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The Impact of Situational Awareness on Organisational Resilience and Performance in Healthcare Organisations: An Integrative Review

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Abstract

Background. Hospitals and health systems are complex adaptive systems. Safe care, continuity of services and the ability to adapt under pressure all depend on people noticing what is happening, making sense of it and anticipating what comes next. Situational awareness (SA), a concept that grew out of military aviation and human factors engineering, is now built into clinical non-technical skills frameworks, organisational resilience models and crisis management practice.

Aim. This review brings together theoretical and empirical work on how SA, held by individuals, teams and whole organisations, shapes organisational resilience and performance in healthcare. Where the evidence transfers, it also draws on aviation, energy, manufacturing, supply chain management and emergency management.

Methods. An integrative narrative review of peer-reviewed studies, systematic reviews, meta-analyses, seminal theoretical works and authoritative reports, identified through PubMed/PMC, Crossref-indexed publisher databases, Semantic Scholar and AHRQ PSNet.

Results. Failures of SA, and failures of perception in particular, feature prominently in adverse events in anaesthesia, critical care, ward deterioration and primary care diagnosis. Interventions that build shared and distributed SA are associated with fewer medical errors and preventable adverse events, lower surgical mortality and fewer patient-flow delays. Established organisational resilience models treat situation monitoring as a core attribute, and the ‘monitor’ and ‘anticipate’ potentials of resilience engineering do much the same work as Endsley’s three levels of SA. Leadership, psychological safety, information systems, workload and culture all influence how far SA translates into resilience.

Conclusions. SA is necessary for organisational resilience and performance, but it is not sufficient on its own. The evidence is strongest for patient safety outcomes and thinnest for financial and longer-term organisational outcomes, and measurement remains fragmented. We propose a multilevel framework, a research agenda and practical recommendations for healthcare managers.

Keywords: situational awareness; distributed situation awareness; organisational resilience; resilient health care; Safety-II; high reliability organisations; patient safety; non-technical skills; hospital performance

1. Introduction

Since the Institute of Medicine published To Err Is Human (Kohn et al., 2000), healthcare has looked repeatedly to safety-critical industries for an answer to an uncomfortable question: why do competent professionals, working in well-resourced organisations, still harm patients? One of the most influential ideas to come out of that search is situational awareness. Endsley (1995) defined it as the perception of 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. Put more plainly, it means knowing what is going on, understanding what it means and having a reasonable idea of what will happen next. SA is now widely regarded as one of the most important non-technical skills in clinical work and as a foundation for sound clinical decisions and patient safety (Ghaderi et al., 2023).

Over the same period, organisational resilience has moved to the centre of healthcare management. Ebola, COVID-19 and persistent workforce shortages have shown that hospitals must be able to anticipate, absorb, adapt to and recover from disruption. Scholars of resilient health care (Hollnagel et al., 2013; Braithwaite et al., 2015; Barasa et al., 2018) and management researchers (Williams et al., 2017) increasingly accept a simple point: an organisation can only respond to what it has noticed. The New Zealand model of organisational resilience makes this explicit by treating situation awareness as one of the three defining attributes of a resilient organisation (McManus et al., 2008).

Even so, the two bodies of work have grown up largely apart. Research on SA in healthcare concentrates on individuals and teams in operating theatres, intensive care units and emergency departments. Research on resilience works mostly at the level of the organisation or health system and says little about how an organisation comes to know what is happening inside and around it. This review tries to connect the two by asking three questions. How are SA and organisational resilience related in theory? What evidence links SA, and interventions designed to strengthen it, to resilience and performance in healthcare organisations? And what can healthcare learn from other sectors that have grappled with the same problem?

2. Methodology of the Review

We chose an integrative narrative design because the relevant evidence is methodologically mixed. It includes theoretical models, psychometric studies, malpractice claims analyses, quality-improvement reports, quasi-experimental evaluations and qualitative case studies, none of which lend themselves to statistical pooling.

We searched PubMed/MEDLINE and PMC, Crossref-indexed publisher platforms (SAGE, Wiley, Springer, BMJ, Elsevier, ASCE and Emerald), Semantic Scholar and AHRQ PSNet. Search strings combined ‘situation awareness’ or ‘situational awareness’, including distributed, shared and team variants, with terms for organisational resilience, resilient health care, Safety-II, high reliability, patient safety, huddles, command centres, handoffs, non-technical skills and COVID-19, along with sector-specific terms. We also followed citations backwards from key reviews (Barasa et al., 2018; Ghaderi et al., 2023; Walshe et al., 2021).

Sources were included if they defined, theorised or measured SA at any level, or examined organisational resilience or performance outcomes, and if they were peer-reviewed, seminal or produced by an authoritative body. Only sources whose bibliographic details could be verified were retained. We did not carry out formal risk-of-bias scoring. Instead, the design and limitations of each study are described alongside its findings.

3. Conceptual Foundations

3.1 Situational awareness at individual, team and system level

Endsley's three-level model treats SA as a state of knowledge that comes before decision and action. Level 1 is the perception of relevant cues, Level 2 is the comprehension of what those cues mean together, and Level 3 is the projection of how the situation is likely to develop. Each level is shaped by individual factors such as mental models, attention and working memory, and by features of the task and system such as workload, stress, interface design and automation. The model also offers a taxonomy of SA errors at each level (Endsley, 1995). Two decades later, Endsley (2015) responded to common misreadings of the model, the most persistent being the habit of confusing SA itself with the processes people use to acquire it.

Team SA and shared SA extend the idea to groups. Team SA describes how far each member has the awareness their own role requires. Shared SA describes how far members hold a common understanding of the information they all need. It is shared SA that allows an anaesthetist, a surgeon and a scrub nurse to arrive at the same reading of a falling blood pressure.

Distributed situation awareness (DSA) goes a step further. In this view, SA in a socio-technical system is an emergent property held across both people and artefacts. Different agents hold different but compatible parts of the picture, and one agent can make up for gaps in another's awareness (Stanton et al., 2006). The approach was developed in command-and-control settings (Salmon et al., 2008, 2009), reviewed across individual, team and system levels (Stanton et al., 2017), and has since been extended to technologies and whole socio-technical systems (Salmon & Plant, 2022). It fits hospitals well. No single person in a hospital knows the bed state, the staffing position, which patients are deteriorating and what demand is about to arrive. Whatever the organisation 'knows' emerges from exchanges between bed managers, nurses in charge, information systems and executives.

Organisational SA refers to an organisation's understanding of its operating environment, its hazards and vulnerabilities and its dependencies on others, together with its ability to recognise that a crisis is developing (McManus et al., 2008). Lee et al. (2013) made this measurable as 'situation monitoring and reporting', an indicator that captures whether staff are encouraged to stay alert to the organisation, its performance and emerging problems.

3.2 Organisational resilience

Barasa et al. (2018) systematically reviewed empirical work on organisational resilience in health and other sectors. They grouped the factors that contribute to resilience into 'hardware' (resources, infrastructure and information systems) and 'software' (leadership, culture, relationships and sensemaking), and concluded that software matters at least as much as hardware. They also drew attention to 'everyday resilience', the ability to cope with chronic strain, as something distinct from resilience to sudden shocks. Williams et al. (2017) brought crisis management and resilience research together in a framework covering durability, organising and adjusting, responding to major disturbances, and learning, with particular weight on leadership and mindfulness. Writing in the aftermath of Ebola, Kruk et al. (2015) described a resilient health system as aware, diverse, self-regulating, integrated and adaptive. Awareness came first on their list.

3.3 Resilient health care, Safety-II and high reliability

The resilient health care movement shifts attention from Safety-I, which tries to keep the number of things that go wrong as low as possible, to Safety-II, which tries to ensure that as many things as possible go right. In practice this means studying the everyday variation in performance through which work usually succeeds (Hollnagel et al., 2015; Wears et al., 2015). Resilience engineering describes four potentials that

make resilient performance possible: the abilities to respond, to monitor, to learn and to anticipate. The CARE model applied these potentials to quality improvement, focusing on the gap between work as imagined and work as actually done (Anderson et al., 2016).

High reliability organisation (HRO) theory came from studying nuclear power plants, aircraft carriers and air traffic control, settings where serious failures are rare despite constant hazard. Weick and colleagues attributed this record to 'collective mindfulness', which comprises preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise (Weick et al., 1999; Weick & Sutcliffe, 2015). Sensitivity to operations, meaning a shared and current view of the bigger picture, is essentially organisational SA under another name. Vogus and Sutcliffe (2007) turned these processes into the Safety Organizing Scale for hospital nursing units.

3.4 Performance in healthcare organisations

Performance in healthcare spans several domains: patient safety, clinical outcomes, operational efficiency, financial performance, continuity of service and the wellbeing of the workforce. Research on SA has concentrated heavily on the first two. There is some emerging evidence on efficiency and continuity, and very little on finance or the workforce.

4. Theoretical Frameworks Linking SA, Resilience and Performance

The literature offers four bridges between SA and resilience.

SA as the cognitive engine of resilience. Endsley's perception, comprehension and projection correspond closely to the 'monitor' and 'anticipate' potentials of resilience engineering. Responding well and learning from events also depend on accurate SA: the first to choose the right action, the second to make sense of what happened afterwards.

SA as a defining attribute of resilient organisations. Working with ten New Zealand organisations, McManus et al. (2008) defined organisational resilience as a function of situation awareness, management of keystone vulnerabilities and adaptive capacity, a formulation known as the Relative Overall Resilience model. It later became the Benchmark Resilience Tool (BRT), with 13 indicators and 53 items grouped under planning and adaptive capacity; situation monitoring and reporting sits under adaptive capacity (Lee et al., 2013). Thirteen-item short forms produced results similar to the full instrument (Whitman et al., 2013). One finding deserves attention. Lee et al. (2013) could not confirm either the original three-factor structure or an adjusted four-factor structure, and settled on two factors. Situation awareness may therefore be difficult to separate statistically from other components of resilience, even if it is conceptually distinct.

Collective mindfulness and sensemaking. HRO theory locates reliability in ongoing, interactive processes through which organisations keep their understanding of operations up to date (Weick et al., 1999). Huddles, briefings and escalation pathways are the everyday routines that turn one person's awareness into a shared picture and make deference to expertise possible.

Distributed cognition. DSA theory predicts that resilience depends less on everyone knowing everything than on the right information reaching the right person at the right moment (Stanton et al., 2006, 2017). This is the logic behind structured handoffs, command centres and role-specific dashboards.

Taken together, these bridges point to a mediated model. SA, building from the individual to the team to the organisation, enables the resilience capabilities of monitoring, anticipating, responding and learning, and these capabilities in turn drive performance. Leadership, culture, psychological safety, technology and workload moderate each link. Table 1 shows how the main constructs line up.

Table 1

Correspondence between SA levels, resilience potentials, HRO principles and healthcare practices

SA level	Resilience potential	HRO principle	Illustrative healthcare practice
Perception (Level 1)	Monitor	Sensitivity to operations; preoccupation with failure	Early warning scores, huddle risk reports, closed-loop test-result tracking
Comprehension (Level 2)	Monitor; respond	Reluctance to simplify	Structured handoffs, team briefings, joint sensemaking in huddles
Projection (Level 3)	Anticipate	Preoccupation with failure; commitment to resilience	Predictive capacity analytics, contingency planning in I-PASS
Action and learning (beyond SA)	Respond; learn	Deference to expertise; commitment to resilience	Escalation pathways, debriefs, Safety-II reviews of work as done

Note. Author's synthesis based on Endsley (1995), Hollnagel et al. (2015) and Weick et al. (1999).

5. Evidence from the Healthcare Sector

5.1 When situational awareness fails

Anaesthesia and critical care

Schulz et al. (2013) introduced Endsley's model to anaesthesiology. When they later analysed 200 reports from a German critical incident reporting system in anaesthesia and critical care, they identified SA errors in 81.5% of cases (Schulz et al., 2016). An analysis of the US Anesthesia Closed Claims Project for 2002 to 2013 found that SA errors contributed to death or brain damage in 198 of 266 claims, or 74%. Perception errors were the most common type at 42%, with comprehension and projection errors each accounting for 29%. Damaging respiratory events were also more frequent where SA errors were present (56% compared with 21%) (Schulz et al., 2017).

The predominance of perception failures matters to managers, because missed cues often originate in the system rather than in the individual: poorly designed alarms, information overload, interruptions and thin staffing. These data still need careful reading. They are retrospective, not randomly sampled and open to hindsight bias.

Diagnostic error

Singh et al. (2012) used an SA framework to study diagnostic errors in primary care and found repeated failures to notice and follow up abnormal findings. In a later study using electronic triggers, the same group identified 190 diagnostic errors involving 68 different missed diagnoses. The most frequent were pneumonia (6.7%), decompensated heart failure (5.7%), acute renal failure (5.3%), primary cancer (5.3%) and urinary tract infection (4.8%) (Singh et al., 2013). Diagnostic error in primary care is a large problem worldwide (Singh et al., 2017). Seen through an SA lens, much of it is as much an organisational problem as a cognitive one, involving how test results are tracked, how overloaded inboxes are handled and how follow-up is coordinated across fragmented services.

Ward deterioration and nursing

A meta-narrative review of SA in nursing identified individual, team and system perspectives, a patient

safety narrative, and solution-focused narratives about communication tools, technology and education. Unrecognised patient deterioration emerged as one of the main consequences of poor SA (Walshe et al., 2021).

5.2 Non-technical skills: making SA trainable and observable

The Anaesthetists' Non-Technical Skills (ANTS) system groups 15 elements under four categories: task management, team working, situation awareness and decision making. When 50 consultant anaesthetists used it to rate eight simulated scenarios, it showed satisfactory validity, reliability and usability, provided raters had been trained (Fletcher et al., 2003). The Non-Technical Skills for Surgeons (NOTSS) system (Yule et al., 2006a, 2006b) places situation awareness alongside decision making, communication and teamwork, and leadership. Testing with 44 consultant surgeons from five Scottish hospitals showed a consistent internal structure and rating accuracy above 60% in every category (Yule et al., 2008). Both systems grew out of the non-technical skills tradition in aviation (Flin et al., 2008). Their main contribution has been to make SA something that can legitimately be taught, observed and appraised in clinical practice.

5.3 Interventions that build situational awareness

Tiered huddles and proactive risk identification

At Cincinnati Children's Hospital Medical Center, a programme combining proactive risk identification, unit-level huddles and safety officer rounds targeted what the team called 'unrecognised situation awareness failure events' (UNSAFE). These were transfers from the wards to intensive care in which a patient's deterioration had not been recognised in time. The rate of UNSAFE transfers fell from 4.4 to 2.4 per 10,000 non-ICU inpatient days, which the investigators described as a near 50% reduction (Brady et al., 2013). The huddles ran at three levels, on units, among managers and among senior leaders, and were used to debrief events, identify high-risk patients and mobilise resources, drawing explicitly on HRO principles (Goldenhar et al., 2013). Qualitative work at the same hospital showed that hierarchy, team familiarity and the structure of communication all affected whether risks were identified and escalated (Brady & Goldenhar, 2014). The authors went on to propose SA as a model for predicting and preventing deterioration (Brady et al., 2014).

Structured handoffs

The I-PASS bundle (Illness severity, Patient summary, Action list, Situation awareness and contingency planning, Synthesis by receiver) was introduced across nine paediatric residency programmes covering 10,740 admissions. Medical errors fell by 23%, from 24.5 to 18.8 per 100 admissions, and preventable adverse events fell by 30%, from 4.7 to 3.3, without any harm to workflow (Starmer et al., 2014). Two qualifications apply. Error rates did not change significantly at three of the nine sites, and the before-and-after design limits causal claims.

Team training and crew resource management

The Veterans Health Administration's Medical Team Training programme drew on crew resource management (CRM) principles, briefings and checklists. Annual surgical mortality fell by 18% in the 74 facilities that took part, compared with 7% in 34 facilities that did not, and each additional quarter of training was associated with 0.5 fewer deaths per 1,000 procedures (Neily et al., 2010). Observed surgical morbidity fell by 17% (Young-Xu et al., 2011). A meta-analysis of team training in healthcare found improvements in reactions, learning, transfer and results, with effect sizes ranging from d = .37 to .89 (Hughes et al., 2016).

A separate meta-analysis of 20 CRM studies in acute care was more cautious. It reported large effects on knowledge (d = 1.05) and behaviour (d = 1.25), only a small effect on attitudes (d = 0.22), and too little

evidence to judge the effect on clinical outcomes (O'Dea et al., 2014). The WHO Surgical Safety Checklist, whose briefing step supports shared SA, was piloted in eight hospitals in eight cities. After it was introduced, the death rate fell from 1.5% to 0.8% and inpatient complications from 11.0% to 7.0% (Haynes et al., 2009).

Simulation and measurement

Wright et al. (2004) showed that objective, query-based measures of SA, specifically the Situation Awareness Global Assessment Technique (SAGAT), can be used in medical simulation. This gives a sound basis for evaluating SA training and the design of clinical displays.

Capacity command centres and dashboards

The Johns Hopkins Hospital used a systems engineering approach to build its Capacity Command Center, which brings operational teams together in one place and combines real-time data with predictive analytics. Proactive capacity management shortened sub-cycle times, and occupancy rose from 85% to 92% while patient delays fell (Kane et al., 2019). A patient-flow dashboard based on the Donabedian model supported this work (Martinez et al., 2018). Non-peer-reviewed institutional reports describe larger gains, and a central role for the centre in coordinating transfers between hospitals during the COVID-19 pandemic. Those figures have not been independently verified and the centre was developed with a commercial partner, so they are best treated with caution. Even so, the case illustrates how infrastructure built for everyday awareness can become crisis infrastructure when it is needed.

5.4 COVID-19 and disaster response

Mohammadinia et al. (2023) interviewed members of hospital incident command systems in Iran about their pandemic response. Participants described problems with human and material resources, information flow and coordination. The strategies that helped centred on clear command structures, good communication and a willingness to reorganise services quickly. This fits the wider resilience literature (Kruk et al., 2015; Barasa et al., 2018). Organisational SA has to be designed before a crisis arrives. Hospitals that already had command structures, dashboards and huddle routines could scale them up, whereas those relying on informal information flows found it much harder to see and forecast demand.

5.5 Synthesis of the healthcare evidence

Table 2 summarises the key healthcare studies reviewed above. Most show associations rather than proven causal effects, but they point consistently in the same direction.

Table 2
Summary of key healthcare studies linking situational awareness to performance

Study	Setting and design	SA level	Key finding
Schulz et al. (2017)	US closed claims analysis; 266 claims	Individual	SA errors in 74% of death or brain-damage claims; perception errors 42%
Schulz et al. (2016)	German incident reporting system; 200 cases	Individual	SA errors in 81.5% of incidents
Singh et al. (2012, 2013)	US primary care; record review	Individual and organisational	190 diagnostic errors involving 68 missed diagnoses

Study	Setting and design	SA level	Key finding
Brady et al. (2013)	Paediatric hospital; quality improvement	Team and organisational	UNSAFE transfers fell from 4.4 to 2.4 per 10,000 non-ICU inpatient days
Starmer et al. (2014)	Nine hospitals; 10,740 admissions; pre–post	Shared (handoff)	23% fewer medical errors; 30% fewer preventable adverse events
Neily et al. (2010)	108 VA facilities; comparison of trained vs untrained	Team (CRM)	18% vs 7% fall in surgical mortality, with a dose–response relationship
Hughes et al. (2016)	Meta-analysis of team training	Team	Effect sizes d = .37 to .89 across training outcomes
Kane et al. (2019)	Johns Hopkins command centre; case study	Organisational	Occupancy rose from 85% to 92% with fewer delays

Note. CRM = crew resource management; VA = Veterans Health Administration; UNSAFE = unrecognised situation awareness failure events.

6. Evidence from Other Sectors and Lessons for Healthcare

Aviation. Military aviation gave SA theory its start (Endsley, 1995), and commercial aviation later made CRM standard practice. Salas et al. (2006) reviewed 28 evaluations of CRM training in aviation, medicine, offshore oil, shipping and nuclear power. Trainees generally reacted well, but effects on learning and behaviour were mixed, and the authors could not determine whether CRM improved safety or the bottom line. The lesson for healthcare is that aviation's safety record does not rest on training alone. It rests on training woven into procedures, incident reporting, recurrent simulation, cockpit design and a just culture. Hospitals that import CRM as a stand-alone course should expect weaker clinical effects, which is broadly what O'Dea et al. (2014) found.

Military command and control, and energy. DSA theory emerged from defence research on command and control (Stanton et al., 2006) and was then applied to control rooms in energy distribution. There, awareness was spread across control-room operators, field engineers and the artefacts they used, and coordination depended on their awareness being compatible rather than identical (Salmon et al., 2006). Hospital bed management and incident command have the same structure. A good dashboard therefore maps which person needs which information, instead of showing everyone everything and swamping their perception.

Nuclear power and other high-reliability industries. HRO routines such as formal handovers, operational briefings and the authority of any worker to halt operations build sensitivity to operations into everyday practice (Weick et al., 1999). Safety huddles and 'stop the line' policies in hospitals will only work if they come with genuine deference to expertise and psychological safety.

Business continuity and critical infrastructure. The Resilient Organisations research programme in New Zealand put SA at the heart of organisational resilience. It applied the BRT to organisations in Auckland (Stephenson et al., 2010) and to critical infrastructure providers (Brown et al., 2017), and its

findings were later brought together for managers by Seville (2016). Hospitals are critical infrastructure too. Their resilience depends on awareness of external dependencies, including supply chains, IT vendors, utilities and social care, which clinical SA training rarely covers.

Supply chains. Ambulkar et al. (2015) developed and validated a scale measuring firms' resilience to supply chain disruption. They found that a firm's orientation towards disruption built resilience through resource reconfiguration when disruptions were severe (full mediation), and in combination with risk management infrastructure when disruptions were less severe. In short, awareness has to be matched by the ability to move resources. Shortages of personal protective equipment early in the COVID-19 pandemic showed what happens when it is not.

Manufacturing teams. In a study of 51 manufacturing work teams, Edmondson (1999) found that psychological safety was associated with learning behaviour, which in turn mediated its link with team performance. Speaking up is how one person's perception becomes the team's understanding, and steep clinical hierarchies tend to discourage it.

Crisis management and finance. Management research emphasises anticipation, sensemaking and adjustment before, during and after adversity (Williams et al., 2017). We did not find enough verifiable empirical work linking SA constructs to resilience in banking to draw firm conclusions. This is a gap in the evidence, not evidence of no effect.

Read across sectors, the evidence suggests five lessons for healthcare. SA has to be engineered into systems and cannot depend on training alone. Information should be matched to roles rather than broadcast to everyone. Awareness needs to be paired with the capacity to adapt. HRO routines are the mechanism that turns individual awareness into collective awareness. And psychological safety is what allows weak signals to travel upwards.

7. Mediating and Moderating Factors

Leadership. NOTSS treats leadership as a skill in its own right, and the Cincinnati model relied on senior-level huddles with the authority to commit resources (Goldenhar et al., 2013). Leadership within incident command structures was equally central to hospital responses to COVID-19 (Mohammadinia et al., 2023).

Communication tools. SBAR, I-PASS and team briefings reduce the mental effort needed to pass awareness from one person to another. The I-PASS results suggest that structured communication, introduced with proper training as part of a bundle, is one of the pathways through which SA improves safety (Starmer et al., 2014).

Culture and collective mindfulness. In a validation study involving 1,685 registered nurses across 125 units, higher scores on the Safety Organizing Scale were associated with fewer reported medication errors and patient falls (Vogus & Sutcliffe, 2007).

Psychological safety and hierarchy. These shape whether what one person notices ever becomes part of the team's picture (Edmondson, 1999; Brady & Goldenhar, 2014).

Information systems. Electronic health records, early warning scores and dashboards can strengthen perception and projection. They can also generate information overload, alert fatigue and missed results (Singh et al., 2012). DSA theory predicts that technology improves SA only when what it displays fits the goals and roles of the people using it (Stanton et al., 2006).

Workload, fatigue and staffing. All three degrade SA (Endsley, 1995). Time pressure contributes to diagnostic error (Singh et al., 2013), and chronic understaffing wears away everyday resilience (Barasa et al., 2018).

8. Measurement

Four broad approaches are used to measure SA. Freeze-probe techniques such as SAGAT pause a scenario and question participants, and they have been shown to work in medical simulation (Wright et al., 2004). Real-time probe techniques such as the Situation Present Assessment Method (SPAM) ask questions without stopping the task. Endsley's (2021) meta-analysis of 243 studies found SAGAT and SPAM equally predictive of performance, but SAGAT was more sensitive (94%, compared with 64% for SPAM and 73% for real-time probes), and SPAM was intrusive in 40% of the studies that used it. Self-rating scales such as the Situational Awareness Rating Technique (SART; Taylor, 1990) are easy to administer but tend to capture confidence rather than accuracy. Behavioural marker systems such as ANTS and NOTSS rely on trained observers (Fletcher et al., 2003; Yule et al., 2008).

A review using COSMIN methodology examined 25 studies and 15 instruments and concluded that clinical settings urgently need better-developed and better-evaluated measures of SA (Ghaderi et al., 2023). Network methods for analysing distributed SA are available (Salmon et al., 2009) but have rarely been used in healthcare. Resilience is measured with the BRT-53 and its short forms (Lee et al., 2013; Whitman et al., 2013), supply chain resilience scales (Ambulkar et al., 2015) and the Safety Organizing Scale (Vogus & Sutcliffe, 2007). Health system resilience, by contrast, is mostly assessed qualitatively, and there is no agreed way of measuring it (Barasa et al., 2018). Performance is usually captured through error and preventable adverse event rates (Starmer et al., 2014), risk-adjusted mortality and morbidity (Neily et al., 2010; Young-Xu et al., 2011), unrecognised deterioration (Brady et al., 2013) and patient flow (Kane et al., 2019). Table 3 summarises the main instruments.

Table 3

Selected instruments for measuring situational awareness and organisational resilience

Construct	Instrument	Type	Comment
Individual SA	SAGAT	Freeze-probe query	Most sensitive in meta-analysis (94%); feasible in medical simulation
Individual SA	SPAM	Real-time probe	As predictive as SAGAT, but intrusive in 40% of studies
Individual SA	SART	Self-rating	Quick to administer; reflects confidence more than accuracy
SA within non-technical skills	ANTS; NOTSS	Behavioural markers	Validated in anaesthesia and surgery with trained raters
Organisational resilience	BRT-53; BRT-13	Survey	Includes situation monitoring and reporting; two-factor structure
Collective mindfulness	Safety Organizing Scale	Survey	Higher scores linked to fewer medication errors and falls
Supply chain resilience	Ambulkar et al. (2015) scale	Survey	Validated firm-level measure of resilience to disruption

Note. SAGAT = Situation Awareness Global Assessment Technique; SPAM = Situation Present Assessment Method; SART = Situational Awareness Rating Technique; BRT = Benchmark Resilience Tool.

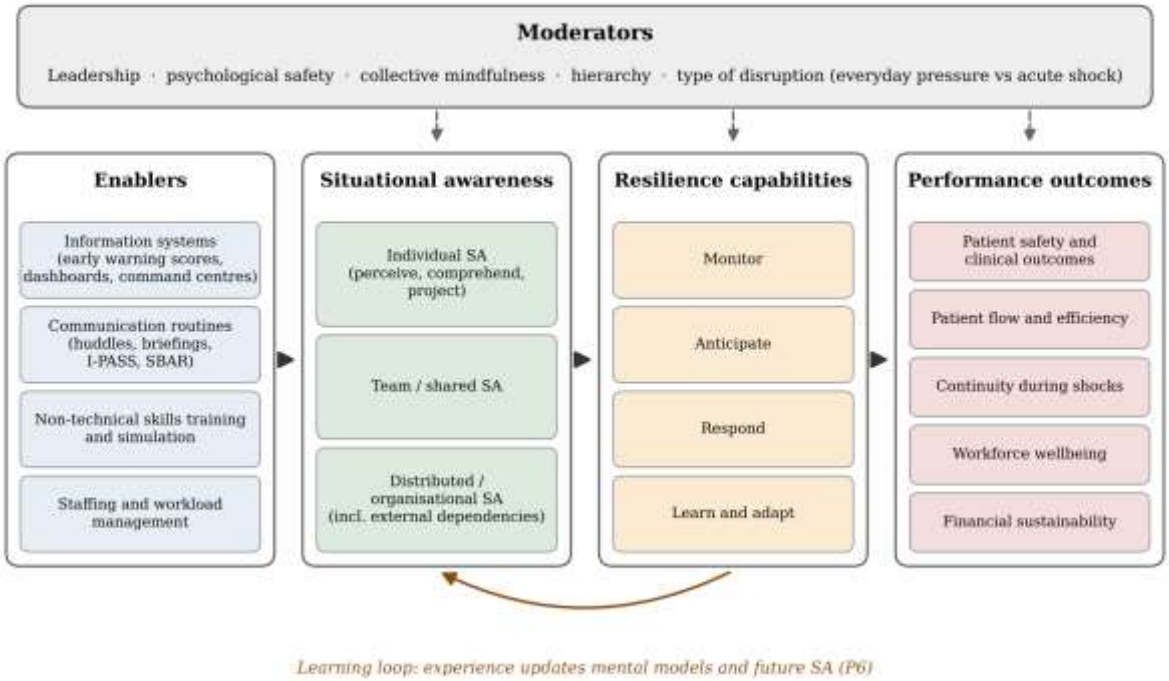
The central weakness of the field is that SA, resilience and performance are almost never measured in the same study. SA is rarely measured as a mediator, so the mechanisms that link interventions to outcomes are inferred rather than demonstrated.

9. A Proposed Conceptual Framework

Drawing the evidence together, we propose a Multilevel Situational Awareness–Resilience–Performance (MSARP) framework, shown in Figure 1. Enablers such as information systems, communication routines, non-technical skills training and staffing support SA at three nested levels: individual, team and distributed or organisational. SA in turn underpins the resilience capabilities of monitoring, anticipating, responding and learning, and these capabilities drive performance across safety, flow, continuity, workforce and financial outcomes. Leadership, psychological safety, collective mindfulness, hierarchy and the type of disruption moderate each link, and learning feeds back to update mental models and future SA.

Figure 1

The Multilevel Situational Awareness–Resilience–Performance (MSARP) framework



Note. Author's synthesis. Arrows indicate proposed relationships; dashed arrows indicate moderating influences.

The framework yields six propositions that future studies can test.

Proposition 1. Higher individual SA reduces adverse events, and the largest gains come from improving perception (Schulz et al., 2016, 2017).

Proposition 2. Routines that share SA across a team improve safety beyond what individual training achieves (Brady et al., 2013; Starmer et al., 2014).

Proposition 3. Organisational SA improves performance mainly through anticipation and response; awareness without adaptive capacity achieves little (Ambulkar et al., 2015).
Proposition 4. Psychological safety and leadership moderate the conversion of individual awareness into collective awareness (Edmondson, 1999).
Proposition 5. SA infrastructure built for everyday operations strengthens resilience to acute shocks (Kane et al., 2019).
Proposition 6. Learning loops, including Safety-II analysis of what goes right, update mental models and improve future SA.

10. Research Gaps and Future Directions

Several gaps stand out. The most important is that SA is seldom measured as a mediator between an intervention and its outcomes. Until studies measure SA directly, alongside resilience and performance, claims about mechanism will remain plausible inference rather than demonstrated fact.
There are also no well-validated instruments for organisational or distributed SA in hospitals, although DSA network methods and the situation monitoring items of the BRT offer useful starting points. The links between SA and financial performance, staff wellbeing and retention are almost unexplored, and economic evaluations of huddles, command centres and team training would be especially valuable to managers deciding where to invest.
Stronger study designs are needed too. Stepped-wedge cluster trials and controlled interrupted time series would support firmer conclusions than the before-and-after designs that dominate the field. Most of the evidence comes from high-income countries, while low- and middle-income settings, where everyday resilience under chronic resource strain is critical (Barasa et al., 2018), remain under-represented.
The spread of AI-enabled alerts and predictive analytics raises an open question: do these tools strengthen projection, or do they erode SA through automation complacency and alert fatigue? Comparative studies across sectors, including finance and logistics, would test how far lessons really transfer. Finally, SA research has focused on acute hospital care, and primary care, mental health, maternity and community services deserve much more attention.

11. Practical Implications for Healthcare Managers

For hospital administrators and service leaders, the evidence translates into nine practical steps.
Build tiered huddles. Link unit, manager and executive huddles so that risks identified at the bedside reach people who can commit resources the same day (Goldenhar et al., 2013; Brady et al., 2013).
Standardise handoffs. Implement the full I-PASS bundle, including training, faculty development and direct observation, rather than adopting the mnemonic on its own (Starmer et al., 2014).
Invest in simulation-based non-technical skills training. Use ANTS- or NOTSS-style assessment, and embed training in everyday briefings, checklists and debriefs instead of running one-off courses (Neily et al., 2010; Hughes et al., 2016).
Create an organisation-wide operating picture. A capacity command centre or integrated dashboard, with predictive views tailored to each role, lets the organisation see demand coming instead of reacting to it (Kane et al., 2019).
Design for perception. Because most SA failures begin with missed cues, give priority to alarm management, closed-loop tracking of test results, inbox management and protection from interruptions (Schulz et al., 2017; Singh et al., 2012).

Cultivate psychological safety and deference to expertise. Reward speaking up, and make it normal for anyone to pause care when something looks wrong (Edmondson, 1999; Weick et al., 1999).
Map external dependencies. Identify the suppliers, utilities, IT providers and partner services the hospital relies on, and test plans for their failure through exercises (McManus et al., 2008; Lee et al., 2013).
Measure the whole chain. Track SA process indicators, such as huddle reliability and handoff quality, together with resilience measures such as the BRT or the Safety Organizing Scale and the outcomes that matter to patients and the organisation.
Learn from what goes right. Use Safety-II methods to study work as it is actually done, not only the incidents that go wrong (Hollnagel et al., 2015; Anderson et al., 2016).

12. Limitations of this Review

This is a narrative review. It did not use formal systematic screening or risk-of-bias assessment, so some selection bias is possible. Much of the healthcare evidence comes from retrospective claims analyses, single-centre or before-and-after quality-improvement studies and qualitative research, all of which limit causal inference. Some reported gains from hospital command centres come from institutional rather than peer-reviewed sources and have been treated cautiously. Evidence from the financial sector was limited. SA is also a contested concept: Endsley's model of individual cognition and the distributed model of Stanton and Salmon rest on different assumptions, and studies differ in which they adopt. Finally, publication bias probably favours positive findings.

13. Conclusion

Situational awareness is a foundation of organisational resilience and performance in healthcare, though it is not enough on its own. Failures of individual awareness, especially failures to perceive, are implicated in most catastrophic anaesthesia events and in a good deal of diagnostic error. Routines and technologies that build shared and distributed awareness, including tiered huddles, structured handoffs, team training and command centres, are associated with meaningful reductions in harm, mortality and delay. Resilience models from New Zealand, resilience engineering and HRO theory all put awareness at their core. Evidence from aviation, energy, supply chains and manufacturing adds an important qualification: awareness produces resilience only when it is matched by the capacity to adapt, by psychological safety and by capable leadership.

For managers, the message is to treat SA as an organisational capability that has to be designed, resourced and measured, not simply as a personal skill. For researchers, the priorities are to measure SA as a mediator, to develop organisation-level measures, and to extend the outcomes studied to finance, the workforce and service continuity.

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