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## Key Words

Situational Awareness; Clinical Reasoning; Clinical Judgment; Case-Based Discussion

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# Tying in Situational Awareness, Clinical Reasoning and Clinical Judgment through Cross-Training Using Case-Based Discussions in Emergency Medicine

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## Abstract

Situational Awareness (SA) is knowing about what is going on around oneself, whether as an individual or as a team. It is the mental impression of where you are, what surrounds you and what lies ahead. SA has been noted to be one of the most important non-technical skills in medicine. It is a foundational concept in many high reliability organizations and industries for its importance in operational decision-making. Clinical Reasoning essentially summarises the process of making timely and accurate diagnosis. It goes through the steps of history taking, physical examination, performing diagnostic investigations, interpreting the results that are returned and planning management for patient care. It is a fundamental in the practice of medicine and even in today's context of technology and Artificial Intelligence (AI) applications, these steps are incorporated into the algorithmic formulae. Clinical Judgment, on the other hand involves the process of "noticing, interpreting, responding and reflection" Just from the three definitions above, it can be seen that there may be overlaps between the three terms. They are also very often used almost interchangeably. Practitioners of academic medicine, educators and faculty, need to understand the similarities and differences between the three terms. They are often called upon to assess their learners in these domains. Thus, clarity on what each term exactly means is essential. In this paper, the author shares her experience as an educator and core faculty in Emergency Medicine Residency on the utilization of Case-Based Discussions (CBD) in the nurturing and inculcation as well as assessment of all these three domains. The ability to plan and use CBD in such a manner is time efficient and effective for emergency physicians, as it can be consciously prepared with the coverage of SA, CR and CJ skills all incorporated into the shared narrative or scenario management.

## Introduction

### Situational Awareness and the Practice of Emergency Medicine

Emergency Medicine (EM) is the specialty dedicated to the diagnosis and treatment of new or unforeseen illnesses and injuries. The practice can be complex and inter-twined with other disciplines and it requires a high level of astuteness and vigilance. It encompasses proper planning and organization, ability to manage extremely dynamic situations with adequate oversight and supervision, and timely execution of care for a very wide spectrum of presentations by patients. The practice requires training to build up capabilities as well as the mental model to approach care delivery in Emergency Departments (ED). At the same time, in most teaching hospitals, there will be residents and students at various stages of learning and development who are embedded for experiential learning from Emergency Physicians (EP) [1,2]. In such an adaptive, complex and fast changing hectic environment, astute and robust Situational Awareness (SA) is crucial to support the cognitive as well as behavioural processes in the ED. SA is knowing about what is going on around oneself, whether as an individual or as a team. It is the mental impression of where we are, what surrounds us and what lies ahead. SA has been noted to be one of the most important non-technical skills in medicine. It is a foundational concept in many high reliability organizations and industries for its importance in operational decision making [3-5]. In the context of EM, it has to do with being able to see clearly, what our patients are presenting with, understand the seriousness and implications, manage these appropriately by developing management and coping plans. At times, certain conditions or diagnoses may not be so apparent and requires an EP to take a step back, review the whole big picture and develop a perspective that will enable analysis of options, opportunities and thus, make informed decisions. It will now seem that SA is at the core of the practice of EM. It is essentially the perception of the elements in the environment, within the volume of time and space, the understanding of their meaning and the projection of this status into the near future [6-8]. This helps us define the domains of SA [9,10]:

**Level 1 SA:** Perception of the environment. This involves being observant and gathering information from all possible sources (eg. history from patient, collateral history from relatives or eyewitnesses, checking electronic medical records, performing physical examination and ordering relevant diagnostic tests). When all the pieces of information are put together, the patient's story or narrative will become clearer.

**Level 2 SA:** Understanding the meaning of the gathered information and situation, interpreting results as they become ready and reviewing the list of differential diagnoses under consideration, fit into this level of SA. With the comprehension of these, appropriate treatment can be started as well. This is usually the stage when there is assignment of meaning to the presentation scenario and the "big picture" begins to become clearer.



**Level 3 SA:** This is the stage involving projection of future events of the situation, which means realization of the possible trajectories and potential complications and outcomes. This should be combined with the planning on the management of likely and probable events in the near future. This is also the stage when the “understanding” achieved in Level 2 SA is applied in thinking ahead, in order to anticipate issues which may arise. An EP moves through all these levels, making the appropriate and timely decisions pertaining to patient management. This is often done subconsciously, within a circumscribed period of time and space. The practice of emergency medicine today is not a solo endeavour, thus team SA is also important as it represents the shared mental model in team coordination, communications and action. Team SA refers to the collective perception, understanding and projection involved in patient management. It involves the knowledge of team tasks, roles and responsibilities. Individual members will share knowledge and inputs of the situation, which goes towards putting the whole picture of the case together [8, 10, 11]. SA can be promoted both consciously or subconsciously. It requires EPs to be alert to the dynamic and evolving conditions of the acute patients, with the appreciation of the urgency of the situation. Switching from task to task should also be systematic and coordinated, in order to be more analytical and to be able to think ahead in a step-wise fashion. EPs are continually perceiving, interpreting, understanding and projecting, for their patients. Novices may find difficulties at various stages, especially projecting ahead due to their lack of exposure, experience and training. Guided facilitation by experienced faculty can help them come to realization and be more conscious about these tasks [3,4,8]. Loss of SA will find oneself in a thoughtless position, with the risk of disconnection, and irrational expectations. It is not uncommon to find this in situations of cognitive or emotional overload. In the ED, multiple situations can impose significant psychological burden on EPs and healthcare workers. Stress during the handling of life-threatening cases can disrupt SA. Fixation and fixation errors can do the same. Other day-to-day issues such as shortfall in staffing, challenging work environment, distractions in many forms, unmanageable tasks loads, insufficient timing and even poor human-centric designs can lead to the compromise of SA [12]. Hierarchy and power distance can affect performance. Fatigue can also affect the flow of work processes. The latter can lead to lapses in attention and memory as well as a reduction in the speed and accuracy of processing information. Not forgetting also that the culture of an organization or department has a role to play in developing SA. A ‘flat’ or less hierarchical department with open and honest communications, and better satisfaction levels amongst staff can see SA flourish. As it is, disruptions and compromise can happen at one or multiple levels, or even as a subset of one level of SA. This is often an unconscious process, which makes the team drift away from safe practices [9,13,14]. Thus, when one ED team member is at risk of error, other members may hear and see things differently and be able to identify the under-appreciated risk, which can be highlighted. This illustrates how the culture of team support can be crucial in the ED. Table 1 and Table 2 also shares the factors that can commonly affect SA.

Table 1: Threats to The Development of Good Situational Awareness

Examples of Threats to Good Situational Awareness
Lack of knowledge, training or experience
Incompetence
Fatigue
Stress
Fixation/ fixation errors
Loss of focus/ distractions
Impaired physical or cognitive function
Lapse in memory
Poor communications/ lack of closed loop communications
Poor or dysfunctional team dynamics
Interruptions
Shortage of manpower/ staffing
Patient overload
Hierarchy and Power Distance
Culture

Table 2: Factors Influencing Situation Awareness (with examples)

	Factors Influencing SA	Details (examples)
1	The Patient	Name, age, ethnic group, communications, vitals, evolving medical condition and presentation
2	The Environment	Space, lighting, design of rooms and ergonomic considerations, physical layout, temperature, background noise
3	Human factors	The people involved, their knowledge, experience, training, staffing, communications, memory, familiarity with protocols
4	Performance Modifying factors	Stress, fatigue, hunger, emotional distress, information or tasks overload
5	Tasks	Complex, dynamic, evolving and ever-changing tasks Data gathering, physical examination, ordering investigations, interpretation of results, coming up with differential diagnoses, monitoring, judicious resource allocation
6	Time	Elapsed time, time efficiency for time dependent conditions, losing track of time, poor time allocation with tasks overload

**Error Points in Situational Awareness**

The Level 1 SA (Perception) errors which can happen in practice in the ED are:

- Failure to perceive information gathered
- Information is not available because of omission of tasks or steps have been skipped
- Blind spots: whereby some information is difficult to pick up or if there is too much information, the relevant information may become lost or blind-sighted
- Failure to monitor or observe certain data and information
- Misperceptions of information or pointers
- Memory lapse, due to information overload or interruptions and
- Poor and ineffective communications

Level 2 SA errors (Understanding and Comprehension) would include:

- Improper or inadequate integration of information available due to lack of understanding
- Incomplete development of mental model or use of incorrect mental model. This can be due to cognitive challenges or differences in interpretation, and
- Over-reliance on default values: assuming the way they have always comprehended it is the correct and acceptable way

Level 3 SA errors of Projection may carry forth from earlier Levels 1 and 2 errors. They may also arise entirely as a Level 3 error with no link to Level 1 or 2 lapses.

- Over or under projection of the trajectory the patient may take, which is linked to a misjudgement issue
- Projection of the wrong or incomplete mental model (which may be carried forward from earlier errors or fixations), and
- Unrealistic expectations

**Clinical Reasoning (CR) and Clinical Judgment (CJ)**

Besides SA, CR and CJ are two other terminology that is often used in clinical practice, including in EM. However, there is often a lack of understanding of how and when the three terms should be used and what each one encompasses. There are also



some similarities and differences between them.

Table 3: Tying in Situational Awareness, Clinical Reasoning and Clinical Judgment

CLINICAL REASONING			
Clinical Judgment	Situational Awareness (SA)	Definition	Components
Noticing	SA Level 1	Perception of situational elements	Visual/ general impression History taking Physical examination Diagnostic investigations
Interpreting	SA Level 2	Comprehension or understanding of the elements in the situation	Pattern recognition Interpretation of results Diagnosis/ differential diagnoses: 'rule in' or 'rule out'
Responding	SA level 3	Projection of the learning for future situations	Treatment/ therapeutics  Next line of investigations Disposition decision Potential course/ complications/ trajectory
Reflection			

The main components of CR are [15,16]: (Table 3, within the outlined box)

1. Thorough and directed history, with appropriate and specific questioning to enable one to reach the diagnosis or differential diagnoses. This step also involves filtering of the data obtained into the more important and relevant ones.
2. Targeted physical examination to confirm the differential diagnoses above.
3. Critical selection of the choice of investigations which will provide additional information needed to confirm the diagnosis or rule in/ out the differential diagnoses. Training and experience will help one with the range of investigations that will value add to the diagnostic process, as well as,
4. Targeted management and treatment plans

CR essentially summarises the process of making timely and accurate diagnosis. In today's context of technology ad Artificial Intelligence (AI) applications, these steps are incorporated into the algorithmic formulae. In Table 3, the process of CR is boxed within the outline. This will also show that CR is encompassed within the framework of SA, or it can be viewed as a subset of SA. It has similar components at Levels 1, 2 and part of level 3 SA [17,18].

(Table 3) At the novice and trainee levels, these steps are reiterated and reinforced every time there is a patient encounter. As an EM resident continues to gain experience and moves towards competency, he will come to realize that there may be atypical cases and presentations that have to be considered as well. This may not fit into the usual pattern recognition, yet it still needs to be considered. An example would be when a 50 year old man presenting to the ED with severe, compressive left sided chest pain associated with cold sweats. One of the diagnosis is, quite evidently, an Acute Myocardial Infarction (AMI). Now, when a 70 year old lady who presents to the ED with new onset giddiness and shortness of breath the last two days, but without chest pain, she must also have an AMI ruled out in the work-up. The 70 year old lady may not have the classical chest pain but she may have an atypical presentation of an AMI.

The other term often confused with SA and CR, is CJ. With reference to Table 3, CJ involves four basic components [19-24]:

1. **Noticing:** This corresponds to SA Level 1, where all the necessary observations and data have to be gathered. This is the initial and essential component of CJ. What a novice notices may be different from what an expert would notice. Signs may make more meaning to the trained and experienced eye.
2. **Interpreting:** This represents a very dynamic and complex phase, especially in the ED, where new information will continue to be discovered and revealed (new collateral history from relatives who show up have to be taken into account) and results will become ready for analysis and interpretation. Proper and adequate

interpretation will allow the appropriate interventions to be executed for the patient.

3. **Responding:** This is where the necessary treatment and therapy is delivered to the patient, based on the proper interpretation of investigations outcomes and results. 'Responding' is also dependent on the level of expertise of the personnel concerned. This is true especially for the more subtle alterations from normal which may be more apparent to the experienced EP.
4. **Reflection:** This is the final phase of CJ. As in Table 3, it is not categorically covered under CR or SA. Reflection seeks for one to understand self or the situation they are in. It helps you recognise what you know and do not know, as well as your strengths and weaknesses. Reflection can help in the development of self-directed learning skills. Self reflection is useful but it can also be a guided experience by an EP faculty mentor. The process can help build a learning scaffold. Reflection involves learning from experience, interpretation based on knowledge and beliefs and it also can help to link new and existing knowledge [25-27].

With these definitions, one can clearly see there are overlaps between the three entities. This is one of the reasons why SA, CR and CJ are often used inter-changeably or perhaps in the wrong context. It is important to understand the differences, especially for academics, educators, those involved in supervision, mentoring and work place based assessments. Being aware is an important first step in helping to nurture and integrate these into training programmes.

### Training and Inculcation of Situational Awareness, Clinical Reasoning and Clinical Judgment

All the three; SA, CR, CJ are essential to the good practice of EM. These will continue to be strengthened over time and will get better with experience and seniority of the EPs. There have been various methods and options used to teach and inculcate SA, CR and CJ. Some of these include the use of OSCE (Objective Structured Clinical Examination) stations, simulation with/ without standardised patients, survey questionnaire to assess understanding, condition mapping, scenario-based learning and Case-Based Discussions (CBD). SA and CR have been found to be the highest rated deficient non-technical skills amongst final year medical students and residents in some studies and this has been attributed to lack of or inadequate training and awareness [28,29]. CBD is a form of structured, guided work-place based learning, which is a spin-off from Chart Stimulated Recall (CSR). CSR is the process whereby the faculty reviews one or more of a selection of clinical cases and discusses with the learner on data gathering/ history, diagnosis, problem solving and management, utilization of the ED resources and recordkeeping [30,31]. CBD can be part of a formative or summative assessment, with developmental feedback to identify strengths and weaknesses. CBD usually uses authentic clinical cases, with the gradual release of information and results as one is guided through the case by a supervisor. This is very similar to work in the ED when information may become available in step-wise fashion. In the preparation, the faculty will base the approach according to the curriculum blueprint. The resident or junior EP will have the opportunity to apply his knowledge and skills in clinical reasoning and judgment as he negotiates the case to completion. This is helpful to link theory to clinical case and its management. The CBD experience can be made engaging and inspiring with the stimulating narrative or scenario, realistic results and information becoming available gradually and the EP faculty painting the realistic picture of the case. The narrative with its compelling picture can evoke empathy to a certain extent as well. The CBD method can be used for both individual learning as well as small group learning, guided by faculty. The cases selected usually represents the starting point of the discussion and conversation with learners. Faculty need to be prepared with the knowledge of the case, the range of questions to be used to help reflection and recall of the case management. The approach is very much styled like a viva voce. Discussions are always evidence-based or competency-based as relevant for each case. Faculty can also explore record keeping and documentation, areas for improvement, areas that were done well and future planning in terms of learning or take-away points. In some departments, EP faculty develop a library of CBD cases which can be used on different occasions, ranging from simpler cases to more complex ones [32,33]. Table 4 summarises the elements in a CBD. It also highlights which of the three cognitive domains are the focus. The overlap in these areas can be seen as reinforcements. Reflection is covered under CJ. However, it would be quite apparent that as one goes through the CBD, reflection would be involved at the various stages as well. This is also very dependent on the line of questioning framed by the EP faculty. Table 5 goes on to illustrate the steps in the CBD with an actual example of a clinical case presenting to the ED. The Decision-Action cycles happens at various stages and it can be seen that the flow is extremely dynamic.



**Table 4:** Tying SA, CR and CJ through the use of Case-based Discussions

Elements	Case-based Discussion Domains	Cognitive Process Involved
Scenario/ narrative setting Setting the background/ situation and surrounding	<ul style="list-style-type: none"> <li>Pre-arrival preparation</li> <li>Triage</li> <li>Key points in history from patient and family/ Building rapport with patient and family</li> <li>Counter-check against electronic health records</li> <li>Inter-professional team/ personnel and communications</li> </ul>	SA: Perception CR: History CJ: Noticing
Initial assessment/ Physical examination Systematic Approach Bite-size/ gradual release or availability of information/ results	<ul style="list-style-type: none"> <li>Primary, secondary and tertiary assessment, physical examination</li> <li>Resuscitation/ initial management and interventions</li> <li>Clear delegation of tasks and collaborative roles in teams</li> <li>Diagnostic investigation</li> </ul>	SA: Perception CR: Physical examination CJ: Noticing
Initial impression Continued progression and development of a dynamic situation (Decision-Action Cycle)	<ul style="list-style-type: none"> <li>Pattern recognition</li> <li>Differential diagnoses and refinement/ review</li> <li>Secondary/ additional investigations to help 'rule in' or 'rule out' differentials</li> <li>Interpreting results as they become available</li> <li>Responsiveness/ action</li> </ul>	SA: Understanding CR: Selection/ choice of diagnostic investigations CJ: Interpreting
Review options Disposition Complications (Potential) Progress/ Trajectory Future learning	<ul style="list-style-type: none"> <li>Rational choice of drugs/ medications</li> <li>Treatment/ further interventions</li> <li>Dynamic Management/ step-wise</li> <li>Cost efficient use of resources</li> <li>Informed consent</li> <li>Ethical considerations</li> <li>Management plans: admit, discharge, follow up, hand-over</li> <li>Considerations of the trajectories in the near future</li> </ul>	SA: Understanding/ Projection CR: Investigation/ management cycle (Decision-Action Cycle) CJ: Interpreting and Responding
Learning scaffold Future learning focus Good practices/ lessons	<ul style="list-style-type: none"> <li>Reflection 'of the job' or 'of the case' ad 'reflection on the case'</li> </ul>	CJ: Reflection

**Table 5:** A sample case-based discussion showing the step-by-step approach as well as the domains of SA, CR and CJ covered during each stage

Elements	Case-based Discussion	Line of Questioning by faculty
Scenario/ narrative setting Setting the background/ situation and surrounding	AW is a 70 year old man with a history of hypertension, ischaemic heart disease (IHD), smoking and chronic obstructive lung disease (COLD). He is on long-term home oxygen use at 2 litres every night. His family sent him to the ED for fever with cough and altered mental state for 2 days. The family doctor had visited him at home 2 days prior and started oral antibiotics but his condition did not improve.	What is your initial impression from the data given? Possible diagnoses?  Considerations for sepsis, SIRS

<p><b>Initial assessment/ Physical examination Systematic Approach Bite-size/ gradual release or availability of information/ results</b></p>	<p>Initial vitals: BP: 117/65, HR: 117, RR:20, Sats: 88% on room air, Temp: 38°</p> <p>He is awake but lethargic. He is able to recognise the doctors and nurses. Heart: s1, s2</p> <p>Lungs: crepitations in the left lower zone. During the conduct of the examination he continues to cough, with productive yellow sputum.</p> <p>4 litres oxygen via nasal prong was given and the Sats improved to 93%</p> <p>The daughter brought the family doctor's card and contact was made. The family doctors said he had prescribed a course of tablet Augmentin Vitamin B Complex and Paracetamol.</p> <p>Investigations were ordered: Full blood count (FBC), electrolytes, blood sugar level, blood cultures, lactate level, Chest Xray (CXR), ECG ART (antigen rapid test) and PCR swabs for Covid 19 were taken in view of the ongoing pandemic</p> <p>IV Ceftriaxone/ Azithromycin was commenced after the cultures were taken.</p>	<p>Interpretation of the initial vitals Impression and considerations with the examination findings</p> <p>Initial management you can commence?</p> <p>First line investigation you would order. How do you decide on these?</p> <p>Any further review of your management? Review of your differentials</p>
<p><b>Initial impression Continued progression and development of a dynamic situation (Decision-Action Cycle)</b></p>	<p>The CXR confirmed the left lower lobe pneumonia (can show CXR to learner)</p> <p>The next set of vitals: BP: 92/50, HR: 122, Rr: 26, Sats: 92% on 4 litres Patient appears more drowsy now</p> <p>His FBC results was ready: Hb: 9.9, TW:17 000, platelet: 197 000, neutrophils: 83%</p> <p>Electrolytes: Na: 137, K: 3.9, Cl: 101, Glu 5.9, Lactate: 5.3</p> <p>Arterial blood gas test was done: On arrival: pH: 7.31, pCO2: 59, pO2: 83, BE: 10 After 4 litres of nasal prongs O2: pH: 7.30, pCO2: 62, pO2: 92, BE: 12</p> <p>His ART result: Positive for Covid 19, PCR : pending. In view of this IV and Remdesivir was added.</p> <p>His vital signs were closely monitored in view of the likelihood of septic shock developing.</p> <p>Considerations for the use of inotropic agents were being weighed. Also the issues of airway management with NIV versus intubation/ ventilation were being considered</p>	<p>Interpretation of the next set of vitals</p> <p>Review results coming in (part of interpretation-decision-action cycle) How do you interpret the lactate level of 5.3?</p> <p>What does the ABG results show? What is the trend? What is your oxygen therapy strategy? What is the Covid 19 + management pathway?</p> <p>Impression on the severity of disease we are dealing with now. Septic shock definition and interventions</p>





<p><b>Review options</b> <b>Disposition</b> <b>Complications (Potential)</b> <b>Progress/Trajectory</b> <b>Future learning</b></p>	<p>Discussion with his family members were initiated, covering the issues of end of life care, any Advanced Care Plans being made, sharing information with the closest relatives on his critical condition.</p>	<p>What are the possible trajectories in this patient? How to prepare for them? Any other colleagues to get involved? How to engage the family and next of kin ? Communications pointers for end of life discussions. Bearing in mind the Asian context and culture here</p> <p>Decision and further management plans: intubation or NIV? High dependency or ICU admission?</p>
<p><b>Learning scaffold</b> <b>Future learning focus</b> <b>Good practices/lessons</b></p>		<p>Learning and take away points Management of Type 2 respiratory failure and Oxygen strategy Prognostic factors in COVID</p>

**Conclusion**

The regular use of CBD, spanning the spectrum of clinic cases in the ED can certainly help train and enhance the awareness of learners about SA, CR and CJ. Understanding what each of these domains mean and comprise of, is important, as the terms can be rather abstract. Though distinct, there are similarities between them that can be tied in through the use of CBD. Training EP faculty on the use of CBD is beneficial and can be undertaken to ensure a shared mental model amongst faculty when teaching and assessing their learners and residents.

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