to the reference cited there for additional information and more detail on the theory behind situational awareness in healthcare and other safety critical domains.

Test your knowledge

Q1. In what safety critical industry did situational awareness first originate? _____

Q2. What is the difference between situation assessment and situational awareness?

_____

_____

Q3. Define "team situational awareness". _____

_____

_____

Q4. Of the three levels of situation assessment, which one is most important for building and maintaining team situational awareness? Why? _____

_____

_____

Q5. Write down an example of good situational awareness from your own practice. When you do this, break it down into the three activities: perception, comprehension, and projection. How did this help you make the right decision?

Perception (getting the information) _____

_____

Comprehension (understanding it) _____

_____

Projection (thinking ahead) _____

_____

_____

Discussion questions

Initiate a discussion where participants are encouraged to share examples of good or bad team situational awareness from their own experience. Start with the following questions:

- How do you ensure situational awareness in your practice?
- Has anyone ever been in a situation where you thought you were "on the same page" as one or more team members, but then realized that there was a disconnect? How did you discover and rectify what could have been a loss of team situational awareness? Can you comment on how addressing this "disconnect" impacted you or your team member(s) situational awareness?

Answers to knowledge testing questions

Q1. Aviation

Q2. Situation assessment is the process of attaining situational awareness.

Q3. Wellens (1993) defines team situational awareness as "the sharing of a common perspective between two or more individuals regarding current environmental events, their meaning, and projected future status" (p. 272). More recently, team situational awareness in healthcare has been defined as "task- and team-oriented knowledge held by everyone in the team and the collective understanding of the unfolding situation" (Parush, 2010).

Q4. Information sharing as opposed to cognitive processing is more central to building and maintaining team situational awareness. This is because information sharing allows for shared knowledge to be constructed and maintained among team members.
Note that the activity of "getting information" as part of establishing and maintaining situational awareness is discussed further in the next section of the Primer and this independent learning .

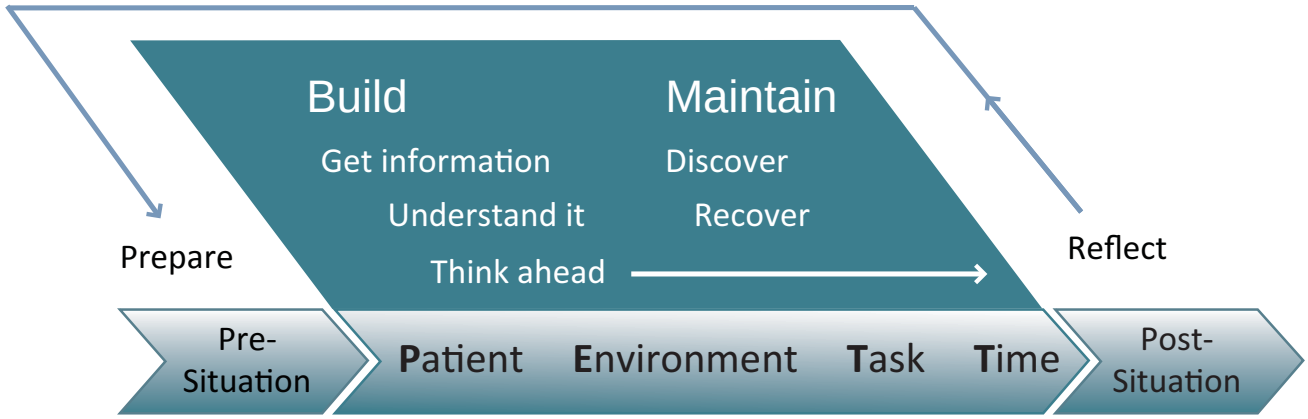
Q5. [Answers will vary]

The Process of Situational Assessment and Awareness

Review of key concepts

Recall from the Primer, that situational assessment and awareness as a process and a state of knowledge needs to be as dynamic as the safety critical situation that is being assessed.

Figure 2.
The Process of Situational Awareness and Assessment



Situation assessment starts in the pre-situation phase, and then the situation unfolds with building and maintaining situational awareness. Continuously thinking ahead allows for complete understanding and building a bridge to decision making. When the situation is over, you have the opportunity to reflect – on your own or as a team. This reflection or debrief helps solidify knowledge and understanding for use in future pre-situation preparation.

Test your knowledge

Answer each of the following questions based on the case we read before, with Mr. Fortin (Case 1 in the paper cases section of this binder).

Q1. Explain how you would build situational assessment for this case.

Q2. Once you had established initial situational assessment, how would you maintain it as the situation evolved? In your answer, be specific about the type of information that you would be looking for and how often you would go about getting it.

Q3. The last component of situational awareness is thinking ahead to complete the understanding of the situation and help you make decisions. Identify where in the case Dr. Virk failed to think ahead and consequently made decisions that were not in the patient's best interest. If he had been thinking ahead, what other decisions do you think would reasonably have been made?

Discussion questions

The above questions can be applied to any case. Consider asking the same questions for the Elaine Bromiley case, used in the presentation slide set, or any of the paper cases provided in the course binder.

Answers to knowledge testing questions

Q1. Building situational awareness requires continuously getting information on the various situational elements and understanding them. The process is cyclical wherein one needs the most up to date knowledge to implement and revise decisions and actions. In this case you might start with carefully reviewing the information provided by the nurse, identifying any gaps in this information, and then questioning the patient, noting differences between previous and current complaints, relating this to the information provided by the nurse and evaluating the potential implications of all information provided.

Q2. Maintaining situational awareness includes also being aware of one's own knowledge of the situation, detecting possible obstacles to building and maintaining situational awareness, holes in that knowledge, and loss of situational awareness, and then recovering. The cyclical nature of situation assessments requires one to detect and recover information to be used in the building and maintenance of situational awareness. In this case you might watch out for, or detect, your own potential bias regarding a regular patient whose symptoms have been of little concern in the past, and the urge to rush through the assessment because of external factors (i.e. the need to pick your child up at daycare). Being aware of these potentially influencing factors might help you maintain or recover focus on the task at hand.

Q3. Dr. Virk failed to think ahead to anticipate possible progression of Mr. Fortin's symptoms, what they could mean and what might happen in the near or mid-term future should the worst-case scenario be, in fact, correct. If Dr. Virk had anticipated the potential serious diagnosis he should have sent the patient to Emergency immediately.

The Elements of Situational Awareness

Recall there are three main elements of the process of situational awareness:

- Getting information
- Understanding information
- Thinking ahead

Getting the information

A review of key concepts

To ensure you get the information you need, you should:

- **Scan and search**, i.e. be proactive in getting information
- **Pay attention** to what is going on around you
- **Remain watchful** and expect the unexpected
- **Communicate** the information and your understanding with your team and peers

Tip

Remember that some information is static, i.e. it will not change over time, and other information is dynamic. The dynamic information is such that you need to continually check-in on the information source to catch new information as it becomes available. This is where the "scan and search" strategy comes in handy.

Test your knowledge

Q1. Think of two examples of passive information acquisition that you perform in clinical work. Write them down below:

1. _____

2. _____

Q2. Think of two examples of active information gathering, where you had to make a special effort to get important information regarding your patient or task. Write them down below:

1. _____

2. _____

Example PETT Analysis for Getting the Information

Think back to Case 1, with Dr. Virk and Mr. Fortin, and recall the PETT tables we generated earlier. We are now going to extend the tables and identify all of the sources, delivery methods and the nature of the information provided to Dr. Virk in the scenario.

Situation Elements		Nature	Delivery	Sources
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **Final:** cardiac arrest, aortic dissection and death	**Static:** Background info. **Dynamic:** patient status over the course of the scenario	**Passive:** nurse report. **Active:** patient complaints	The nurse The patient
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road.	Static	Active/Passive	**Self:** Familiarity with the clinic
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin. **Associated task:** Orders tests. **Secondary:** picking up child from daycare, various interruptions/distractions.		Passive and active	The nurse, the patient
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time to cardiac arrest:** 2 hours	Dynamic	Passive	The patient, the nurse.

Now you try

Now take a look at Case 2 in the paper cases section of this learning package. Use the table below to guide your own assessment of the situation elements and the information sources, delivery mechanisms and nature as we have done above.

		Get the information		
Situation Elements		Nature	Delivery	Sources
Patient				
Environment				
Task				
Time				

Answers to the knowledge testing questions

Q1. [Answers will vary. Your two examples should illustrate information that is "pushed" to you without you having to go looking for or ask for it]

Q2. [Answers will vary. Your two examples should illustrate times when you are proactive and ask for information from others or consciously search for information from a source]

Answers to case analysis for getting information.

		Get the information		
	Situation Elements	Nature	Delivery	Sources
Patient	*Background: Trauma patient arrives with an isolated abdominal injury from a motor vehicle collision.* *Initial: Patient is stabilized. Upon opening the belly the team starts addressing a large liver laceration* *Mid-way: Vital signs deteriorate, transfusion does not seem to help and BP continues to drop* *Final: Liver laceration is repaired. Spleen laceration is discovered. Patient arrests.*	*Static (background)* *Dynamic: Patient status over the course of the scenario*	*Passive: handoff* *Active: surgeon presumably goes looking for damage and settles on the first obvious laceration* *Passive: Anesthesiologist volunteers information more than once* *Passive: Spleen laceration is revealed once the liver has been repaired*	*Possibly a handoff from ED staff or First Responders.* *Observation (surgeon)* *Anesthesiologist* *Surgeon (observation)*
Environment	*Background: 3AM and the surgeon is tired after a full day in the OR. She is anxious to rest up before the next day – so are the surgical residents* *CT scanner is down* *Mid-way: Dr. Kessel is irritated that her preferred retractor is not available. Nurse leaves the OR to find the retractor. Another trauma code is called and the senior resident scrubs out to attend it. Dr. Kessel is irritated at the anesthetic is repeating the BP warning and asserts she is working as fast as she can and the liver laceration no longer appears to be oozing* *Final: The anesthesiologist calls other staff for help with additional transfusions.*	*Static busy state of the OR, dynamic human environment as members of the attending team (nurse, residents) leave and others come in to help (anesthesiologist)*	*Passive/Active*	*Familiarity with the physical and organizational environment*
Task	*Primary task: identify and repair abdominal injury(ies)* *Associated task: ensure abdominal packing is secured, monitor patient's vital signs* *Secondary tasks: look for retractor, attend other codes,*	*Static* *Dynamic* *Dynamic*	*Passive/Active* *Active/Passive* *Active*	*Observation, problem solving* *Observation, anesthesiologist* *Searching, nurse, resident*
Time	*Start: 3AM* *Present: Surgeon is repairing the liver laceration as fast as she can. Sometime into the operation the anesthesiologist informs the surgeon that the BP is dropping and more blood is being transfused. The transfusion does not seem to be working. Two minutes later the anesthesiologist calls for help to transfuse even more blood.* *Elapsed: Unknown*	*Dynamic*	*Passive*	*Anesthesiologist*

Understanding the information

A review of key concepts

We know the next step after getting the information is developing an understanding of it: What does this mean for the patient, for me, or my team? Recall from the Primer that there are a couple of tricks to sorting through this information and turning it into understanding:

- **Compare** the information you gather to what you know and what you expect
- **Critique** the information; check information accuracy, completeness, source and relevance. As you get new information, cross-reference it with what you already know and assess conflicts and contradictions.
- **Diagnose** by asking what this information means and why it may (or not) have happened.

For example, in the case of Mr. Fortin with Dr .Virk, we can see that though Dr. Virk received the information from the nurse that Mr. Fortin's blood pressure was high and different on each arm, Dr. Virk presupposed the outcome (nothing serious is wrong) based on historical visits. There was no apparent diagnosis of the information itself to determine – on the spot – what these symptoms mean and what could be causing them. Instead, Dr. Virk puts off the diagnosis by prescribing additional testing at a later date.

Example PETT Analysis for Understanding the Information

Here is a PETT analysis for Dr. Virk's understanding of the information in this scenario.

		Understanding the information		
Situation Elements		Compare	Critique	Diagnose
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **End:** cardiac arrest, aortic dissection and death	Based on a comparison of current and past vital signs, the nurse flags an elevated BP and different pressures on each arm. Based on past visits, Dr. Virk concludes the case is not urgent	Seems that no critical thinking was done by Dr. Virk to assess the possible cause of the elevated BP, non-symetrical BP and associated arm/ leg pain.	It is clear after-the-fact what the cause of the symptoms were.
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation.The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road	The medical tasks appear to be routine. Dr. Virk ignores the red flags provided by the nurse. The secondary task of picking up his child from daycare, may not be routine.	No critical thinking about the implication of the environmental elements on the internal state of the physician.	

Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions/distractions	The medical tasks appear to be routine. Dr. Virk ignores the red flags provided by the nurse. The secondary task of picking up his child from daycare, may not be routine.		
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours			Seems like Dr. Virk considered the possibility that something was wrong, but failed to link the symptoms with immediate danger.

Now you try

Work through the same exercise using information presented in Case 2 and the blank table below

		Understand the information		
Situation Elements		Compare	Critique	Diagnose
Patient				
Environment				
Task				
Time				

Answer to case analysis for understanding the information

	Situation Elements	Understand the information: Compare	Understand the information: Critique	Understand the information: Diagnose
Patient	*Background: Trauma patient arrives with an isolated abdominal injury from a motor vehicle collision* *Initial: Patient is stabilized. Upon opening the belly the team starts addressing a large liver laceration* *Mid-way: Vital signs deteriorate, transfusion does not seem to help and BP continues to drop* *End: Liver laceration is repaired. Spleen laceration is discovered. Patient arrests.*	*No images to compare against* *Comparing current vital signs against expected vital signs for a patient of that age and gender* *Once the liver laceration is repaired the abdominal cavity is compared against the expected state*	*No critiquing of the single laceration diagnosis* *No critique by the surgeon or anesthesiologist as to why the transfusion is not proving sufficient*	*No complete evaluation for diagnosis* *No problem-solving around the apparent continued low blood pressure*
Environment	*Background: 3AM and the surgeon is tired after a full day in the OR. She is anxious to rest up before the next day – so are the surgical residents* *CT scanner is down* *Mid-way: Dr. Kessel is irritated that her preferred retractor is not available. Nurse leaves the OR to find the retractor. Another trauma code is called and the senior resident scrubs out to attend it. Dr. Kessel is irritated that the anesthesiologist is repeating the BP warning and asserts she is working as fast as she can and the liver laceration no longer appears to be oozing* *End: The anesthesiologist calls other staff for help with additional transfusions.*	*Dr. Kessel and residents seem to be abnormally fatigued*	*No critical thinking as to the implications of the environmental elements on the surgeon or residents in this fatigued state* *e.g. no critique of her own irritation at the anesthesiologist sharing information about the patient*	*It is clear after the liver laceration has been repaired, that this was not the only laceration requiring attention and that the spleen was likely the cause of excess blood loss*
Task	*Primary task: identify and repair abdominal injury(ies)* *Associated task: ensure abdominal packing is secured, monitor patient's vital signs* *Secondary tasks: look for retractor, attend other codes,*	*The task appears to be routine*	*Dr. Kessel fails to do a complete examination of the abdomen* *No critical thinking about why the BP continues to drop and why so much blood is required given that the liver laceration is almost repaired.*	
Time	*Start: 3AM* *Present: Surgeon is repairing the liver laceration as fast as she can. Sometime into the operation the anesthesiologist informs the surgeon that the BP is dropping and more blood is being transfused. The transfusion does not seem to be working. Two minutes later the anesthesiologist calls for help to transfuse even more blood.* *Elapsed: Unknown*			*Seems like Dr. Kessel failed to link the information being presented by the anesthesiologist to the possibility of another source of blood loss.* *It is possible also that Dr. Kessel assumed the dropping blood pressure should be the responsibility of the anesthesiologists*

Thinking Ahead

A review of key points

Let's assume you have collected all of the information, evaluated it and understand the situation – now what do you do? Think ahead: where could this lead? What are the possible outcomes of the action you have decided to take? Recall from the Primer that thinking ahead is taking all of the information gathered and understood and using it to extrapolate the status of the situation in the near and extended future.

Example PETT analysis for thinking ahead

The following is a PETT analysis example for Case 1 for thinking ahead:

		Think Ahead	
Situation Elements		Extrapolation	"What if?"
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **Final:** cardiac arrest, aortic dissection and death	There could possibly have been an extrapolation by the nurse calling Dr. Virk in to see this patient.	The nurse may have been thinking about a potential diagnosis or what could happen – which is why she flagged Mr. Fortin's vitals.
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes **Mid-way:** Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road	Not clear if extrapolation was done with respect to repeated interruptions and their impact on Dr. Virk's attention to Mr. Fortin's case.	
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions/distractions	No extrapolation on the impact of the interruptions on Dr. Virk's primary task of diagnosing the patient.	Perhaps some "what if" analysis was done with respect to Dr. Virk being late to pick up his child, but this is a distraction from Mr. Fortin's case.
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours	No extrapolation by Dr. Virk of the possible progression of the symptoms over time.	No "what if" was done with respect to the possible need for a more immediate diagnosis.

Now you try

Now you try using Case 2 and the blank PETT table below.

		Think Ahead	
Situation Elements		Extrapolation	"What if?"
Patient			
Environment			
Task			
Time			

Discussion questions

Consider the following discussion questions:

- How do you establish or maintain situational awareness when you are in a very time sensitive situation? What do you do if you feel you have no time to question the information that is given to you or verify your own understanding of the situation?
- How could you use your colleagues to help you do this?

	Situation Elements	Think Ahead: Extrapolation	Think Ahead: "What if?"
Patient	*Background: Trauma patient arrives with an isolated abdominal injury from a motor vehicle collision* *Initial: Patient is stabilized. Upon opening the belly the team starts addressing a large liver laceration* *Mid-way: Vital signs deteriorate, transfusion does not seem to help and BP continues to drop* *Final: Liver laceration is repaired. Spleen laceration is discovered. Patient arrests.*	*There could possibly have been extrapolation by the anesthesiologist that the blood loss was caused by another source, but it was not verbalized, so we can never know* *No extrapolation by Dr. Kessel that the liver might not be the only laceration*	*No "what if" the liver laceration is not the only injury?*
Environment	*Background: 3AM and the surgeon is tired after a full day in the OR. She is anxious to rest up before the next day – so are the surgical residents* *CT scanner is down* *Mid-way: Dr. Kessel is irritated that her preferred retractor is not available. Nurse leaves the OR to find the retractor. Another trauma code is called and the senior resident scrubs out to attend it. Dr. Kessel is irritated that the anesthesiologist is repeating the BP warning and asserts she is working as fast as she can and the liver laceration no longer appears to be oozing* *Final: The anesthesiologist calls other staff for help with additional transfusions.*	*No extrapolation at the impact of fatigue on the mood or problem-solving abilities of Dr.Kessel* *Perhaps some extrapolation that Dr. Kessel's performance may be hindered by the absence of her preferred retractor*	*No "what if" analysis done regarding the potential deterioration of the team after the nurse and senior resident leave*
Task	*Primary task: identify and repair abdominal injury(ies)* *Associated task: ensure abdominal packing is secured, monitor patient's vital signs* *Secondary tasks: look for retractor, attend other codes,*	*No extrapolation that the missing retractor could be a distraction*	*No "what if "analysis that the transfusions might not be enough to stabilize the patient*
Time	*Start: 3AM* *Present: Surgeon is repairing the liver laceration as fast as she can. Sometime into the operation the anesthesiologist informs the surgeon that the BP is dropping and more blood is being transfused. The transfusion does not seem to be working. Two minutes later the anesthesiologist calls for help to transfuse even more blood.* *Elapsed: Unknown*	*No extrapolation regarding the rate of blood loss and what implications this could have*	

Maintaining Situational Awareness Over Time

A review of key concepts

As we have seen in a number of the cases reviewed thus far, clinical situations are dynamic and unexpected events, environmental or task factors can be introduced in a way that might turn a routine case into something quite unexpected. Thus once you have built a comprehensive picture of the situation, you need to keep this in mind and work to maintain it. This means continued information gathering and understanding to ensure you do not lose the situational awareness you have consciously built.

Test your knowledge

Use the space provided to answer the questions below. Each of these questions is based on the information presented in the Situational Awareness Primer and your own understanding of that information.

Q1. The key activities for maintaining situational awareness can be described as "discover and recover". In practice, what could you do to achieve this? Describe the actions you would take.

Q2. Provide an example from your own practice (if possible) of a time when you felt you had lost situational awareness. How did you discover that you had lost situational awareness? What did you do to recover in this case? Knowing what you do now, from the Situational Awareness Primer, would you change anything, e.g. take different or additional actions, to recover in that same situation?

Q3. Based on your understanding of the factors that can influence situational awareness, identify one type of influencing factor and describe how it could contribute to a loss of situational awareness and what you could do to prevent this loss.

Answers to the knowledge testing questions

Q1. Recall that your objective is to discover potential situational awareness loss, and recover it by getting more information, understanding it, and thinking ahead. You can use all the tools we spoke about in earlier sections (getting information, understanding it and thinking ahead). One thing you can do is be proactive in obtaining information, periodically ask yourself "Do I have all the information I need now? Is this information recent? Could it have changed without me noticing? Communication with other team members can also help to identify new information, share understanding, detect loss of situational awareness by any member of the team and recover. Apart from sharing your own understanding of the situation, you can ask others if they have any other information, what their understanding of this information is and how it could impact the patient or the task.

Q2. [Answers will vary but should include one or more of the following: probing for information from others, scanning the environment, asking clarifying questions to others, communicating the feeling that you may not have the right understanding of what is going on, etc.]

Q3. [Answers will vary. For example: stress, fatigue and workload are all factors that could contribute to a loss of situational awareness if you do not first, recognize that you are stressed, tired or multitasking beyond your abilities and second, take actions to mitigate the potential consequences of these factors by perhaps notifying your team of how you feel or taking the time to evaluate the tasks on your plate and prioritize them so that you can attach one at a time, or ask for help.]

Possible Obstacles to Adequate Situational Awareness

Review of key concepts

Human information processing has limited cognitive resources and a tremendous quantity of information to parse through. Heuristics are the collection of experienced based techniques that we use to help us make decisions, such as rules of thumb, intuition or common sense. Heuristics can help, but also hinder good judgment by biasing the physician. For example, hearing one patient's description of their symptoms might lead you to jump to a conclusion based on recent experience with a patient exhibiting the same symptoms – without verifying the symptoms against other patient characteristics, this could lead to a dangerous assumption.

Recall from the Primer that there are two main types of biases: cognitive and attentional.

Cognitive biases influence thinking, problem solving and decision making. Here are some examples:

- Anchoring occurs when there is a fixation on the initial assessment, making it unlikely that the initial assessment will be reassessed and updated with new information
- Confirmation bias is the tendency to look for evidence that confirms or matches the current situation or decision

Attentional biases influence perception and attention, in other words, how you perceive information and what you pay attention to in the environment. Here are some examples:

- Tunneling is when your attention narrows to the exclusion of other potentially critical information
- Other 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

Example case analysis for biases

Using your understanding of cognitive and attentional biases, take a look at those that were identified in our case with Dr. Virk. Instead of breaking the case into situational elements, as we have done in previous exercises, we are going to go back to the initial text and look at events step by step.

Case 1 Family Medicine Clinic	Biases
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr Virk thinks it is likely benign in nature, as with previous visits.	*Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be* **anchoring** *on the "nothing is seriously wrong" conclusions of previous visits by this patient.*
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	*Carry over from above*

Case 1 Family Medicine Clinic	Biases
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	*Carry over from above*
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.	*Carry over from above. Influencing factors lead to* **tunneling** *which becomes an obstacle for the adequate comprehension and thinking ahead activities.* *These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.*
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.	

Now you try

Now, using the blank table below, do the same analysis of biases for Case 2. We have already put the case description into the table for you.

Case 2 Trauma MVC	Biases
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.	
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.	
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.	
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.	
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.	
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.	
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.	
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.	

Case 2 Trauma MVC	Biases
Dr. Kessel acknowledges this and proceeds to repair the laceration.	
Dr. Kessel criticises the junior resident for not keeping the operating field clear.	
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.	
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.	
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.	
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.	

Answer to the analysis of biases in Case 2

Case 2 Trauma MVC	Biases
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.	
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.	The anxiety could lead to **anchoring**.
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.	
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.	There does not seem to be any bias at this point.
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.	
Sometime into the case, another trauma code is called and the senior resident scrubs **out** to attend to it.	
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.	
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.	
Dr. Kessel acknowledges this and proceeds to repair the laceration.	**Anchoring:** Despite this information, no other lacerations are expected/anticipated
Dr. Kessel criticises the junior resident for not keeping the operating field clear.	
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.	
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.	**Anchoring:** Dr. Kessel appears to be fixated on the liver laceration as the only possible cause for BP dropping No one is challenging Kessel's perception of the situation. Therefore they are either all fixated on the liver laceration OR there may be an authority gradient preventing them from speaking out.
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.	They are either all suffering from an **anchoring** bias, or no-one is willing to speak up and challenge the surgeon's view of the situation.
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.	**Tunnelling**: before the liver laceration had been repaired, Dr. Kessel seemed to be unable to look for/at anything else

Putting it all Together

Throughout this instructional supplement we have been looking repeatedly at the case of Dr. Virk and Mr. Fortin where a serious vascular problem went unnoticed. You learned how to identify key elements of the situation and conduct a PETT analysis (Patient, Environment, Task, Time) as well as how to identify potentially influencing factors based on human capabilities and limitations. We also discussed and practiced the three cyclical stages of situation assessment, and practiced identifying cognitive and attentional biases that can hinder the building and maintaining of situational awareness. Now, let's put it all together for a complete case analysis. Take a look at the table below showing a complete analysis for Case 1. You will notice that the analysis for the stages of situation assessment: getting the information, understanding it and thinking ahead, has been compressed from what we practiced earlier. Here we only present the conclusions from that detailed analysis.

Example full-case analysis

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	**Workload** Possible internal **distraction** stemming from the need to leave immediately Possible **stress**		Dr. Virk appears to be aware of the time		
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. *Dr. Virk thinks it is likely benign in nature, as with previous visits.*	**Workload, distraction** and possible **stress** carried over from above. Additional **workload** imposed by the complexity of the case (i.e. an elderly patient with diabetes and abdominal pain could have a long list of diagnoses)	Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be **anchoring** on the "nothing is seriously wrong" conclusions of previous visits by this patient.	Patient brings a complaint; patient's history is reviewed.	At this time it is not clear what the comprehension is, but it is implied that Dr.Virk might compare the present symptoms to those reported in previous visits, all of which resulted in nothing, or no more than, minor complications related to diabetes	It is not clear if any thinking ahead was done

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	Interruption Increased **workload** Increased likelihood for cognitive biases	Carry over from above	A lot of other information, unrelated to this particular patient is introduced and the physician's focus is taken away from the task at hand.	Dr. Virk understands that each of these calls require his immediate attention. The potential of a serious health problem with Mr.Fortin is not understood.	There is no thinking about Mr.Fortin at this time.
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	**Carry over from above** Possible **authority gradient** (i.e. organizational or vocational cultural factor that hinders communication between staff members in different positions)	Carry over from above	Additional information is gathered about the patient's condition Dr. Virk does not perceive the "red flags" that are being presented by both the nurse and the patient	This new information is compared to the complaints presented on previous visits. The nurse recognizes that there are some concerning abnormalities in the vital signs	The nurse flags elevated vitals because she predicts the doctor needs this information. It is also likely that she predicts an ominous diagnosis, but does not share this directly.

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week	**Anxiety suggests stress** **Distraction caused by workload**	Carry over from above. Influencing factors lead to **tunneling** which becomes an obstacle for the adequate comprehension and thinking ahead activities. These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.	Dr. Virk makes a connection between the symptoms presented and possible cardiac problem He does not see any immediate danger and prescribes the patient medication and testing rather than a more immediate referral to the ED	He does not think ahead to the potential severity of the situation and a decision is made based on a biased comprehension of the situation	There is no thinking about Mr. Fortin at this time
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening			The diagnosis could have been discovered earlier with improved communication, between the nurse and the doctor; attention to and comprehension of the red flags; and insight into the nature of interruptions, their timing and impact on one's likelihood to make cognitive errors.		

Now you try

Now you have a chance to put all of the skills you have learned together to analyze a completely new case.
Complete the following table for Case 2.

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.					
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.					
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.					
A trauma patient arrives to the OR *for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the* OR. *The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.*					

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.					
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.					
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.					
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.					
Dr. Kessel acknowledges this and proceeds to repair the laceration.					
Dr. Kessel criticises the junior resident for not keeping the operating field clear.					

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.					
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.					
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.					
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.					

Answers to the full case analysis

Answers to the complete Case 2 analysis can be found in the Case Studies section of your learning package

Practical Takeaways

Congratulations! You have completed the instructional supplement. Look to the Situational Awareness Primer for a situational awareness checklist that you can use as reminders of the key lessons reviewed here.

Discussion questions

Review the situational awareness checklist presented at the end of the Situational Awareness Primer. Use this list of practical takeaways to start a discussion as to the relative utility of each one. How would physicians use this list in practice? Which item do you think is the most useful? What are you most likely to remember from this course? What do you think is the most practical piece of knowledge, skill or experience gained through this course?

Chapter 7

Situational Awareness: An Introductory Self-Instructional Module

Contents

About This Instructional Supplement

The objectives of this Instructional Supplement are to:

1. Support the material provided in the Situational Awareness Primer and in-class lessons by:
   a. Reviewing key concepts
   b. Providing practical examples illustrating key concepts
2. Provide independent learning exercises to test your understanding of key concepts
3. Provide detailed answers to the independent learning exercises so you can check your understanding and identify and rectify gaps in learning

In order to meet these objectives, the sections within this Instructional Supplement are ordered according to the presentation of information in the Situational Awareness Primer that appears earlier in this learning package.

Each section follows an instructional pattern: a **review of key concepts**, followed by an **example** illustrating how to conduct situational awareness assessment and maintenance activities; and **"test your knowledge"** questions and/or skill testing exercises titled: **now you try**. In addition, as you work through this Instructional Supplement, you will notice a number of **Tips** and **Notes** that provide users of this Instructional Supplement with additional support and ideas for how to establish and maintain situational awareness in your practice.

Throughout this instructional supplement you will be asked to use elements of Case 1 from the case studies section of this learning package to have a hands-on practice and assess your understanding of concepts. Thus, as you develop your understanding of situational awareness theory and process, you will be able to apply your understanding to a specific case.

At the end of this Instructional Supplement you will have the opportunity to perform a comprehensive analysis of a new case integrating all of the knowledge and skills developed throughout this.

What Do You Know About Situational Awareness?

Review of key concepts

The purpose of this initial section is to get you thinking intuitively about situational awareness. The situational awareness primer associated with this independent learning opens with the following statement:

> *Many adverse medical events are associated with so-called "human factors" in Healthcare settings. Situational awareness is a key component of human factors and refers to a person's perception and understanding of the dynamic information that is present in their environment. Essentially it is the process of integrating relevant information from the environment into a concise picture based on which all decision making and action take place.*

Example

Let's review the following short case excerpt to get us thinking about things that happen in clinical circumstances:

> *During an emergency C-section, the anesthesiology team has difficulty intubating 29-year-old Laura Small. Amidst acrimonious debate between the surgeon anxious to begin the procedure and the anesthesiologist struggling to get Ms. Small's airway secured, the baby is delivered. The mother's uterus is noted as blue, and her vital signs rapidly deteriorate... After a 12-hour shift and no lunch, Martina Pellos, an obstetrics nurse who is assisting in the emergency, is directed to rapidly administer vitamin K to the baby. Nurse Pellos reaches for an ampule of vitamin K from the set of bins at the side of the room holding several medications commonly used in the delivery suite. After injecting the medication, she notices that she has inadvertently given the baby methylergonovine (Methorgine - a potent vasoconstrictor).*

What are some of the factors in this case description that could influence the eventual decision-making and performance?

1. There is acrimonious debate between the surgeon and the anesthesiologist. Could this have impacted their focus on the patient, their awareness of what was going on around them, or their ability to make clear-headed decisions regarding the course of action? How does the human or organizational environment impact performance?
2. Nurse Pellos is at the end of her shift and has not eaten. It is very likely she is suffering from physical fatigue. How could this affect her performance?
3. Also, the placement or labeling of bins holding medications could have been such that they "encouraged" or made it easy for a mistake like this to happen. What was the physical design like for this piece of equipment? Were all the bins open, making it easy to reach for one and grab another? Are the vials similar in size and or colour?

So far, we have identified three factors that could have influenced performance: acrimonious debate; fatigue; and equipment design.

Now you try

Think back to a case from your own experience, or something you heard or read about, where a seemingly routine case went wrong. Use the space provided below to write out a description of what happened. Then, ask yourself if there was a lack of situational awareness by any member of the medical team at any point in this case? Did this contribute or could it have contributed to an adverse outcome? If so, how? At this point you may not be sure if situational awareness was really a key factor, but there may be other things that contributed to the less-than-ideal outcome, for example: fatigue, lack of communication, availability of tools, equipment or expertise, etc. Based on your intuitive understanding of the case, identify factors that you believe could have contributed to the outcome.

Your case description: _____

With your intuitive understanding, identify any loss of situational-awareness and how it could have affected decision-making or contributed to the adverse outcome: _____

Can you identify any other factors that may have contributed to the loss of situational awareness or adverse outcome?

Answers to "Now you try" questions

A wide variety of case examples are acceptable; there is no correct or incorrect answer. It is most important that you try to identify factors that could impact decision-making and performance. Here we are trying to get you to express your own intuitive definition of situational awareness. The objective is for you to start thinking critically about elements of the internal or external environment that may ultimately impact decision-making and performance.

Understanding the Human Factors Framework

Review of key concepts

Recall from the Situational Awareness Primer that "Human Factors" (HF):

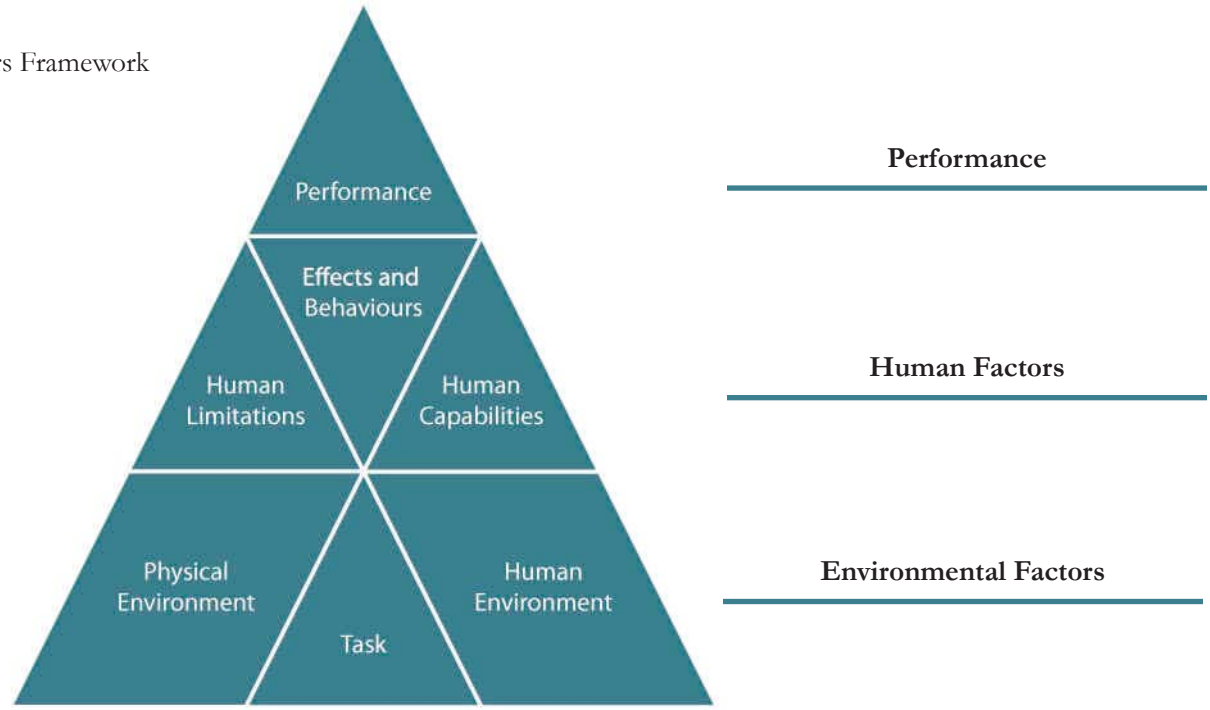
- Is a discipline addressing human behaviour, abilities, limitations, and relationship to the work environment (physical, organizational, cultural);
- Applies to the design and evaluation of safer and more effective tools, machines, systems, tasks, jobs, and environments; and
- Is recognized by The Royal College of Physicians and Surgeons of Canada, and the Canadian Patient Safety Institute as a Core Safety Competency (2008).

The **Human Factors Framework** depicts the interactions between human, environmental and task characteristics that illustrate how these types of factors can influence human behaviour and performance. This framework should help you understand what's in a situation and what factors can play a role in influencing situational awareness.

Do you remember each of the components of the HF Framework and how they contribute to human performance?

As a reminder, see the Human Factors Framework in Figure 1.

Figure 1
Human Factors Framework



Test your knowledge

Use your understanding of the human factors framework to answer the questions below. If you get stuck, go back to the Situational Awareness Primer. Answers to these questions are provided at the end of this section.

Q1. Why are the environmental factors presented on the bottom of the pyramid?

_____

_____

Q2. Fill in the blanks in the following statement:
The components of the HF framework "act together in an _____ fashion to produce effects and behaviours such as distractions, _____, _____, _____, stress, etc".

Q3. Where is situational awareness placed within the human factors framework, and why?

_____

_____

_____

_____

Example case analysis (part 1)

Now, read the case description below. Note this is Case 1 in the Paper Cases section of this course package.

It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous incidents.

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.

Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

Now, let's work through the case step by step and identify potential influencing factors from the human factors framework.

Case excerpt	Analysis
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	• The fact that Dr. Virk is "running late" suggests elevated workload. This is a characteristic of the work environment, or organizational environment and falls into the Human Environment component of the HF framework. • The fact that he feels he "has to leave immediately to pick his child up" is a possible internal distraction – because he may be preoccupied with something other than the task at hand. This feeling may also lead to stress. Both distractions and stress are factors related to human limitations

Now you try (case analysis part 1)

Now you try analyzing the next section of the case, extracted below. Remember that factors identified previously could carry-over and continue to influence performance or decision-making as the situation evolves.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous incidents.

Tip

Underline the information in the case that you think is important or might suggest a potential influencing factor in the mix.

[Use this space to enter your answer]

Example case analysis (part 2)

As the case evolves, we can see other potentially influencing factors in the situation:

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.

- As is obvious from the language used in the case description, the calls are **interruptions** which can affect Dr. Virk's focus on the task because it is hard to keep so many different things in your mind at the same time – this is a characteristic of the environment that interacts with human limitations: these interruptions increase **workload**

Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".

- Again, all factors carry over from above and could continue to influence Dr. Virk's decision-making
- The fact that Dr. Virk ignores the nurse's flag of vital signs could suggest a possible **authority gradient**: an organizational or vocational cultural factor that hinders communication between staff members in different positions – this is considered part of the human environment

Now you try (case analysis part 2)

Now you try identifying factors in the last part of the case description

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

[Use this space to enter your answer]

Answers to knowledge-testing question

Q1. The physical and human environments in which a task is being performed are the basic elements of a situation, this is why they are at the bottom of the pyramid. Human capabilities and limitations are applied within this "situation" in an effort to achieve the task. Thus the human capabilities and limitations are applied on top of the physical and human environment that is already in place.

Q2. The components of the HF framework act together in an interdependent fashion to produce effects and behaviours such as distractions, interruptions, fatigue, workload, stress, etc.

Q3. Situational Awareness fits within the Effects and Behaviours block of the framework because it is often a product of the physical and human environment you work in, and your own capabilities and limitations when working in that environment.

Answers to the case analysis

Part 1:

- Workload, distraction and possible stress carried over from section above – in other words, these factors can continue to impact situational assessment and awareness unless they are adequately addressed or otherwise eliminated. For example, if Dr. Virk's wife called and said she could pick up the child from daycare, then all of a sudden the cognitive workload, distraction and any possible rushing or stress associated with that task would disappear.
- Additional workload imposed by the complexity of the case (i.e. an elderly patient with diabetes and abdominal pain could have a long list of diagnoses)

Part 2:

- Anxiety suggests stress
- The secondary task of getting to the daycare is a distraction and results in added mental workload

What is a "Situation"?

Review of key concepts

Recall from the Situational Awareness Primer, that a situation is "a set of environmental conditions and system states with which the participant is interacting that can be characterized uniquely by a set of information, knowledge and response options" (Pew, 2000).

When you participate in a situation, the fundamental elements of the situation will become your building blocks for situation assessment and awareness.

The fundamental elements of a clinical situation include:

- the **Patient**
- the physical and human **Environment**,
- the **Task** itself and
- how all of these change over **Time**

Note that all these situational elements are at the base of the human factors framework. Though "time" does not have an explicit placeholder in the framework, it is implicit in the task, and it can impact the other elements.

Test your knowledge

How much do you remember from the Situational Awareness Primer? Test your knowledge by answering the following questions:

Q1. Fill in the blanks:

The _____ is likely the most important element of the situation in medical practice.

Q2. Using your own personal practice experience, provide an example of static patient information and one example of dynamic patient information that change over time. Explain why this distinction is important.

Static: _____

Dynamic: _____

Explanation: _____
_____
_____

Q3. Describe the two kinds of environment that need to be considered, including examples of what you might find/ consider part of each.

1._____
_____
2._____
_____

Now, keeping these points in mind, let's take a look at how we can use the PETT elements to systematically understand a clinical situation.

Example case analysis

First, read the case description below:

> *During an emergency C-section, the anesthesiology team has difficulty intubating 29-year-old Laura Small. Amidst acrimonious debate between the surgeon, anxious to begin the procedure, and the anesthesiologist, struggling to get Ms. Small's airway secured, the baby is delivered. The mother's uterus is noted as blue, and her vital signs rapidly deteriorate. A Code Blue is called and CPR begun. Still waiting for the airway backup team, an obstetrician attempts a tracheostomy. After defibrillation and medication restore a normal sinus rhythm, it is estimated that Ms. Small was anoxic for at least 10 minutes.*

Now let's look for all of the **Patient** information in this case.

Situation elements in this example	
Patient	**Static information:** patient age and name (29-year-old Laura Small) **Dynamic information:** Initial - Pregnant and giving birth, appears to have a compromised airway and requires intubation. Mid-way - Baby is delivered and uterus is noted blue, vital signs rapidly deteriorate Final - Normal sinus rhythm is restored after she was anoxic for at least 10 minutes
Environment	**Physical environment:** little information is presented in this situation but the room is likely full of people **Human environment**: there is an anesthesiology team, there is acrimonious debate between the surgeon and anesthesiologist… that may suggest interpersonal or organizational aspects that should be considered, an airway team is called… but does not arrive immediately, and there is an obstetrician.
Task	**Primary task:** Emergency C-section **Associated tasks:** monitoring vital signs **Secondary tasks:** securing the airway, intubation, calling Code Blue, CPR, tracheostomy, defibrillation, medication administration
Time	**Start:** unknown **Elapsed time** between recognition of the need to intubate and restoration of sinus rhythm: unknown, greater than 10 minutes

Now you try doing a PETT analysis for case 1

Recall the case with Mr. Fortin that was presented earlier in this instructional supplement (OR, Turn to Case 1 in the Paper Cases section of your binder). Read the case again and then perform a PETT analysis on the situation using the blank PETT table below.

Spend 10 minutes on this activity.

Tip

As you read through the case, highlight or underline all of the information you think is important for this analysis, then put it in the table below.

Situation elements	
Patient	**Static information:** **Dynamic information:** Initial - Mid-way - Final -
Environment	**Physical environment:** **Human environment**:
Task	**Primary task:** **Associated tasks:** **Secondary tasks:**
Time	**Start:** **Present:** **Elapsed time**

Now you have established a certain level of understanding with respect to the situation presented in this case. Essentially, you have developed a certain level of "awareness" with respect to the situation that is presented.

Answers to knowledge testing questions

Q1. Patient

Q2. Examples of static patient information could include: name, age, allergies, or any confirmed aspect of medical history.
Examples of dynamic patient information could include: vital signs, patient status (stable, unstable, critical, etc.).
Explanation of why this is important: Each type of information implies a different way of ensuring you have the info. Static, does not require constant monitoring and attention, in contrast to dynamic info that requires one to scan and monitor and attend all the time. A lack of awareness of how dynamic information is changing over time could result in an important change going unnoticed. In the worst case, this change could be life threatening and if it goes unnoticed result in serious harm or death.

Q3. (1) The physical environment, including equipment, space and tools, and
(2) The human environment, including the medical team, and other people, that may enter or leave the situation as it progresses, as well as the social and cultural climate in the team or organization in which everyone is interacting.

Answer for Case 1 PETT analysis

Situation elements	
Patient	**Static information:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Dynamic information:** Initial – abdominal pain, elevated HR, different blood pressures on each arm Mid-way – feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling Final – aortic dissection, cardiac arrest and death
Environment	It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes Dr. Virk is interrupted by three calls during the consultation The nurse has flagged certain symptoms Dr. Virk is anxious to get on the road
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions/distractions
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours

Situational Awareness – A General Definition

Review of key concepts

Recall from your earlier reading that "situational awareness" is…

- Knowing what is going on around you
- Includes having team awareness,
- The ability to detect, integrate and interpret data gathered from the environment, and
- Your ability to remain aware of everything that is happening and to integrate this awareness into what you are doing at the moment

In other words, "situational awareness" is both a process of assessing a situation and the resulting knowledge or awareness of that situation.

Test your knowledge

Based on your reading and/or participation in the face-to-face course, answer the following knowledge testing questions. Use the space below to record your answers.

Spend 10 minutes on this activity.

When you are done, check your knowledge by looking at the answers located at the end of this section.

Q1. Define "good" Situational Awareness

Q2. What can happen if you are not "aware"?

Q3. Does Situational Awareness cause behaviour?

Q4. Does good Situational Awareness always lead to good performance?

Q5. Write down an example from your practice, something you witnessed or heard about where a lack of situational awareness affected the performance of a medical procedure or diagnosis.

Answers to knowledge testing questions

Q1. Good situational awareness would be when you are aware of what is going on in a certain medical situation, are able to perceive change, understand the impact of all elements of the situation, and integrate that information into your decision making.

.

Q2. Many things, including: critical information or a change in patient status can go unnoticed. This could lead to an incorrect diagnosis or delay to correct diagnosis. You may also succumb to one of the cognitive biases identified later in the Primer, for example you could be so focused on a task or aspect of the case (tunneling) that you become oblivious to the surrounding environment and may not hear a warning from one of your colleagues, or see how your own actions are affecting other elements of the situation. Furthermore, if you are not "aware", you will be less able to think ahead, plan future actions, or foresee the implications that the current situation could have on the future state of the patient condition.

Q3. Not necessarily. One's awareness of the situation can affect behaviour. Behaviour can also be impacted by other factors (such as knowledge, skill, fatigue, interruption, etc.) that can help or hinder situational awareness.

Q4. Good or poor performance could result from good or poor Situational Awareness. Situational Awareness can also be improved by better performance or degraded by poor performance that is influenced by other factors. See page 36 in the Situational Awareness Primer.

Q5. [Your answer should illustrate that you understand Situational Awareness; identify the loss of SA; and how it impacted decision-making or performance.]

Situational Awareness – Why is it so Important?

Review of key concepts

Why is situational awareness so important in medicine? One of the examples given in the Situational Awareness Primer highlights that errors of wrong site surgery, wrong drug, wrong dose or wrong patient, can often be related to a lack of situational awareness. Misperception of a patient's situation can lead to erroneous decision-making and potentially serious adverse events.

Practice-based research shows that situational awareness is:

- One of the most essential non-technical skills for the achievement of safe clinical practice
- Especially critical when changes in the patient's condition have to be responded to promptly

Situational awareness is also negatively impacted by a number of factors that are common in healthcare, including: interruption, distraction, fatigue, stress, etc. This makes medical professionals particularly prone to loss of situational awareness.

Test your knowledge

Q1. Write down an example from your own practice of a loss of situational awareness – even if it was only momentary and you recovered quickly from it.

_____

_____

Q2. What factors contributed to this loss of situational awareness?

_____

_____

Q3. Using the above example, or another hypothetical example, explain how a loss of situational awareness could affect your ability to appropriately diagnose or treat a patient?

_____

_____

Answer the knowledge testing questions

Q1. [Your answer should demonstrate an event where you either missed information, or misinterpreted information e.g. misdiagnosis of a patient, delay in treatment, wrong drug, wrong site procedure, you were conducting rounds and mistook one patient for another….etc.]

Q2. [Distraction? Interruption? Fatigue? Stress? Workload? Organization/cultural factors? Lack of communication? Team dynamics? Etc… One or more of these factors could contribute to loss of situational awareness]

Q3. Recall the answer to question 2 in the previous section: A loss of situational awareness could lead to an incorrect diagnosis or delay to correct diagnosis. You may also succumb to one of the cognitive biases identified later in the Primer, for example you could be so focused on a task or aspect of the case (tunneling) that you become oblivious to the surrounding environment and may not hear a warning from one of your colleagues, or see how your own actions are affecting other elements of the situation. Furthermore, if you are not "aware", you will be less able to think ahead, plan future actions, or foresee the implications that the current situation could have on the future state of the patient condition.

Situational Awareness – A Bit of Research and Theory

Review of key concepts

Situational awareness is considered central to safe and effective decision making in many domains. The theory of situational awareness is frequently used to explain how and why decision makers are able to assimilate information in complex tasks in a way that allows them to "know what is going on" and make critical decisions.

Recall that the three levels, or activities required to build and maintain situational awareness are perception, or getting the information; comprehension, or understanding the information; and projection, or thinking ahead.

Note

An annotated bibliography is included at the end of this learning package. Look to the reference cited there for additional information and more detail on the theory behind situational awareness in healthcare and other safety critical domains.

Test your knowledge

Q1. In what safety critical industry did situational awareness first originate? _____

Q2. What is the difference between situation assessment and situational awareness?

_____

_____

Q3. Define "team situational awareness". _____

_____

_____

Q4. Of the three levels of situation assessment, which one is most important for building and maintaining team situational awareness? Why? _____

_____

_____

Q5. Write down an example of good situational awareness from your own practice. When you do this, break it down into the three activities: perception, comprehension, and projection. How did this help you make the right decision?

Perception (getting the information) _____

_____

Comprehension (understanding it) _____

_____

Projection (thinking ahead) _____

_____

_____

Answers to knowledge testing questions

Q1. Aviation

Q2. Situation assessment is the process of attaining situational awareness.

Q3. Wellens (1993) defines team situational awareness as "the sharing of a common perspective between two or more individuals regarding current environmental events, their meaning, and projected future status" (p. 272). More recently, team situational awareness in healthcare has been defined as "task- and team-oriented knowledge held by everyone in the team and the collective understanding of the unfolding situation" (Parush, 2010).

Q4. Information sharing as opposed to cognitive processing is more central to building and maintaining team situational awareness. This is because information sharing allows for shared knowledge to be constructed and maintained among team members.
Note that the activity of "getting information" as part of establishing and maintaining situational awareness is discussed further in the next section of the Primer and this independent learning supplement .

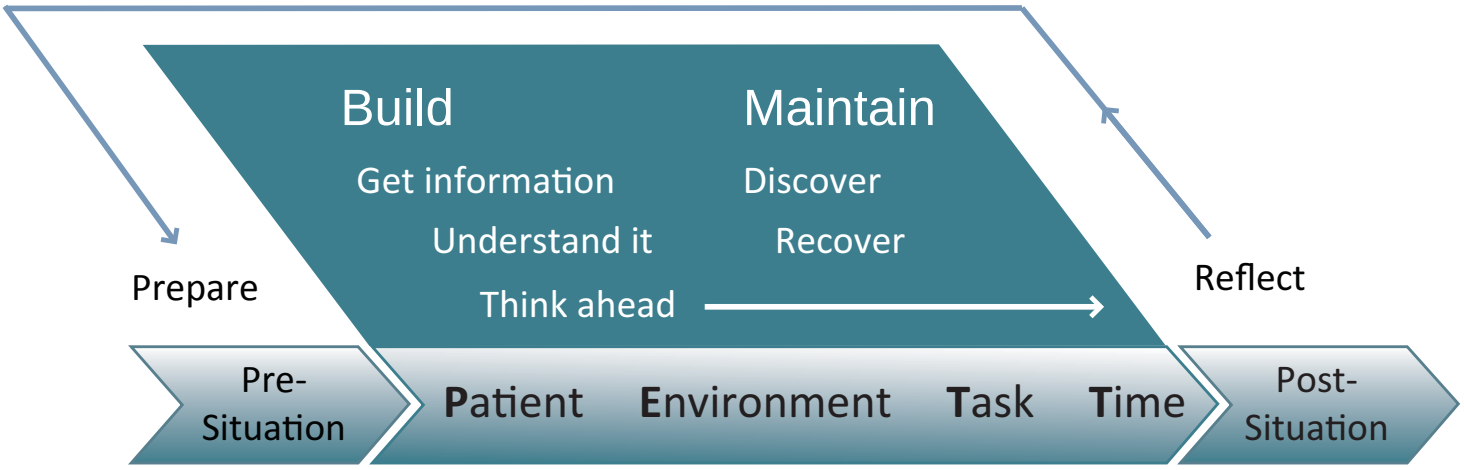
Q5. [Answers will vary]

The Process of Situational Assessment and Awareness

Review of key concepts

Recall from the Primer, that situational assessment and awareness as a process and a state of knowledge needs to be as dynamic as the safety critical situation that is being assessed.

Figure 2
The Process of Situational Awareness and Assessment



Situation assessment starts in the pre-situation phase, and then the situation unfolds with building and maintaining situational awareness. Continuously thinking ahead allows for complete understanding and building a bridge to decision making. When the situation is over, you have the opportunity to reflect – on your own or as a team. This reflection or debrief helps solidify knowledge and understanding for use in future pre-situation preparation.

Test your knowledge

Answer each of the following questions based on the case we read before, with Mr. Fortin (Case 1 in the paper cases section of this binder).

Q1. Explain how you would build situational assessment for this case.

Q2. Once you had established initial situational assessment, how would you maintain it as the situation evolved? In your answer, be specific about the type of information that you would be looking for and how often you would go about getting it.

Q3. The last component of situational awareness is thinking ahead to complete the understanding of the situation and help you make decisions. Identify where in the case Dr. Virk failed to think ahead and consequently made decisions that were not in the patient's best interest. If he had been thinking ahead, what other decisions do you think would reasonably have been made?

Answers to knowledge testing questions

Q1. Building situational awareness requires continuously getting information on the various situational elements and understanding them. The process is cyclical wherein one needs the most up to date knowledge to implement and revise decisions and actions. In this case you might start with carefully reviewing the information provided by the nurse, identifying any gaps in this information, and then questioning the patient, noting differences between previous and current complaints, relating this to the information provided by the nurse and evaluating the potential implications of all information provided.

Q2. Maintaining situational awareness includes also being aware of one's own knowledge of the situation, detecting possible obstacles to building and maintaining situational awareness, holes in that knowledge, and loss of situational awareness, and then recovering. The cyclical nature of situation assessments requires one to detect and recover information to be used in the building and maintenance of situational awareness. In this case you might watch out for, or detect, your own potential bias regarding a regular patient whose symptoms have been of little concern in the past, and the urge to rush through the assessment because of external factors (i.e. the need to pick your child up at daycare). Being aware of these potentially influencing factors might help you maintain or recover focus on the task at hand.

Q3. Dr. Virk failed to think ahead to anticipate possible progression of Mr. Fortin's symptoms, what they could mean and what might happen in the near or mid-term future should the worst-case scenario be, in fact, correct. If Dr. Virk had anticipated the potential serious diagnosis he should have sent the patient to Emergency immediately.

The Elements of Situational Awareness

Recall there are three main elements of the process of situational awareness:

- Getting information
- Understanding information
- Thinking ahead

Getting the information

A review of key concepts

To ensure you get the information you need, you should:

- **Scan and search**, i.e. be proactive in getting information
- **Pay attention** to what is going on around you
- **Remain watchful** and expect the unexpected
- **Communicate** the information and your understanding with your team and peers

Tip

Remember that some information is static, i.e. it will not change over time, and other information is dynamic. The dynamic information is such that you need to continually check-in on the information source to catch new information as it becomes available. This is where the "scan and search" strategy comes in handy.

Test your knowledge

Q1. Think of two examples of passive information acquisition that you perform in clinical work. Write them down below:

1. _____

2. _____

Q2. Think of two examples of active information gathering, where you had to make a special effort to get important information regarding your patient or task. Write them down below:

1. _____

2. _____

Example PETT Analysis for Getting the Information

Think back to Case 1, with Dr. Virk and Mr. Fortin, and recall the PETT tables we generated earlier. We are now going to extend the tables and identify all of the sources, delivery methods and the nature of the information provided to Dr. Virk in the scenario.

Situation Elements		Nature	Delivery	Sources
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **Final:** cardiac arrest, aortic dissection and death	**Static:** Background info. **Dynamic:** patient status over the course of the scenario	**Passive:** nurse report. **Active:** patient complaints	The nurse The patient
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road.	Static	Active/Passive	**Self:** Familiarity with the clinic
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin. **Associated task:** Orders tests. **Secondary:** picking up child from daycare, various interruptions/distractions.		Passive and active	The nurse, the patient
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time to cardiac arrest:** 2 hours	Dynamic	Passive	The patient, the nurse.

Now you try

Now take a look at Case 2 in the paper cases section of this learning package. Use the table below to guide your own assessment of the situation elements and the information sources, delivery mechanisms and nature as we have done above.

Situation Elements		Nature	Delivery	Sources
Patient				
Environment				
Task				
Time				

Answers to the knowledge testing questions

Q1. [Answers will vary. Your two examples should illustrate information that is "pushed" to you without you having to go looking for or ask for it]

Q2. [Answers will vary. Your two examples should illustrate times when you are proactive and ask for information from others or consciously search for information from a source]

Answers to case analysis for getting information.

	Situation Elements	Nature	Delivery	Sources
Patient	*Background: Trauma patient arrives with an isolated abdominal injury from a motor vehicle collision.* *Initial: Patient is stabilized. Upon opening the belly the team starts addressing a large liver laceration* *Mid-way: Vital signs deteriorate, transfusion does not seem to help and BP continues to drop* *Final: Liver laceration is repaired. Spleen laceration is discovered. Patient arrests.*	*Static (background)* *Dynamic: Patient status over the course of the scenario*	*Passive: handoff* *Active: surgeon presumably goes looking for damage and settles on the first obvious laceration* *Passive: Anesthesiologist volunteers information more than once* *Passive: Spleen laceration is revealed once the liver has been repaired*	*Possibly a handoff from ED staff or First Responders.* *Observation (surgeon)* *Anesthesiologist* *Surgeon (observation)*
Environment	*Background: 3AM and the surgeon is tired after a full day in the OR. She is anxious to rest up before the next day – so are the surgical residents* *CT scanner is down* *Mid-way: Dr. Kessel is irritated that her preferred retractor is not available. Nurse leaves the OR to find the retractor. Another trauma code is called and the senior resident scrubs out to attend it. Dr. Kessel is irritated that the anesthesiologist is repeating the BP warning and asserts she is working as fast as she can and the liver laceration no longer appears to be oozing* *Final: The anesthesiologist calls other staff for help with additional transfusions.*	*Static busy state of the OR, dynamic human environment as members of the attending team (nurse, residents) leave and others come in to help (anesthesiologist)*	*Passive/Active*	*Familiarity with the physical and organizational environment*
Task	*Primary task: identify and repair abdominal injury(ies)* *Associated task: ensure abdominal packing is secured, monitor patient's vital signs* *Secondary tasks: look for retractor, attend other codes,*	*Static* *Dynamic* *Dynamic*	*Passive/Active* *Active/Passive* *Active*	*Observation, problem solving* *Observation, anesthesiologist* *Searching, nurse, resident*
Time	*Start: 3AM* *Present: Surgeon is repairing the liver laceration as fast as she can. Sometime into the operation the anesthesiologist informs the surgeon that the BP is dropping and more blood is being transfused. The transfusion does not seem to be working. Two minutes later the anesthesiologist calls for help to transfuse even more blood.* *Elapsed: Unknown*	*Dynamic*	*Passive*	*Anesthesiologist*

Understanding the Information

A review of key concepts

We know the next step after getting the information is developing an understanding of it: What does this mean for the patient, for me, or my team? Recall from the Primer that there are a couple of tricks to sorting through this information and turning it into understanding:

- **Compare** the information you gather to what you know and what you expect
- **Critique** the information; check information accuracy, completeness, source and relevance. As you get new information, cross-reference it with what you already know and assess conflicts and contradictions.
- **Diagnose** by asking what this information means and why it may (or not) have happened.

For example, in the case of Mr. Fortin with Dr. Virk, we can see that though Dr. Virk received the information from the nurse that Mr. Fortin's blood pressure was high and different on each arm, Dr. Virk presupposed the outcome (nothing serious is wrong) based on historical visits. There was no apparent diagnosis of the information itself to determine – on the spot – what these symptoms mean and what could be causing them. Instead, Dr. Virk puts off the diagnosis by prescribing additional testing at a later date.

Example PETT Analysis for Understanding the Information

Here is a PETT analysis for Dr. Virk's understanding of the information in this scenario.

Situation Elements		Compare	Critique	Diagnose
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **End:** cardiac arrest, aortic dissection and death	Based on a comparison of current and past vital signs, the nurse flags an elevated BP and different pressures on each arm. Based on past visits, Dr. Virk concludes the case is not urgent	Seems that no critical thinking was done by Dr. Virk to assess the possible cause of the elevated BP, non-symetrical BP and associated arm/leg pain.	It is clear after-the-fact what the cause of the symptoms were.

Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation.The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road	The medical tasks appear to be routine. Dr. Virk ignores the red flags provided by the nurse. The secondary task of picking up his child from daycare, may not be routine.	No critical thinking about the implication of the environmental elements on the internal state of the physician.	
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions,/distractions	The medical tasks appear to be routine. Dr. Virk ignores the red flags provided by the nurse. The secondary task of picking up his child from daycare, may not be routine.		
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours			Seems like Dr. Virk considered the possibility that something was wrong, but failed to link the symptoms with immediate danger.

Now you try

Work through the same exercise using information presented in Case 2 and the blank table below

		Understand the information		
Situation Elements		Compare	Critique	Diagnose
Patient				
Environment				
Task				
Time				

Answer to case analysis for understanding the information

	Situation Elements	Understand the information: Compare	Critique	Diagnose
Patient	*Background: Trauma patient arrives with an isolated abdominal injury from a motor vehicle collision.* *Initial: Patient is stabilized. Upon opening the belly the team starts addressing a large liver laceration* *Mid-way: Vital signs deteriorate, transfusion does not seem to help and BP continues to drop* *End: Liver laceration is repaired. Spleen laceration is discovered. Patient arrests.*	*No images to compare against* *Comparing current vital signs against expected vital signs for a patient of that age and gender* *Once the liver laceration is repaired the abdominal cavity is compared against the expected state*	*No critiquing of the single laceration diagnosis* *No critique by the surgeon or anesthesiologist as to why the transfusion is not proving sufficient*	*No complete evaluation for diagnosis* *No problem-solving around the apparent continued low blood pressure*
Environment	*Background: 3AM and the surgeon is tired after a full day in the OR. She is anxious to rest up before the next day – so are the surgical residents* *CT scanner is down* *Mid-way: Dr. Kessel is irritated that her preferred retractor is not available. Nurse leaves the OR to find the retractor. Another trauma code is called and the senior resident scrubs out to attend it. Dr. Kessel is irritated that the anesthesiologist is repeating the BP warning and asserts she is working as fast as she can and the liver laceration no longer appears to be oozing* *End: The anesthesiologist calls other staff for help with additional transfusions.*	*Dr. Kessel and residents seem to be abnormally fatigued*	*No critical thinking as to the implications of the environmental elements on the surgeon or residents in this fatigued state* *e.g. no critique of her own irritation at the anesthesiologist sharing information about the patient*	*It is clear after the liver laceration has been repaired, that this was not the only laceration requiring attention and that the spleen was likely the cause of excess blood loss*
Task	*Primary task: identify and repair abdominal injury(ies)* *Associated task: ensure abdominal packing is secured, monitor patient's vital signs* *Secondary tasks: look for retractor, attend other codes,*	*The task appears to be routine*	*Dr. Kessel fails to do a complete examination of the abdomen* *No critical thinking about why the BP continues to drop and why so much blood is required given that the liver laceration is almost repaired.*	
Time	*Start: 3AM* *Present: Surgeon is repairing the liver laceration as fast as she can. Sometime into the operation the anesthesiologist informs the surgeon that the BP is dropping and more blood is being transfused. The transfusion does not seem to be working. Two minutes later the anesthesiologist calls for help to transfuse even more blood.* *Elapsed: Unknown*			*Seems like Dr. Kessel failed to link the information being presented by the anesthesiologist to the possibility of another source of blood loss.* *It is possible also that Dr. Kessel assumed the dropping blood pressure should be the responsibility of the anesthesiologists*

Thinking Ahead

A review of key points

Let's assume you have collected all of the information, evaluated it and understand the situation – now what do you do? Think ahead: where could this lead? What are the possible outcomes of the action you have decided to take? Recall from the Primer that thinking ahead is taking all of the information gathered and understood and using it to extrapolate the status of the situation in the near and extended future.

Example PETT analysis for thinking ahead

The following is a PETT analysis example for Case 1 for thinking ahead:

		Think Ahead	
	Situation Elements	**Extrapolation**	**"What if?"**
Patient	**Background:** Mr. Fortin, diabetic, frequently visits the clinic, nothing has been found in earlier testing apart from minor complications related to diabetes. Has complained about abdominal pain before **Initial:** abdominal pain, elevated HR, different blood pressures on each arm **Mid-way:** feels very unwell, also has tingling in his right leg and pain in left arm that started with a "tearing" feeling **Final:** cardiac arrest, aortic dissection and death	There could possibly have been an extrapolation by the nurse calling Dr. Virk in to see this patient.	The nurse may have been thinking about a potential diagnosis or what could happen – which is why she flagged Mr. Fortin's vitals.
Environment	**Background:** It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes. **Mid-way:** Dr. Virk is interrupted by three calls during the consultation. The nurse has flagged certain symptoms. Dr. Virk is anxious to get on the road	Not clear if extrapolation was done with respect to repeated interruptions and their impact on Dr. Virk's attention to Mr. Fortin's case.	
Task	**Primary task:** Information collection, diagnosis and treatment of Mr. Fortin **Associated tasks:** orders tests **Secondary tasks:** picking up child from daycare, various interruptions, distractions	No extrapolation on the impact of the interruptions on Dr. Virk's primary task of diagnosing the patient.	Perhaps some "what if" analysis was done with respect to Dr. Virk being late to pick up his child, but this is a distraction from Mr. Fortin's case.
Time	**Start:** unknown **Present:** Friday afternoon, Dr. Virk is running late **Elapsed time** to cardiac arrest: 2 hours	No extrapolation by Dr. Virk of the possible progression of the symptoms over time.	No "what if" was done with respect to the possible need for a more immediate diagnosis.

Now you try

Now you try using Case 2 and the blank PETT table below.

Situation Elements		Extrapolation	"What if?"
Patient			
Environment			
Task			
Time			

Answer to case analysis for thinking ahead..

	Situation Elements	Think Ahead: Extrapolation	Think Ahead: "What if?"
Patient	*Background: Trauma patient arrives with an isolated abdominal injury from a motor vehicle collision.* *Initial: Patient is stabilized. Upon opening the belly the team starts addressing a large liver laceration* *Mid-way: Vital signs deteriorate, transfusion does not seem to help and BP continues to drop* *Final: Liver laceration is repaired. Spleen laceration is discovered. Patient arrests.*	*There could possibly have been extrapolation by the anesthesiologist that the blood loss was caused by another source, but it was not verbalized, so we can never know* *No extrapolation by Dr. Kessel that the liver might not be the only laceration*	*No "what if" the liver laceration is not the only injury?*
Environment	*Background: 3AM and the surgeon is tired after a full day in the OR. She is anxious to rest up before the next day – so are the surgical residents* *CT scanner is down* *Mid-way: Dr. Kessel is irritated that her preferred retractor is not available. Nurse leaves the OR to find the retractor. Another trauma code is called and the senior resident scrubs out to attend it. Dr. Kessel is irritated that the anesthesiologist is repeating the BP warning and asserts she is working as fast as she can and the liver laceration no longer appears to be oozing* *Final: The anesthesiologist calls other staff for help with additional transfusions.*	*No extrapolation at the impact of fatigue on the mood or problem-solving abilities of Dr.Kessel* *Perhaps some extrapolation that Dr. Kessel's performance may be hindered by the absence of her preferred retractor*	*No "what if" analysis done regarding the potential deterioration of the team after the nurse and senior resident leave*
Task	*Primary task: identify and repair abdominal injury(ies)* *Associated task: ensure abdominal packing is secured, monitor patient's vital signs* *Secondary tasks: look for retractor, attend other codes,*	*No extrapolation that the missing retractor could be a distraction*	*No "what if" analysis that the transfusions might not be enough to stabilize the patient*
Time	*Start: 3AM* *Present: Surgeon is repairing the liver laceration as fast as she can. Sometime into the operation the anesthesiologist informs the surgeon that the BP is dropping and more blood is being transfused. The transfusion does not seem to be working. Two minutes later the anesthesiologist calls for help to transfuse even more blood.* *Elapsed: Unknown*	*No extrapolation regarding the rate of blood loss and what implications this could have*	

Maintaining Situational Awareness Over Time

A review of key concepts

As we have seen in a number of the cases reviewed thus far, clinical situations are dynamic and unexpected events, environmental or task factors can be introduced in a way that might turn a routine case into something quite unexpected. Thus once you have built a comprehensive picture of the situation, you need keep this in mind and work to maintain it. This means continued information gathering and understanding to ensure you do not lose the situational awareness you have consciously built.

Test your knowledge

Use the space provided to answer the questions below. Each of these questions is based on the information presented in the Situational Awareness Primer and your own understanding of that information.

Q1. The key activities for maintaining situational awareness can be described as "discover and recover". In practice, what could you do to achieve this? Describe the actions you would take.

Q2. Provide an example from your own practice (if possible) of a time when you felt you had lost situational awareness. How did you discover that you had lost situational awareness? What did you do to recover in this case? Knowing what you do now, from the Situational Awareness Primer, would you change anything, e.g. take different or additional actions, to recover in that same situation?

Q3. Based on your understanding of the factors that can influence situational awareness, identify one type of influencing factor and describe how it could contribute to a loss of situational awareness and what you could do to prevent this loss.

Answers to the knowledge testing questions

Q1. Recall that your objective is to discover potential situational awareness loss, and recover it by getting more information, understanding it, and thinking ahead. You can use all the tools we spoke about in earlier sections (getting information, understanding it and thinking ahead). One thing you can do is be proactive in obtaining information, periodically ask yourself "Do I have all the information I need now? Is this information recent? Could it have changed without me noticing? Communication with other team members can also help to identify new information, share understanding, detect loss of situational awareness by any member of the team and recover. Apart from sharing your own understanding of the situation, you can ask others if they have any other information, what their understanding of this information is and how it could impact the patient or the task.

Q2. [Answers will vary but should include one or more of the following: probing for information from others, scanning the environment, asking clarifying questions to others, communicating the feeling that you may not have the right understanding of what is going on, etc.]

Q3. [Answers will vary. For example: stress, fatigue and workload are all factors that could contribute to a loss of situational awareness if you do not first, recognize that you are stressed, tired or multitasking beyond your abilities and second, take actions to mitigate the potential consequences of these factors by perhaps notifying your team of how you feel or taking the time to evaluate the tasks on your plate and prioritize them so that you can attack one at a time, or ask for help.]

Possible Obstacles to Adequate Situational Awareness

Review of key concepts

Human information processing has limited cognitive resources and a tremendous quantity of information to parse through. Heuristics are the collection of experienced based techniques that we use to help us make decisions, such as rules of thumb, intuition or common sense. Heuristics can help, but also hinder good judgment by biasing the physician. For example, hearing one patient's description of their symptoms might lead you to jump to a conclusion based on recent experience with a patient exhibiting the same symptoms – without verifying the symptoms against other patient characteristics, this could lead to a dangerous assumption.

Recall from the Primer that there are two main types of biases: cognitive and attentional.

Cognitive biases influence thinking, problem solving and decision making. Here are some examples:

- Anchoring occurs when there is a fixation on the initial assessment, making it unlikely that the initial assessment will be reassessed and updated with new information
- Confirmation bias is the tendency to look for evidence that confirms or matches the current situation or decision.

Attentional biases influence perception and attention, in other words, how you perceive information and what you pay attention to in the environment. Here are some examples:

- Tunneling is when your attention narrows to the exclusion of other potentially critical information
- Other 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

Example case analysis for biases

Using your understanding of cognitive and attentional biases, take a look at those that were identified in our case with Dr. Virk. Instead of breaking the case into situational elements, as we have done in previous exercises, we are going to go back to the initial text and look at events step by step.

Case 1 Family Medicine Clinic	Biases
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous visits.	Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be **anchoring** on the "nothing is seriously wrong" conclusions of previous visits by this patient.
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	Carry over from above

Case 1 Family Medicine Clinic	Biases
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	Carry over from above
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.	Carry over from above. Influencing factors lead to **tunneling** which becomes an obstacle for the adequate comprehension and thinking ahead activities. These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.	

Now you try

Now, using the blank table below, do the same analysis of biases for Case 2. We have already put the case description into the table for you.

Case 2 Trauma MVC	Biases
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.	
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.	
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.	
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.	
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.	
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.	
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.	
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.	

Case 2 Trauma MVC	Biases
Dr. Kessel acknowledges this and proceeds to repair the laceration.	
Dr. Kessel criticises the junior resident for not keeping the operating field clear.	
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.	
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.	
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.	
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.	

Answer to the analysis of biases in Case 2

Case 2 Trauma MVC	Biases
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is *tired after a full day in the OR.*	
She rounded on her patients in the evening and is **anxious to leave** to rest up before *another full day of clinic and ward tomorrow.*	The anxiety could lead to **anchoring**.
The surgical residents are also quite **tired** after being on call "1 in 2" this week and with a *full load of evening consults looming ahead.*	
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.	There does not seem to be any bias at this point.
During the procedure Dr. Kessel expresses her *irritation* that her *preferred retractor is not readily available.* One *or nurse leaves* to find the retractor.	
Sometime into the case, *another trauma code* is called and the *senior resident scrubs out* to attend to it.	
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.	
The anesthesiologist informs Dr. Kessel that the *patient's blood pressure is dropping* and that he has *begun to transfuse* further blood.	
Dr. Kessel *acknowledges* this and *proceeds to repair the laceration.*	**Anchoring:** Despite this information, no other lacerations are expected/anticipated
Dr. Kessel *criticises* the junior resident for not keeping the operating field clear.	
The anesthesiologist *informs* Dr. Kessel that the *blood pressure is continuing to drop despite the transfusion.*	
In an *irritated outburst* Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that *the laceration seems to be no longer oozing.*	**Anchoring:** Dr. Kessel appears to be fixated on the liver laceration as the only possible cause for BP dropping No one is challenging Kessel's perception of the situation. Therefore they are either all fixated on the liver laceration OR there may be an authority gradient preventing them from speaking out.
Two minutes later the *anesthesiologist calls a colleague for assistance,* another line is inserted, and blood is being transfused by two warmers.	They are either all suffering from an **anchoring** bias, or no-one is willing to speak up and challenge the surgeon's view of the situation.
Dr. Kessel completes the liver laceration repair and discovers a *previously unseen splenic laceration.* Before the spleen can be repaired, the *patient arrests and cannot be resuscitated.*	**Tunnelling**: before the liver laceration had been repaired, Dr. Kessel seemed to be unable to look for/at anything else

Putting it all Together

Throughout this instructional supplement we have been looking repeatedly at the case of Dr Virk and Mr. Fortin where a serious vascular problem went unnoticed. You learned how to identify key elements of the situation and conduct a PETT analysis (Patient, Environment, Task, Time) as well as how to identify potentially influencing factors based on human capabilities and limitations. We also discussed and practiced the three cyclical stages of situation assessment, and practiced identifying cognitive and attentional biases that can hinder the building and maintaining of situational awareness. Now, let's put it all together for a complete case analysis. Take a look at the table below showing a complete analysis for Case 1. You will notice that the analysis for the stages of situation assessment: getting the information, understanding it and thinking ahead, has been compressed from what we practiced earlier. Here we only present the conclusions from that detailed analysis.

Practical Takeaways

Congratulations! You have completed the instructional supplement. Look to the Situational Awareness Primer for a list of situational awareness checklist that you can use as reminders of the key lessons reviewed here.

Example full-case analysis

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	**Workload** Possible internal **distraction** stemming from the need to leave immediately Possible **stress**		Dr. Virk appears to be aware of the time		
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. *Dr Virk thinks it is likely benign in nature, as with previous visits.*	**Workload, distraction** and possible **stress** carried over from above. Additional **workload** imposed by the complexity of the case (i.e. an elderly patient with diabetes and abdominal pain could have a long list of diagnoses)	Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be anchoring on the "nothing is seriously wrong" conclusions of previous visits by this patient.	Patient brings a complaint; patient's history is reviewed.	At this time it is not clear what the comprehension is, but it is implied that Dr.Virk might compare the present symptoms to those reported in previous visits, all of which resulted in nothing, or no more than, minor complications related to diabetes	It is not clear if any thinking ahead was done

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	Interruption Increased **workload** Increased likelihood for cognitive biases	Carry over from above	A lot of other information, unrelated to this particular patient is introduced and the physician's focus is taken away from the task at hand.	Dr. Virk understands that each of these calls require his immediate attention. The potential of a serious health problem with Mr.Fortin is not understood.	There is no thinking about Mr.Fortin at this time.
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	**Carry over from above** Possible **authority gradient** (i.e. organizational or vocational cultural factor that hinders communication between staff members in different positions)	Carry over from above	Additional information is gathered about the patient's condition Dr. Virk does not perceive the "red flags" that are being presented by both the nurse and the patient	This new information is compared to the complaints presented on previous visits. The nurse recognizes that there are some concerning abnormalities in the vital signs.	The nurse flags elevated vitals because she predicts the doctor needs this information. It is also likely that she predicts an ominous diagnosis, but does not share this directly.

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week	**Anxiety suggests stress** **Distraction caused by workload**	Carry over from above. Influencing factors lead to **tunneling** which becomes an obstacle for the adequate comprehension and thinking ahead activities. These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.	Dr. Virk makes a connection between the symptoms presented and possible cardiac problem He does not see any immediate danger and prescribes the patient medication and testing rather than a more immediate referral to the ED	He does not think ahead to the potential severity of the situation and a decision is made based on a biased comprehension of the situation	There is no thinking about Mr. Fortin at this time.
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening			The diagnosis could have been discovered earlier with improved communication, between the nurse and the doctor; attention to and comprehension of the red flags; and insight into the nature of interruptions, their timing and impact on one's likelihood to make cognitive errors.		

Now you try

Now you have a chance to put all of the skills you have learned together to analyze a completely new case.
Complete the following table for Case 2.

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.					
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.					
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.					
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.					

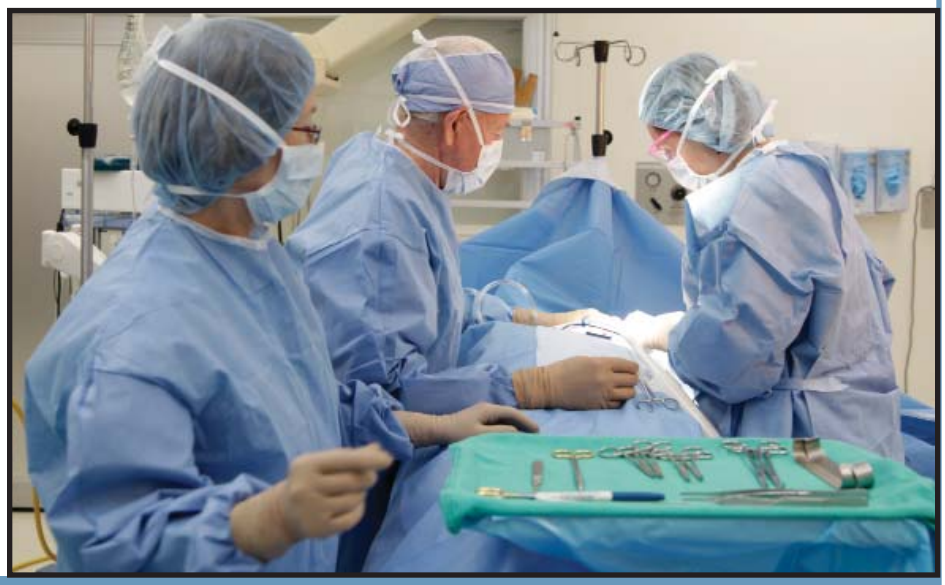
			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.					
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.					
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.					
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.					
Dr. Kessel acknowledges this and proceeds to repair the laceration.					
Dr. Kessel criticises the junior resident for not keeping the operating field clear.					

			Situation Assessment and Awareness		
Case 2 Trauma MVC	**Influencing Factors**	**Biases**	**Info Gathering**	**Understanding**	**Thinking Ahead**
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.					
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.					
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.					
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.					

Answers to the full case analysis

Answers to the complete Case 2 analysis can be found in the case studies section of your learning package.

Chapter 8



Situational Awareness Case Studies

Clinical Case Descriptions With Associated Situational Awareness Analysis

Introduction

The purpose of this section is to present clinical case descriptions that can be used to support the development of situational awareness knowledge and skills for physicians. It may be used as a resource for both independent and group learning scenarios.

This section contains two parts. The first part introduces five clinical case descriptions in which human factors and a loss of situational awareness impacted human performance and contributed to adverse patient outcomes. The second presents step-by-step analyses of each case identifying influencing factors, cognitive and attentional biases, and successes and failures in situational assessment. These case analyses are based on the situational assessment process presented in the Situational Awareness Primer and are also referenced in the associated Instructional Supplement.

Case Descriptions

Case 1: Family Medicine Clinic

It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.

An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. Dr. Virk thinks it is likely benign in nature, as with previous visits.

Note

Cases 1 and 2 are used in the Instructional Supplement

Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.

Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".

Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.

Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.

Case 2: Trauma MVC

It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR. She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow. The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.

A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.

During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor.

Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it. Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.

The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood. Dr. Kessel acknowledges this and proceeds to repair the laceration.

Dr. Kessel criticises the junior resident for not keeping the operating field clear. The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion. In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing.

Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two infusers.

Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration.

Before the spleen can be repaired, the patient arrests and cannot be resuscitated.

Case 3: Elderly fall

It is a busy night shift in the emergency department. Dr. Brisbin is working as the only attending physician and is trying to catch up on the large number of patients to be seen. The waiting room is full.

Mr. Brunner, a frequent visitor to this emergency department, is an elderly man and an alcoholic. He has fallen in his apartment. During Dr. Brisbin's assessment she is interrupted five times by calls and inquiries.

Before going back into the room, Dr. Brisbin pauses and tries to find a cup of coffee, without success.

Dr. Brisbin completes the assessment and finds the patient has a decreased level of consciousness and a small scalp hematoma. She decides that the patient is drunk again and that he just needs to sleep it off.

At 8 A.M. she hands off the patient to her colleague coming in on the day shift, and suggests that the patient be discharged when he is sober.

When the patient is reassessed by the day physician at 10 A.M. he is found to have a blown right pupil and focal deficits on the left side. A CT scan of the head reveals an intracerebral hemorrhage.

Case 4: Procedural sedation

Dr. Leblanc is near the end of his busy night shift in the emergency department. It is 7 A.M. and the ER 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 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.

Note

This case is used in the Situational Awareness Primer.

The nurse reminds Dr. Leblanc that an 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 respiratory therapist 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.

When all present look up they realize the patient is not breathing. The monitor is flashing and the audio alarms had been turned off.

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

Case 5: Elaine Bromiley

Note

Video clips that present and reenact the situation as it unfolded accompany this case description. Refer to the Presentation Slide Set for more information on where to find these clips.

Clip 0 Elaine Bromiley was a fit and healthy young woman who was admitted to hospital for routine sinus surgery. The attending anesthesiologist and his assistant were both quite experienced.

Clip 1 Elaine Bromiley was a fit and healthy young woman who was admitted to hospital for routine sinus surgery. The attending anesthesiologist and his assistant were both quite experienced. A pre-operative assessment raised no cause for concern. Prior to the start of the procedure her pulse rate was 81bpm with an oxygen saturation of 98% (both normal).

The plan was to start with a laryngeal mask. At 8:35am Elaine was anesthetized. During the anesthetic she experienced breathing problems and the anesthesiologist was unable to insert a device to secure her airway.

The first and second laryngeal mask did not fit and it was determined that this was due to muscle tension. Drugs were administered in an attempt to reduce tension in the jaw.

Two minutes had passed since delivery of the aesthetic and Elaine's SAO2 was 75% and falling. The patient was visibly blue.

Clip 2 Within four minutes her SAO2 had fallen to 40% and lower. At approximately 6-8 minutes, the anesthesiologist had attempted to intubate Elaine. Her SAO2 was still at 40% or lower and her heart rate had started to deteriorate.

Clip 3 The ENT surgeon waiting to perform the procedure entered the operating theatre. Another Anesthesiologist from an adjoining theatre perceived a "commotion" and walked in to see what could be done. And at least three nurses answered a call for help.

The three highly experienced consultants made numerous unsuccessful attempts to secure Elaine's airway using a variety of techniques and different pieces of equipment.

Early on nurses informed the team that they had brought emergency equipment to the room and booked a bed in intensive care but neither were utilised.

Clip 4 After 10 minutes it was a situation of 'can't intubate, can't ventilate'; a recognised anesthetic emergency for which guidelines exist. The patient still had very low oxygen saturation levels and was visibly blue.

For a further 15 minutes the consultants continued to try to intubate and eventually get her oxygen saturation up to 90%.

The physicians decide not to continue with the operation. However, the airway is not secured and as they continue to "fiddle" with the intubation equipment Elaine's oxygen saturation falls below 90% for a further 10 minutes.

35 minutes after the start of the anesthetic it was decided that Elaine should be allowed to wake up naturally and was transferred to the recovery unit. When she failed to wake up she was then transferred to the intensive care unit. Elaine never regained consciousness and after 13 days the decision was made to withdraw the ventilation support that was sustaining her life.

Case Analysis Results

Case 1: Family Medicine Clinic

Key lesson: Beware of emotional distractions that may lead you to want to rush through a diagnosis or procedure.

Note

In the analysis tables we use a check or a cross mark to indicate activities that may have contributed to the establishment and maintenance of situational awareness or degradation of situational awareness:
☒ = constructive to situational awareness
☑ = could potentially contribute to a loss of situational awareness

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
It's Friday afternoon. Dr. Virk is running late in his clinic and has to leave immediately to pick his child up from daycare before it closes.	**Workload** Possible **internal distraction** stemming from the need to leave immediately Possible **stress**		☑ Dr. Virk appears to be aware of the time.		
An elderly patient, Mr. Fortin, arrives complaining of abdominal pain. Mr. Fortin is diabetic, and frequently visits this clinic with multiple complaints. Nothing has been found on earlier testing in the last two years, aside from minor complications related to the diabetes. *Dr. Virk thinks it is likely benign in nature, as with previous visits.*	**Workload, distraction** and possible **stress** carried over from above. Additional **workload** imposed by the complexity of the case (i.e. an elderly patient with diabetes and abdominal pain could have a long list of diagnoses)	Could be a situation where the physician thinks the patient has been worked up completely and no further testing is likely to add anything. This would be **anchoring** on the "nothing is seriously wrong" conclusions of previous visits by this patient.	Patient brings a complaint; patient's history is reviewed.	At this time it is not clear what the comprehension is, but it is implied that (☑) Dr.Virk might compare the present symptoms to those reported in previous visits, all of which resulted in nothing, or no more than, minor complications related to diabetes.	☒ It is not clear if any thinking ahead was done

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Dr. Virk is interrupted by three calls during their consultation, the first being a prescription renewal. The second call is the lab calling about a patient's results showing high potassium that needs to be addressed immediately. The last call is from a consultant who Dr. Virk has been trying to reach all week, and who has only 5 minutes to talk.	**Interruption** Increased **workload** Increased likelihood for cognitive and attentional biases	Carry over from above	☒ A lot of other information, unrelated to this particular patient, is introduced and the physician's focus is taken away from the task at hand	☑ Dr. Virk understands that each of these calls require his immediate attention. ☒ The potential of a serious health problem with Mr. Fortin is not understood	☒ There is no thinking about Mr. Fortin at this time
Mr. Fortin has complained about abdominal pain before. Today the nurse flagged a slightly elevated heart rate, and different blood pressures on each arm. Mr. Fortin tells Dr. Virk that he feels very unwell and feels that there is something very wrong. In addition to the pain in his abdomen, the patient has tingling in his right leg, pain in his left arm, and he notes that the pain started with a "tearing feeling".	Carry over from above Possible **authority gradient** (i.e. organizational or vocational cultural factor that hinders communication between staff members in different positions)	Carry over from above	☑ Additional information is gathered about the patient's condition ☒ Dr. Virk does not perceive the "red flags" that are being presented by both the nurse and the patient	☑ This new information is compared to the complaints presented on previous visits ☑ The nurse recognizes that there are some concerning abnormalities in the vital signs	☑ The nurse flags elevated vitals because she predicts the physician needs this information. It is also likely that she predicts an ominous diagnosis, (☒) but does not share this directly

			Situation Assessment and Awareness		
Case 1 Family Medicine Clinic	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Dr. Virk is very anxious to get on the road to get to the daycare. He gives Mr. Fortin a prescription for Percocet, orders an EKG to be done next week, blood work, and asks Mr. Fortin to return in one week.	Anxiety suggests **stress** Distraction caused by **workload**	Carry over from above. Influencing factors lead to **tunneling** which becomes an obstacle for the adequate comprehension and thinking ahead activities. These biases are leading Dr. Virk to focus on treating the pain, and defer the workup, without realizing that both should be happening rapidly, and in a hospital setting.		☑ Dr. Virk makes a connection between the symptoms presented and possible heart trouble. ☒ He does not see any immediate danger and prescribes the patient medication and testing rather than a more immediate referral to the ED.	☒ He does not think ahead to the potential severity of the situation and a decision is made based on a biased comprehension of the situation.
Two hours later Mr. Fortin arrests and is sent to the emergency department. He is resuscitated and imaging shows a type B aortic dissection. He dies that evening.			The diagnosis could have been discovered earlier with improved communication, between the nurse and the doctor; attention to and comprehension of the red flags; and insight into the nature of interruptions, their timing and impact on one's likelihood to make cognitive errors.		

Case 2: Trauma MVC

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
It is 3 A.M. in the operating room and Dr. Kessel the surgeon in charge is tired after a full day in the OR.	**Fatigue** **Workload**		☑ Dr. Kessel may be aware of her own fatigue – it is not explicitly clear	☑ She understands that she needs to get some rest. ☒ There does not seem to be any critical thinking regarding how this fatigue could impact performance.	
She rounded on her patients in the evening and is anxious to leave to rest up before another full day of clinic and ward tomorrow.	Stress possibly induced by **workload**. The knowledge of full day of clinic and ward ahead could also be an internal **distraction**	The anxiety could lead to **anchoring**.	☑ Dr. Kessel is aware of her schedule tomorrow	☑ She understands that it will be another long day	☑ Her desire to leave and rest suggests she is thinking ahead (a good example of self-awareness)
The surgical residents are also quite tired after being on call "1 in 2" this week and with a full load of evening consults looming ahead.	**Fatigue** **Workload**		☑ The residents are aware of their fatigue	☒ There does not seem to be any critical thinking regarding how this fatigue could impact performance.	

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
A trauma patient arrives to the OR for an isolated abdominal injury from blunt trauma from a motor vehicle collision. The CT scanner is down and no imaging of the injured area was done prior to arrival of the patient in the OR. The patient is stabilized, and upon opening the belly the team sets out to repair a large liver laceration.	**Fatigue** **Workload** **Stress** (all three carry-over from above)	There does not seem to be any bias at this point.	☑ Some information is likely received in the handoff from the medics. Some info is probably gathered during the triage performed by ER staff. ☒ There is no evidence indicating that the surgical team did a full assessment of the patient - from hindsight, we know that they are unaware of the splenic laceration The team may know that imaging is not available, but there is (☒) no clear indication that information is sought from any other source.	☑ They diagnosed the symptoms to imply a large liver laceration. They also understood that the patient needed to be stabilized. ☒ There does not seem to be any additional critical thinking about the extent of the patient's injury i.e. there is no evidence of questioning the condition of other organs that may have been injured or the need for additional more sophisticated diagnostics (such as imaging or other tests). ☒ No apparent understanding that the lack of imaging could mean the team is missing a complete picture of the extent of the damage	☑ The decision to stabilize and repair a liver laceration immediately reflects adequate thinking ahead with respect to the patient's status and the immediate potential deterioration.

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
During the procedure Dr. Kessel expresses her irritation that her preferred retractor is not readily available. One OR nurse leaves to find the retractor	Is the missing tool a **distraction** or **interruption**? This could lead to **frustration** and therefore possibly increase **stress**? The irritation may be a reflection of her **fatigue**. Regardless it sets a negative tone to the environment in the OR which may inhibit team communication. There is also a possibility of **reduced teamwork** because the nurse leaves		☑ Dr. Kessel notices that her preferred retractor is not available	☒ Dr. Kessel's expectations are not met. Her expression of irritation suggests she is frustrated (this frustration could hinder her ability to think clearly about what is going on with this case)	☒ Unclear whether there is any thinking ahead

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Sometime into the case, another trauma code is called and the senior resident scrubs out to attend to it.	**Interruption** for the senior resident; it is unclear if this is an interruption or distraction for the rest of the team.		☑ The senior resident hears the code.	☑ The senior resident understands they are needed somewhere else. ☒ There is no evidence of critical thinking as to the impact of the senior resident leaving.	☒ There is no evidence the resident is thinking ahead as to what will happen in this procedure if they leave. ☒ There is no evidence that anyone is thinking ahead as to the potential impact of having less staff on hand for the procedure
Dr. Kessel continues to proceed quickly and fails to check the abdominal packing inserted.	**Rushing** possibly induced by stress. Possible **distraction** from the trauma code and departure of the senior resident. **Reduced teamwork:** the senior resident, who is a key team member capable of checking the surgeon's work, is now absent.		☒ Dr. Kessel fails to check the abdominal packing. This is an error of omission. Is it due to the interruption? Stress? Fatigue?		

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
The anesthesiologist informs Dr. Kessel that the patient's blood pressure is dropping and that he has begun to transfuse further blood.	**Poor team communication**		☑ Anesthesiologist perceives BP drop ☑ Team communication: new info is being pushed by the anesthesiologist.	☑ Anesthesiologist comprehends that the patient needs more blood ☒ More critical thinking about the source of the blood loss does not appear to be done.	☑ Anesthesiologist predicts that the patient's condition will deteriorate if they do not get blood and decides to commence the transfusion. ☒ There is no evidence of any further thinking ahead by the anesthesiologist or the surgeon. ☒ Team communication failure: there is no communication within the team about why this is happening and what the alternatives are.
Dr. Kessel acknowledges this and proceeds to repair the laceration	Carry over **rushing, fatigue** and **workload** from above.	**Anchoring**: Despite this information, no other lacerations are expected/ anticipated	☑ Kessel acknowledges information provided by anesthesiologist. – closed loop communication: information was received	☒ Further assessment of what this blood loss might imply does not appear to have been done by Dr. Kessel.	☒ No other lacerations are expected/anticipated

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Dr. Kessel criticises the junior resident for not keeping the operating field clear	**Distraction** via obstruction of the operating field, could lead to added stress There is also the possibility that the junior resident is not retracting well enough due to **fatigue** or **inexperience**.		☑ Dr. Kessel perceives the operating field is not clear and verbalizes this (team communication)		
The anesthesiologist informs Dr. Kessel that the blood pressure is continuing to drop despite the transfusion.			☑ Team communication: anesthesiologist is pushing information and implies that the blood transfusion is insufficient ☑ Information received; loop is closed in a fashion, by Dr. Kessel's response (below)	☑ Anesthesiologist appears to understand that this is a problem, (☒) but there is no evidence of critical thinking	Anesthesiologist appears to be suggesting that something else needs to be done, (☒) but does not verbalize any concern

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
In an irritated outburst Dr. Kessel asserts that she is repairing the laceration as quickly as possible. She also remarks that the laceration seems to be no longer oozing	The irritated outburst suggests **frustration** or **stress**. **Rushing** and **fatigue, workload**, etc. carried over from previous Possible **authority gradient** preventing others from speaking up and offering alternate possibilities or sources for the blood loss	**Anchoring:** Dr. Kessel appears to be fixated on the liver laceration as the only possible cause for BP dropping No one is challenging Dr. Kessel's perception of the situation. Therefore they are either all fixated on the liver laceration or there may be an **authority gradient** preventing them from speaking out.	☑ This provides information to the team about Dr. Kessel's perception of the situation.	☒ There is no evidence of additional analysis or comprehension activities by any member of the team e.g. if the laceration is not oozing why is there still BP drop, what does this mean?	☒ There is no evidence that anyone is thinking ahead towards what might need to be changed in order to better support the patient.

Key lesson: thinking aloud (verbally sharing thoughts and decisions) is one strategy that can be used to support team situation awareness in critical situations

			Situation Assessment and Awareness		
Case 2 Trauma MVC	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Two minutes later the anesthesiologist calls a colleague for assistance, another line is inserted, and blood is being transfused by two warmers.	Possible **authority gradient**	They are either all suffering from an **anchoring** bias, or no-one is willing to speak up and challenge the surgeon's view of the situation	☑ Anesthesiologist perceives continued BP drop.	☑ Anesthesiologist understands that the blood loss is a serious problem	☒ Rather than asking the surgeon if there is another source of bleeding, the anesthesiologist is attempting to compensate. Though calling for help indicates the anesthesiologist recognizes the need for more hands/ brains, he is also avoiding the main issue.
Dr. Kessel completes the liver laceration repair and discovers a previously unseen splenic laceration. Before the spleen can be repaired, the patient arrests and cannot be resuscitated.		**Tunnelling**: before the liver laceration had been repaired, Dr. Kessel seemed to be unable to look for/at anything else	A new possible cause for the dropping BP is discovered. It appears there is no time to take action before the patient arrests.	The patient bleeds out because spleen was not addressed in time. This shows that **if they did more critical thinking and thinking ahead they may have looked for something else and discovered it earlier.**	

Key lesson: Fatigue can affect your cognitive abilities including your ability to evaluate information and perceive change. It can also put you at greater risk for anchoring and/or tunneling as you gather your mental resources to focus on the task at hand. Fatigue is sometimes unavoidable. Thus it is important to continuously gather information, compare it with what you have already and critique your perception of the situation to maintain situational awareness.

Case 3: Elderly fall

			Situation Assessment and Awareness		
Case 3 Elderly fall	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
It is a busy night shift in the emergency room. Dr. Brisbin is working as the only attending physician and trying to catch up on the large number of patients to be seen, and the waiting room is full.	**Workload, fatigue** because it is a night-shift Possible **rushing** because of the large number of patients and the fact that the waiting room is full				
Mr. Brunner, a frequent visitor to this emergency room, is an elderly man and an alcoholic. He has fallen in his apartment		**Anchoring**: knowledge of Mr. Brunner's history biases Dr. Brisbin making it unlikely that she will re-evaluate her initial diagnosis over time			
During Dr. Brisbin's assessment she is interrupted five times by calls and inquiries	**Interruptions** May lead to some **frustration** and **internal distraction** (taking her mind off of the assessment task)	Carry over from above	Info gathered during the assessment, but may be incomplete due to interruptions (☒).		
Before going back into the room, Dr. Brisbin pauses and tries to find a cup of coffee, without success.	**Fatigue**		☑ Dr. Brisbin is aware of her fatigue	☑ She understands that she needs something to help her be more alert. ☒ She does not see any need to urgently return to her patient.	☑ She tries to mitigate her fatigue, but then gives up (perhaps because she believes attending to the long line of patients is more important?)

			Situation Assessment and Awareness		
Case 3 Elderly fall	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Dr. Brisbin completes the assessment and finds the patient has a decreased level of consciousness and a small scalp hematoma. She decides that the patient is drunk again and that he just needs to sleep it off.	**Fatigue** Possibly **distraction** from **frustration** at not being able to find a coffee (above)	**Confirmation** bias stemming from the anchoring bias above	The assessment is done, but may not be complete (☒) - there is no mention of a neurological exam	The information is linked to prior knowledge about the patient: (☒) Dr. Brisbin appears to attribute the decreased level of consciousness to the patient being drunk and not the hematoma	☒ She does not think ahead as to the possible impact of the hematoma
At 8 A.M. she hands off the patient to her colleague coming in on the day shift, and suggests that the patient be discharged when he is sober	Carry over from above	Carry over from above. In addition she may have biased her colleague by suggesting that the patient be discharged when sober and not asking/suggesting another opinion or an early reassessment.	☒ No evidence that any follow-up assessments were done, failure to reassess before handover or with the new physician to ensure no change in patient's status	Understanding has not changed from initial diagnosis	☒ No evidence of any further thinking about this patient
When the patient is reassessed by the day physician at 10 AM he is found to have a blown right pupil and focal deficits on the left side. A CT scan of the head reveals an intracerebral hemorrhage.				The diagnosis could have been discovered with more info gathering, comprehension, and thinking ahead activities	

Key lesson: Patients who have a known history with familiar prognosis are more likely to cause anchoring and lead you to make a cognitive error. If we view the facts more objectively, an elderly head injury and decreased level of consciousness should have had early investigations or at a minimum frequent reassessments

Case 4: Procedural sedation

			Situation Assessment and Awareness		
Case 4: Procedural sedation	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Dr. Leblanc is near the end of his busy night shift in emergency. It is 7 A.M. and the ER 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 house staff on shift, and prepare for handovers to the day physician before he can get home.	**Fatigue** at the end of a busy night shift **Workload** possibly resulting in **stress** and **rushing** to complete as many evaluations as possible before preparing handovers The staff evaluations might also be a **distraction** taking his attention away from patient care.				
He is also interrupted every two minutes with calls, inquiries from the nurses, residents looking to discuss cases, and reviews of EKGs.	Frequent **interruptions** of various types Increased **workload**				
The nurse reminds Dr. Leblanc that an 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.	Carry over from above Increased **fatigue** leading to **frustration** The cursing reflects a problematic **mood** and state of mind that could lead or be a result of increased **stress**, or reduced **motivation**		☑ Patient information is provided. ☒ The "reminder" suggests that Dr. Leblanc had forgotten about the elderly patient.	It is not clear whether there is any analysis or comprehension here. ☑ The immediate response of the physician suggests he understands this activity as taking priority over the staff assessments he was previously focussed on.	It is not clear if there is any thinking ahead at this time, though the "reminder" may suggest that the nurse is thinking ahead (☑).

			Situation Assessment and Awareness		
Case 4: Procedural sedation	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
With a Respiratory Therapist present, Propofol is administered to the elderly woman to sedate her in order to reduce her shoulder.	**Interruption** Possible **reduced teamwork** because the resident and student leave the room		☒ No evidence of reassessment of the patient prior to starting the procedure. Not stated whether Dr. Leblanc made the original diagnosis, or (☒) if he is assuming that it was/is correct ☑ The stroke code is perceived	☑ Dr. Leblanc understands that the reduction needs to be done, that the respiratory therapist's presence is required	☑ He predicts that more hands are likely needed for the stroke code, but not the potential impact of fewer team members monitoring this procedure. ☑ Presence of the RT may suggest that Dr. Leblanc predicts potential risks associated with the administration of Propofol
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.	Carry over from above **Workload**: MD is both performing the reduction and administering drugs, which is less than ideal.	**Tunnelling**: focus on accomplishing the reduction could contribute to the lack of questioning and analysis	☑ New information about the patient ☒ There does not seem to be any communication between team members encouraging information sharing or critical thinking	☒ Seems to think that the difficulty may be a result of the patient not being sedated enough and does not seem to understand that giving more Propofol increases risk of respiratory depression especially in the elderly	☑ Thinks that the administration of more Propofol might relax the patient further and facilitate the reduction ☒ Does not anticipate any negative effects from the Propofol

			Situation Assessment and Awareness		
Case 4: Procedural sedation	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
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.	RT is **interrupted** from their primary task, which might have been monitoring the patient This is in addition to the factors that carry over from before. The "curse" is an additional reflection of **stress**.	Carry over from above. It appears that the RT and nurse are also narrowing their focus on the task.	☒ Still no questioning about why the reduction is so difficult, no reassessment of the patient ☒ No active information gathering, only passive, e.g. crack heard	☑ Dr. Leblanc understands that this is not a good sound, and sees the potential for fracture, thus orders x-rays.	☒ No one seems to anticipate harm to the patient (they are so focussed on the task) or question why the reduction is so difficult (is this even the right patient?)
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.	Carry over from above. It was the end of the night shift; multiple distractions occurred that could contribute to the cognitive errors that occurred. Lack of communication may reflect **degraded teamwork** with no clear allocation of tasks so someone still continues to monitor the patient	Carry over from above	An outcome that was missed for a while; ☒ there was no awareness of elapsed time and no info gathering by any of the team members, i.e. lack of scanning	☒ There was a lack of acquisition and perception (not watching the patient's respirations to notice that she has stopped breathing – plus the alarms were turned off so there would be no audible cue – removing the RT from his/her role to monitor respirations and asking them to help with the procedure)	This is preventable since this property of Propofol is widely known and we know that if you pick up early that the patient's breathing has slowed down or stopped that you can perform interventions to increase the oxygen in their circulation and prevent deterioration to cardiac arrest.

Key lesson: It is important that everyone is aware of his or her responsibilities within a team. Helping others is good, but should only be done after an assessment of how taking your attention away from your own responsibilities might impact your ability to maintain situation awareness.

Case 5: Elaine Bromiley

			Situation Assessment and Awareness		
Case 5: Elaine Bromiley	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Elaine Bromiley was a fit and healthy young woman who was admitted to hospital for routine sinus surgery. The attending anesthesiologist and his assistant were both quite experienced. A pre-operative assessment raised no cause for concern. Prior to the start of the procedure her pulse rate was 81 bpm with an oxygen saturation of 98% (both normal).			☑ Fully assessed pre-op	Nothing is expected to go wrong	We can only guess that with no expected complications they did not start counting time at this point (☒), however it is not explicit in the case description
The plan was to start with a laryngeal mask. At 8:35 A.M. Elain was anesthetized. During the anesthetic she experienced breathing problems and the anesthesiologist was unable to insert a device to secure her airway. The first and second laryngeal mask did not fit and it was determined that this was due to muscle tension. Drugs were administered in an attempt to reduce tension in the jaw.	Possible **stress** due to repeated unsuccessful attempts to secure the airway	**Tunneling:** fixation on the laryngeal mask fitting	☑ They recognize that the laryngeal masks do not fit. It is unclear whether they perceive the falling SaO2 at this time.	☑ Determine the mask problem is due to muscle tension	☑ Administered drugs to try and resolve the issue. ☒ Did not anticipate "what if we can't resolve the muscle issue?" ☒ Also did not anticipate potential problems associated with the administration of such drugs, i.e. the drug they gave to relieve muscle tension was a paralytic – as a result she could not breathe by herself – it could significantly exacerbate the situation.

			Situation Assessment and Awareness		
Case 5: Elaine Bromiley	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Two minutes had passed since delivery of the aesthetic and Elaine's O2 was 75% and falling. The patient was visibly blue.	**Stress** would carry over from above.	Carry over from above.	☒ It is unclear whether the medical team has perceived the changes in vital signs, or the passing of time; If any of them did notice the deteriorating signs, we don't know if they verbally communicated this perception to the other team member	☒ Unclear if anyone has recognized the significance of the falling saturation oxygen levels in the context of time and what this could mean for the patient	☒ There is no thinking ahead with respect to "what if this situation does not resolve?", what if her SaO2 keeps falling?
Within four minutes her O2 had fallen to 40% and lower. At approximately 6-8 minutes, the anesthesiologist had attempted to intubate Elaine. Her O2 was still at 40% or lower and her heart rate had started to deteriorate.	**Stress**, induced by failed attempts to oxygenate the patient and the worsening situation	**Tunneling:** the team is so focused on securing the airway that they do not realize the passing of time	☑ At this point it is likely they have recognized the falling SaO2 and HR	☑ The recognize the severity of the situation	☒ Without knowing how long Elaine's SaO2 had been down, it would be hard to predict the risk or extent of brain damage at this point.

			Situation Assessment and Awareness		
Case 5: Elaine Bromiley	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
The ENT surgeon waiting to perform the procedure entered the operating theatre. Another Anesthesiologist from an adjoining theatre perceived a "commotion" and walked in to see what could be done. And at least three nurses answered a call for help.	**Distraction** from the sudden increase in staff in the room and the need to explain what is going on to each of them.		☑ Vital sign changes are perceived. ENT surgeon perceives disturbance in the OR, the passage of time and sub-optimal heart rate of the patient	☑ The anesthesiologist calls for help, meaning they understand the situation is becoming serious. ☑ The ENT surgeon understands that the anesthesiologists need help and the patient needs to regain normal SaO2 and HR. (☒) It is unclear whether or not the ENT is aware of how long the patient has been at low O2 and how severe the situation is	☑ The anesthesiologist recognizes the severity of the situation and that it might get worse and consequently call for help. We don't know for sure what kind of help the two anesthesiologists expected when they called for help. From hindsight, there likely was an expectation that the staff ENT surgeon would be the one to initiate a surgical airway – (☒) it is possible others on the team were afraid to suggest it even though it may have been clear to some that that is what she needed
The three highly experienced consultants made numerous unsuccessful attempts to secure Elaine's airway using a variety of techniques and different pieces of equipment.	**Stress**: elevated by the increasing deterioration of the situation	**Tunneling** – there is a lack of insight and restructuring, everyone seems to be stuck on intubation	☑ Vital signs are changing. ☑ Other equipment for intubation is perceived as available.	☑ Everyone seems to understand that what they are doing is not working and the situation is getting worse, (☒) but they may not have realized that this operation is no longer routine	☒ Failed to recognize that "one more try" could do harm to the patient. ☒ Did not anticipate "what if none of the intubation techniques work?"

			Situation Assessment and Awareness		
Case 5: Elaine Bromiley	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
Early on nurses informed the team that they had brought emergency equipment to the room and booked a bed in intensive care but neither were utilised.	Possible **authority gradient:** why did none of the physicians pay attention to the help offered by the nurses?		☒ The team does not perceive any other equipment no related to intubation, i.e. the surgical airway kit	(as above)	(as above)
After 10 minutes it was a situation of 'can't intubate, can't ventilate'; a recognised anesthetic emergency for which guidelines exist. The patient still had very low oxygen levels and was visibly blue. For a further 15 minutes the consultants continued to try to intubate and eventually get her oxygen up to 90%.	Carry over of all factors mentioned previously	**Tunneling** (continued)	☒ Lack of awareness of the passage of time. ☑ Perceive they cannot get the SaO2 rate above 90%	☒ Still appears that the understanding of time is missing and thus the severity of the situation is not well understood (i.e. 20minutes at ~40% SaO2)	
The physicians decide not to continue with the operation. However, the airway is not secured and as they continue to "fiddle" with the intubation equipment Elaine's oxygen saturation falls below 90% for a further 10 minutes.	Carry over from above		We could only guess that, when they make the decision not to proceed with the operations, the patient's vital signs were stabilized. ☑ They perceive that the airway is insecure as the SaO2 is falling	☑ Clear comprehension that complications mean they should not proceed with the operation ☒ There is no verbalization of the severity of the situation	☑ Predict that continuing with operation may encounter more difficulties and may even cause harm to patient ☒ Did not anticipate the possible consequences of an unsecured airway

			Situation Assessment and Awareness		
Case 5: Elaine Bromiley	Influencing Factors	Biases	Info Gathering	Understanding	Thinking Ahead
35 minutes after the start of the anesthetic it was decided that Elaine should be allowed to wake up naturally and was transferred to the recovery unit. When she failed to wake up she was then transferred to the intensive care unit. Elaine never regained consciousness and after 13 days the decision was made to withdraw the ventilation support that was sustaining her life.	**Stress:** carried over from above – a seemingly routine procedure gone very wrong and repeated attempts to secure the airway failed Possible **fatigue** at trying to achieve this task for such an extended period of time.		We could only guess that at this point, the patient's vital signs were acceptable (i.e. SaOx no less than 90% and normal heart rating, etc.) ☒ It is likely that the team still has not recognized how much time has passed up to this point	☒ It is clear the team believes that the patient was in stable condition and the only reason why she hasn't woken up is because of anesthetic ☒ There still seems to be a lack of comprehension of severity	☒ It appears that staff are predicting that as anesthetic diminishes, the patient will wake up; and by then, a new operation can be scheduled ☒ There is no indication that staff anticipated any damage had been caused to patient, nor did they consider the possibility that situation could get worse before the patient woke up

Key lessons: It is important to continuously monitor the passage of time as part of maintaining situation awareness.

Terminology and Definitions

Adverse event	An injury resulting from a medical intervention
Anchoring	Fixation on the initial assessment, making it unlikely that the initial assessment will be reassessed and updated with new information. Anchoring makes the initial elements salient and more difficult to relinquish in the face of new information
Attentional biases	Biases influencing perception and attention
Cognitive biases	Biases influencing thinking, problem solving, and decision making
Confirmation bias	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.
Effects and Behaviours	Influencing factors and behaviors resulting from the interaction between environmental factors, task demands, and human capabilities and limitations. The Effects and Behaviours include factors such as fatigue, stress, distractions and interruptions, physical and mental workload, and situation awareness.
Environmental factors	All elements, physical and human, that are in someone's environment when one does their job.
Human Capabilities	The overall set of one's innate abilities to perceive, think, and act along with technical and non-technical acquired skills.
Human Environment	The human environment includes all other healthcare workers that you either work with or that are in the environment, doing their job not necessarily with you. The human environment also includes organizational aspects such as shift work and handovers, staffing, policies and protocols, training and supervision of residents, consultations, etc
Human Factors	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. Also the set of interrelated components and factors that play a role in the behaviour and performance of individuals and teams.
Human Limitations	The innate constraints and limitations of one's abilities to perceive, think, and act.
Human performance	The eventual behavior of anyone performance of one's job, measured in terms task and job completion and the subsequent outcomes.
Patient safety	Freedom from accidental injury; ensuring patient safety involves the establishment of operational systems and processes that minimize the likelihood of errors and maximize the likelihood of intercepting them when they occur[1].
Physical environment	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.
Situation assessment	Essentially it is the process of integrating relevant information from the environment into a concise picture based on which all decision making and action take place
Situational Awareness	Simply put this is "knowing what is going on around you". It is both a process of assessing a situation and the resulting knowledge or awareness of that situation.
Tunneling	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.

[1] Kohn, L.T., Corrigan, J.M., Donaldson, M.S. (eds.). (2000). To Err is Human. Institute of Medicine, Washington, DC: National Academy Press

Annotated Bibliography

Ahmed, K., Keeling, A., Khan, R., Ashrafian, H., Arora, S., Nagpal, K., et al. (2010). What Does Competence Entail in Interventional Radiology?. *Cardiovascular and interventional radiology,* 33(1), 3–10.

This paper gives an overview of the skills required to be a competent interventional radiologist (IR) along with asuccinct introduction to methods of assessment of technicaland non-technical skills. Due to the multidimensional role of an interventional radiologist, a practitioner in this discipline must have a number of the competencies of anesthetists, surgeons, and radiologists. Components of non-technical competencies reviewed in this article include, among others, teamwork, which in turn consists of communication, cooperation, leadership, and situation awareness. In addition, the author highlighted NOTECHS as valid assessment for non-technical skills in IR.

Beuscart-Zéphir, M., Pelayo, S., Anceaux, F., Maxwell, D., & Guerlinger, S. (2007). Cognitive analysis of physicians and nurses cooperation in the medication ordering and administration process. *International journal of medical informatics*, 76(Suppl 1), S65–S77.

This article investigated the physician–nurse cooperation in the medication ordering and administration process. It differentiated two patterns of such cooperation: synchronous and asynchronous. It also proved that the main benefit from the synchronous organization is the shared contextual knowledge between the physician and the nurse about therapeutic decision making. The second pattern was compared with CPOE situation where the coordination of physicians' and nurses' actions was delegated to the system.

The author introduced the concept of "common frame of reference" and suggested that it was similar to "shared situation awareness".

Beuzekom, M. V., Boer, F., Akerboom, S., & Hudson, P. (2010). Patient safety: latent risk factors. *British Journal of Anaesthesia*, 105(1), 52-59.

This article highlighted system approach as more favorable to patient safety comparing to person-centered approach. It also identified several latent risk factors, including situation awareness, communication, teamwork among others. The significant role of situation awareness, as is seen by the authors, came from the fact that it allowed proactive intervention and can drive changes in priorities as a result of changes in the patient, the operating team environment, or outside the operating team.

Blandford, A. (2004). Situation awareness in emergency medical dispatch. *International Journal of Human-Computer Studies,* 61(4), 421-452.

By focusing on a domain in which situation awareness has not previously been studied—emergency medical dispatch (EMD), findings in this research contributed to the overall understanding of SA in general, and particularly to the understanding of situation awareness in EMD. Multiple qualitative research methods—including observation and interviews—were employed to understand how these EMD operators develop and maintain situation awareness in their dynamic environment, particularly among the more senior EMD operators called allocators. Based on such understanding, the author proposed several high-level requirements for systems to support appropriate situation awareness, to enable EMD staff to complete their work effectively. This study also related to those of others, particularly Endsley and Wickens.

"Mental picture", or the allocator's understanding of the situation, was highlighted in this research, which comprises a static, structural component and a dynamic, temporal component. According to the author, situation awareness is not the mental picture; rather, the mental picture is an outcome of the process of situation awareness; it may be considered a snapshot of the state of events at a point in time.

Boulet, J. R., & Murray, D. J. (2010). Simulation-based Assessment in Anesthesiology: Requirements for Practical Implementation. *Anesthesiology*, 112(4), 1041.

The purpose of this article is to provide a broad overview of the use of simulation for measuring physician skills and competencies.

Cooper, S., Cant, R., Porter, J., Sellick, K., Somers, G., Kinsman, L., et al. (2010). Rating medical emergency teamwork performance: development of the Team Emergency Assessment Measure (TEAM). *Resuscitation*, 81(4), 446-52.

This research aimed to develop a valid, reliable and feasible teamwork assessment measure for emergency resuscitation team performance. Following expert review, selected items were found to have a high total content validity index of 0.96. The final 12 item (11 specific and 1 global rating) are rated using a five-point scale and cover three categories leadership, teamwork and task management. Within these categories are nine elements, two of which are situation awareness (perception) and situation awareness (projection). Also note that this study included an extensive review of the literature for teamwork instruments (14 in total, up to Sep. 08).

Cooper, S., Kinsman, L., Buykx, P., McConnell-Henry, T., Endacott, R., & Scholes, J. (2010). Managing the deteriorating patient in a simulated environment: nursing students' knowledge, skill and situation awareness. *Journal of Clinical Nursing*, 19(15-16), 2309–2318.

This study was to examine, in a simulated environment, the ability of final-year, final-semester nursing students to assess and manage patient deterioration and to measure the relationships between knowledge, situation awareness (SA) and skill performance (SP). No significant correlations were found between knowledge, SP and SA measures; however, there was a borderline correlation between SP and SA scores (ϱ-one-tailed = 0.201,p = 0.079). The mean situation awareness score (measured by SAGAT) across both scenarios was 59% (range 38–82%). Participants tended to identify physiological indicators of deterioration (77%) but had low comprehension scores (44%).

Traditionally patient deterioration data have been gathered by retrospective analysis of patient records and route case analysis strategies. This study adds to this work by its captureof decision-making in action (in a simulated environment).

Croskerry, P., Cosby, K. S., Schenkel, S. M., & Wears, R. L. (2008). Patient Safety in Emergency Medicine. Philadelphia, PA: Lippincott Williams & Wilkins.

With the increasing emphasis on reducing medical errors in practice, this book focuses on patient safety within the emergency department, where preventable medical errors have been reported to occur. The book provided an overview of patient safety within health care, including the "culture of safety", importance of teamwork, organizational change as well as specific guidelines on issues such as medication safety, procedural complications, and clinician fatigue to ensure quality care in emergency department. Special sections discuss emergency department design, medication safety, and awareness of the 'culture of safety.

Fioratou, E, R Flin, R Glavin, & R. Patey. (2010) Beyond monitoring: distributed situation awareness in anaesthesia. *British Journal of Anaesthesia,* 105(1), 83.

This paper reviewed researches in anaesthesia that focused on situation awareness as patient monitoring alone and advocated for a more comprehensive view, namely, a distributed cognition approach, in which the unit of analysis is not just the agent (anaesthetist) but the interaction of the agent withits environment that allows assessment of the agent's adapted behaviour. The author argued that situation awareness was best understood at the level of anaesthetist–environment relationship. By comparing the traditional situation awareness model and the distributed situation awareness model in anaesthetic practice, the author discussed how a distributed situation awareness approach could complement current research scope. Elaine Bromley case was used to illustrate the distributed situation awareness perspective.

Fletcher, G. C. L., McGeorge, P., Flin, R. H., Glavin, R. J., & Maran, N. J. (2002). *British journal of anaesthesia,* 88(3), 418-29.

What is clear from this review is that non-technical skills play a central role in good anaesthetic practice and that a wide range of behaviours are important. These include: monitoring, allocation of attention, planning and preparation, situation awareness, prioritization, applying predefined strategies/protocols, flexibility in decision-making, communication, and team-working.

Flin, R., Winter, J., Sarac, C., & Raduma, M. (2009). *Human Factors in Patient Safety: Review of Topics and Tools*. Report for methods and measures working group of WHO patient safety. Geneva: World Health Organization.

This report was prepared for WHO Patient Safety's Methods and Measures for Patient Safety Working Group. It provides a basic description of major topic areas relating to human factors relevant to patient safety, with some indication of possible tools that can be used in a healthcare workplace for measurement or training of these topics.

First an explanation of the human factors approach is provided. An organizing framework is presented to provide a structure for the discussion of the topics, by categorizing them as follows: i) organizational/ managerial, ii) team, iii) individual, and iv) work environment. Wider social factors and the central role of the patient are also acknowledged but these aspects of the healthcare system are not explicitly covered. Ten topic areas within these four categories are described: organizational culture, managerial leadership, communication, teamwork, team leadership, situation awareness, decision making, stress, fatigue, work environment. A selection of tools for education, measurement or training these human factors topics is described. Some of these may be suitable for application in developing, as well as developed, countries.

Gosbee, J. (2010). Handoffs and Communication: The Underappreciated Roles of Situational Awareness and Inattentional Blindness. *Clinical obstetrics and gynecology,* 53(3), 545-558.

This article reiterated the expanded framework of situational awareness introduced by Wright and Endsley, with more details about how it could be applied to medical field. Besides the three levels of situational awareness, this framework also identified four factors that affect each of the three levels, among which goals and expectations were further discussed in light of inattentional blindness. In the second part of this article, the author gave a series of critique of literature on how communication and handoffs can go awry and potential remedies, which were guided by human factors engineering concepts of situational awareness and inattentional blindness.

Halbesleben, J., Cox, K., & Hall, L. (2010) Transfer of Crew Resource Management Training: A Qualitative Study of Communication and Decision-Making in Two Intensive Care Units. *Leadership in Health Services,* 24(1), 19-28.

This study aims to identify the effect of (crew resource management) CRM training on communication and decision-making, processes that are associated with better teamwork and patient safety. Employees in two intensive care units at a U.S. academic medical center, one with high training penetration (67% trained) and one with low penetration (27%), were observed and interviewed about CRM principles and teamwork. Differences were found between the units in communication and decision-making, suggesting that high levels of training concentration are needed, along with incentives for implementation of CRM principles to maximize effectiveness. This study was intended for adding value to the literature by examining the processes mediating CRM training and its intended patient safety outcomes.

Kostopoulou, O. (2006). From cognition to the system: developing a multilevel taxonomy of patient safety in general practice. *Ergonomics*, 49(5), 486–502.

The paper presents a taxonomy of patient safety in general practice.The taxonomy has a three-level structure. At level one, the information-processing model of cognition is used to classify errors. At level two, immediate causes are identified, internal and external to the individual. At level three, more remote causal factors are classified as either "work organization" or "technical" with subcategories.

Leake, P. A. E., & Urbach, D. R. (2010). Measuring Processes of Care in General Surgery: Assessment of Technical and Nontechnical Skills. *Surgical Innovation*, 17(4), 332-339.

This article reviews recent advances in surgical quality of care measurement with particular emphasis on processes of care, and evaluates existing measures of technical and nontechnical surgical skills as measures of quality of care in surgery. Specifically, nontechnical skills highlighted in this review as critical for surgery include cognitive and interpersonal skills—teamwork, leadership, situation awareness, decision making, task management, and communication. Moreover, the Non-Technical Skills (NOTECHS) scale and the Non-Technical Skills for Surgeons (NOTSS) system were identified as reliable and valid tools for the assessment of surgeons. However they have not been used for the purpose of outcome and quality of care improvement. The authors concluded by arguing that the future of quality of care assessment in surgery lies in the evaluation of processes and structures of care, rather than the traditional narrow focus on surgical outcomes.

Mackintosh, N., Berridge, E.-J., & Freeth, D. (2009). Supporting structures for team situation awareness and decision making: insights from four delivery suites. *Journal of evaluation in clinical practice,* 15(1), 46-54.

Arising from an ethnographic study of safety culture in the delivery suites (DSs) of four UK hospitals, the aim of this study is to describe the main mechanisms supporting team situation awareness (TSA) and examine contrasting configurationsof supports. Handover, whiteboard use and a coordinator role emerged as the key processes facilitating work and team coordination. To generalize this finding, the author commented that these three key factors were not unique to DSs because they had been researched individually elsewhere, although not usually within a TSA or team performance framework. Moreover, the author identified that the interplay between these supporting processes and the contextual features of each site promoted or inhibited TSA.

This article provided a systematic perspective by highlighting external factors that support/inhibit TSA. However, it didn't tackle the problem of training TSA for health workers.

Another closed related research:

Berridge, E.-J., Mackintosh, N. J., & Freeth, D. S. (2010). Supporting patient safety: examining communication within delivery suite teams through contrasting approaches to research observation. *Midwifery*, 26(5), 512-9.

McGaghie, W., Issenberg, S., Petrusa, E. R., & Scalese, R. J. (2010). A critical review of simulation-based medical education research: 2003–2009. *Medical education*, 44(1), 50–63.

This article reviews and critically evaluates historical and contemporary researchon simulation-based medical education (SBME). It also presents and discusses 12 features and best practices of SBME that teachers should know in order to use medical simulation technology to maximum educational benefit. Team training was recognized as one of the features of SBME.

This article cited RAND's report and identified "lack of situational awareness" as a sign of ineffective team work. But in fact, there was nowhere in RAND's report that situational awareness was mentioned; only "situation assessment" was talked about.

Moulton, C., Regehr, G., Lingard, L., Merritt, C., & MacRae, H. (2010) 'Slowing Down When You Should': Initiators and Influences of the Transition from the Routine to the Effortful. *Journal of Gastrointestinal Surgery,* 14(6), 1019–1026.

This study was designed to explore the factors that initiate and influence the transition from the routine to the effortful—i.e. "slowing down when you should"—in operative surgical practice. Twenty-eight surgeons across different surgical specialties were interviewed. Using ground theory, data were collected and analyzed in an iterative design, using a constant comparative approach. Emergent themes were identified and a conceptual framework was developed. This taxonomy consists of two maininitiators, namely proactively planned 'slowing down' moments, which were anticipated preoperatively from operation-specific or patient-specific factors, and situationally responsive 'slowing down' moments, which refer to unexpected events. Surgeons also described several influencing factors on the slowing down phenomenon (e.g. fatigue, confidence).

Besides, surgeons also described details ofsituations that were distinctly different from the experienceof successfully 'slowing down when they should'. Two such categories of experience were articulated in the interviews, one of which was labeled 'plowing through' by the researchers. As constructed by participants, these "failure to slow down" occurred because of being unaware, or not appreciating, all pertinent, available information in their surroundings, or a lack of situation awareness.

As commented by the authors, this taxonomy and framework provided a vocabulary for considering the events surrounding these critical moments in surgery, essential for teaching, self-reflection, and patient safety.

Parker, W. (2010). Understanding Errors During Laparoscopic Surgery. O*bstetrics and Gynecology Clinics of North America*, 37(3), 437-439.

Seven cases were reviewed and analyzed in this article, aiming for a better understanding of cognitive issues as they relate to the performance of surgery. The role that the human brain's hardwiring (connections among neurons) plays in shaping information processing and the role that perceptual learning and situation awareness play during the performance of surgical procedures were considered here. Especially, loss of haptic perception and hence errors of situation awareness was highlighted in case 3. Surgical error prevention and management and the structure of surgical training were also discussed.

Risser, D. T., Simon, R., Rice, M. M., & Salisbury, M. L. (2000). A structured teamwork system to reduce clinical errors. In P. L. Spath (Ed.), *Error Reduction in Health Care: A Systems Approach to Improving Patient Safety* (1st ed., pp. 235-278).

This chapter describes a structured teamwork system--created by the MedTeams Project--that is being tested and used in emergency departments around the country to reduce the risk of clinical errors. It teaches team members to actively coordinate and support each other in the course of clinical task execution using the structure of work teams. The basic concepts and behaviors of teamwork are taught to staff in a one-day course. The behaviors taught become habits and skills through daily practice.

Teamwork behaviors have been organized into a framework composed of five team dimensions here:

- **Maintain team structure and climate**
- **Apply problem-solving strategies**
- **Communicate with the team**
- **Execute plans and manage workloads**
- **Improve team skills**

Specifically, team dimension 3—communicate with the team—focuses on communication activities that help team members establish and maintain a common understanding of patient and operational issues affecting team and teammate workload levels. This objective is generally focused on timely and accurate information transfer and on maintaining a common situation awareness so team members can effectively coordinate actions and recognize pending errors. This dimension addresses specific teamwork actions taken to ensure timely and accurate clinical communication. Team members cannot deliver proper care or effectively coordinate actions without an accurate awareness of the current state of affairs.

Teamwork activities were categorized into two, namely teamwork conferences and individual teamwork. As the latter has been highlighted here, the authors described it as caregivers operating as individual team members observing or briefly connecting with one other team member. Specifically, they monitor, intervene, and correct errors or deviations in both their own and the other team member's situational awareness, i.e. "check". The value of such actions especially when becoming a routine over time, as was explained in this chapter, lied in that it broke error chains.

Rivera-Rodriguez, A. (2010). Interruptions and distractions in healthcare: review and reappraisal. *Quality and Safety in Health Care,* 19(4), 304-312.

This research was to systematically review the peer-reviewed literature on interruptions in healthcare settings to determine the state of the science and to identify the gaps in research. Several important findings were identified: (1) interruptions occur frequently in all healthcare settings, (2) an important gap exists: only seven studies examined outcomes related to interruptions, (3) interruptions in healthcare have only been studied from the viewpoint of the person being interrupted and (4) few studies explicitly or implicitly examined the cognitive implications of interruptions. The researcher identified the complexity of interruptions, i.e. both positive and negative effects of it. For the positive ones, it was suggested that goal-driven interruptions need to be studied as having potential performance benefits that may result in, among others, improved situation awareness.

It is interesting to note that another article published one year ago (Grundgeiger, T., & Sanderson, P. (2009). Interruptions in healthcare: Theoretical views. *International journal of medical informatics,* 78(5), 293–307.) **made similar observation that there little evidence existed in healthcare of the extent to which interruptions lead to adverse effects.**

Robinson, F., Gorman, G., Slimmer, L. W., & Yudkowsky, R. (2010). Perceptions of Effective and Ineffective Nurse–Physician Communication in Hospitals. *Nursing Forum,* 45, 206–216.

This study explored perceptions of effective and ineffective interprofessional communication in hospitals from the perspective of practicing nurses and physicians.

This study adds to the growing knowledge base related to interprofessional communication by using a qualitative focus group methodology whereby professionals offered rich descriptions of personal experiences with communication successes and problems.

Collaborative problem solving (among all the five themes that have been revealed) was seen as effective communication. This supports the vast amount of evidence that suggests interprofessional teamwork is an essential component of safe, quality care (Salas et al., 2008). In fact, the collective knowledge and situation awareness of members of an interprofessional team exemplified through shared problem solving is necessary for patient safety. (Cook, Salas, Cannon-Bowers, & Stout, 2000; Salas et al., 2008).

Smith, A. F., & Greaves, J. D. (2010). Beyond competence: defining and promoting excellence in anaesthesia. *Anaesthesia*, 65(2), 184-91.

Recent trends in medical training have tended to focus on competence, in the sense of adequate performance, rather than excellence. This article reviews published literature and relevant concepts relating to excellence and professionalism from within anaesthesia, from medicine more generally and from outside the profession. A number of conceptual frameworks are presented that could be adapted for the promotion of excellence, and some of the necessary prerequisites for this promotion discussed.

Following a thorough literature review, Fletcher et al. developed a prototype classification of non-technical skills in four domains, namely task management, team working, situation awareness and decision-making.

Tien, G., Atkins, M., Zheng, B., & Swindells, C. (2010). Proceedings of the 2010 Symposium on Eye-Tracking Research & Applications: *Measuring situation awareness of surgeons in laparoscopic training*, (pp. 149–152).

This study compared eye movements of four experts and four novices performing a simulated gall bladder removal task on a dummy patient with an audible heartbeat and simulated vital signs displayed on a secondary monitor. Researchers used a head-mounted Locarna PT-Mini eyetracker to record fixation locations during theoperation. From the result, expert surgeons were observed to be more aware of the changes in patient condition throughout the duration of a simulated minimally-invasive gall bladder operation, measured as the number of times they looked at the secondary display containing the patient's vital information. In comparison, novices concentrated so hard on the surgical display that they were hardly able to look at the patient's vitalsigns, even when heart rate audibly changed during the procedure.
Highlight in this study was to use eyetracking information of surgeons as a probe to measure their situational awareness which, in previous studies, was always measured subjectively by pre-designed assessment forms and results were inconsistent and lack reliability.

Wright, M., & Endsley, M. (2008). Building shared situation awareness in healthcare settings. In C. P. Nemeth (Ed.), *Improving Healthcare Team Communication: Building Lessons from Aviation and Aerospace* (p. 97–114). Burlington: Ashgate Publishing.

In this chapter, the authors presented a model of team situation awareness that described the critical foundations upon which high levels of shared situation awareness were developed in team environments, including the role of communications. They also described devices and processes that facilitated the development of high levels of team situation awareness.

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