

ABSTRACT

Title: Nurses' use of Situation Awareness in decision making: An integrative review

Aim: To critically review the literature related to situation awareness and clinical decision making by nurses.

Background: International recognition that situation awareness positively contributes to clinical decision making has led to a growing body of healthcare literature. To date, research has predominately focused on anaesthetists and surgeons using measurement frameworks from the aviation industry. The evidence focussing directly on situation awareness in decision making by nurses remains limited.

Data sources: Databases: PROQUEST, Web of Science, CINAHL and PUBMED.

Review methods: An integrative review was undertaken following an extensive literature search with the date range January 1965 – March 2011. English language literature reviews, primary qualitative, quantitative and mixed method studies describing situation awareness in decision making by or including nurses were included.

Results: Five empirical studies of nurses' situation awareness were reviewed. Of these, three included decision making and situation awareness by nurses within inter-professional teams; two related solely to situation awareness and decision making by nurses. Findings from the five studies could be grouped under three themes: individual factors influencing situation awareness, interpersonal behaviours influencing situation awareness and situation awareness improving working relationships and patient care.

Conclusion: Further investigation is needed to identify the situation awareness skills that are vital to decision making by nurses. Elucidating essential skills sets associated with situation awareness may inform the development of education and training to enhance clinical decision making by nurses.

Key words: situation-awareness, decision-making, nurse, literature review

SUMMARY STATEMENT

What is already known about this topic

Healthcare studies outline the importance of situation awareness to clinical decision making.

Both technical and non-technical skills are required for effective, safe decision making.

Incorporation of situation awareness and decision making to inter-professional education has improved collaborative working.

What this paper adds

Situation awareness is an essential skill for effective decision making by nurses and can be learned.

Non-technical skills are associated with situation awareness and influence clinical outcomes

Increased awareness of vital technical, non-technical and environmental data for decision making is needed in practice.

Implications for practice

Multidisciplinary non-technical team training may help to develop situation awareness.

Enhanced situation awareness has the potential to improve decision making quality and ultimately improve clinical outcomes for patients.

Situation awareness can be learned indicating that undergraduate and continuing education programs should consider incorporating situation awareness training into curricula.

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INTRODUCTION

Clinical decision making is integral to nursing practice and influences patient outcomes (Fonteyn and Ritter 2008). Over the past decade, the increasing complexity of clinical nursing has necessitated more informed decision making to ensure effective and safe practice (Parsonage 2010). This has stimulated research in relation to environmental or technical aspects of decision making (Bucknall 2007, Flin et al. 2008). Additionally, non-technical aspects, such as social and cognitive skills, identified as 'situation awareness' (SA), influence clinical decision making. There is increasing international recognition that SA impacts on the decision making of all healthcare professionals working in complex and dynamic environments, with higher levels of SA linked to improved clinical outcomes (Singh et al. 2006). However, much of this research evidence arises from the medical professions or clinical teams (Flin et al. 2008). For example, previous studies examining the performance of surgeons and anaesthetists have found that SA influences technical ability and clinical outcomes (Flin et al. 2007, Fioratou et al. 2010, Yule et al. 2008). This paper provides an overview of SA and then critically evaluates studies of nurses' SA.

Background

The Theory of Situation Awareness

The origins of SA arise from the aviation industry where it has been used as a concept to understand causes of decision error and as a model for safe decision making (Singh et al. 2006). In essence, SA is, "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 1995, p. 36). The Model of Situation Awareness (Endsley 1995) identifies three levels of SA linked to decision making. The SA levels are incremental: Level 1 – perception of current situation (gathering data); Level 2 – comprehension of current situation (interpreting information); Level 3 – ability to project what can happen in the future (anticipation of future states). These levels of SA are influenced by individual or cognitive factors, such as ability, preconceptions, memory and information processing. Task or system factors also influence SA, such as system capability, complexity, automated machinery, stress and workload. All of the elements collectively contribute to efficient, safe, decision making (Flin et al. 2008).

SA is the global term for the level of awareness and the dynamic understanding that a practitioner has of a situation. In order to make fully informed, safe, decisions practitioners have to be cognizant of relevant information and pertinent environmental data. Thus, SA is the first step of decision making, providing an understanding of 'what is going on' and 'what is likely to occur next' (Salmon et al. 2009). In practice, safe decision making depends on continuous extraction of technical, environmental information, integration of knowledge and formation of a coherent mental picture to direct perception and anticipate future events (Dominguez 1994). Therefore, SA is essential in all complex, dynamic occupational settings reliant on human operators making decisions where safety is paramount.

The aim of SA is to avoid critical situations evolving. If such situations occur, it is vital for practitioners to know what technical information is relevant and anticipate what data will be needed to inform correct decisions and avert disaster. Lapses in SA can arise from interpersonal behaviours, team dynamics and assertive authority figures (Gawron 2008). Additionally, SA can be obscured by distractions including stress, noise, multi-tasking and physical factors affecting attention e.g. tiredness. Time pressure is also significant as constraints can lead to 'panic' (reactive) decision making. Decision making and heightened SA is improved with training (Gawron 2008, McLucas 2003). Industries, including aviation, military and emergency services, use SA principles to inform decision making and skills learning so that operators are able to 'sense' the decision making process during critical events in practice, preventing adverse events (McLucas 2003).

Situation Awareness and decision making in clinical settings

SA is an essential skill for all health professionals in effectively managing complex systems where decisions are made rapidly and under stressful situations (McIlvaine 2007). Singh et al. (2006) suggest that SA lapses occur at many levels in clinical practice, with decision making error continuing due to subsequent SA gaps by other practitioners. The value of SA to healthcare in actual clinical settings has been predominately studied by medical researchers focussing on medical disciplines or inter-professional teams that include nurses. However, analysis of adverse clinical events do highlight that suboptimal decision making by nurses can be attributed to lapses in SA in the clinical environment (NPSA 2007). The antecedents to compromised clinical decision making by nurses through deficient SA are multifarious and often complex. However, they do relate to the levels of SA as described by Endsley (1995) and include environmental, clinical system capacity and individual factors. The role of experience, expertise and intuition in positively influencing clinical judgement has been perceived as highly significant in decision making by nurses (Benner 1984). However, more recent findings have shown that experience and intuition are used less frequently than previously thought and may not always impact positively upon clinical decision making by nurses (NPSA 2007, Traynor et al. 2010). A study of nurse practitioners found that experience and intuition was not necessarily indicative of anticipatory decision making but the ability to make decisions based on future patient needs was often reliant on individual nurse characteristics and personal insight (White et al. 1992). These findings support those from SA studies by researchers in medical and other industries (Singh et al. 2006, Flin et al. 2008).

Compromised SA and decision making commonly arises from failures in perception, shortcuts in reasoning and latent factors, such as fatigue, stress or interrupted workflow, time pressure, causing cognitive inattention (Braithwaite et al. 2005, Woodward 2010, Yule et al. 2008). To increase SA by avoiding distraction, or confusion, some suggest that clinical settings adopt similar operational practices to aviation (Broom et al. 2011). This includes modifying practitioner behaviours and the 'sterile cockpit concept' that prohibits non-essential tasks and conversation during critical periods. Some distraction factors contributing to decision making error by nurses have been identified and preventative 'sterile cockpit' measures introduced. For example, altered procedures for medication administration with nurses wearing medication safety vests indicating that they should not be

interrupted (Jones 2009). Noise and equipment such as beepers or phones also cause distractions during critical decision making in clinical environments (McIlvaine 2007).

Studies have revealed that SA is influenced by deficits in non-technical skills including communication, teamwork, leadership and participatory decision making. These non-technical skill deficits resulted in compromised awareness of technical components, such as patient data monitoring, and were the most common antecedents to decision errors made by practitioners in operating rooms (Hazlehurst et al. 2007, Kranzfelder et al. 2011, Yule et al. 2008). Literature spanning several decades has repeatedly reported decision making by nurses to be negatively influenced by non-technical aspects particularly interpersonal interactions between medical staff and nurses (Bucknall 2000, Hofling et al. 1966, Odell 2010). The study by Hoffling et al. (1966) was the first to highlight that pressure from overly assertive medical colleagues resulted in serious decision making errors by nurses. This non-technical influence affected both experienced and inexperienced nurses, with errors remaining unchallenged, despite nurses being aware of mistakes. Additionally, decision making by nurses is influenced by decision autonomy, nursing objective and technical aspects such as knowledge and memory (Bucknall 2000).

It is evident from research that models of SA have been applied to various occupational settings and improved decision making. In healthcare, the concept of SA has been integrated into decision making systems and training programs by adapting Endsley's model (1995) for surgeons and anaesthetists with reported benefits for decision making, team working and patient outcomes (Singh et al. 2006). The concept of SA related to decision making by nurses remains largely undefined despite the numerous research findings identifying technical and non-technical factors affecting decision making by nurses in clinical settings. A proposed concept map indicating how SA may be applied to decision making by nurses is displayed in Figure 1. The principal levels of SA are those by Endsley (1995) but reflect the nursing context by incorporating findings from studies that identify naturalistic work setting factors that compromise decision making by nurses.

Figure 1.

THE REVIEW

Aim

The aim of this integrated review was to critically review the literature related to situation awareness and clinical decision making by nurses.

Objectives of this review

The objectives of this review were to: 1) identify published accounts of nurses' use of SA theory and principles in decision making; 2) conduct a quality appraisal of studies of SA in decision making by nurses; and 3) identify themes in the studies that advance nursing knowledge of the application of SA to nurses' decision making.

Design

The diverse language and nomenclature arising from the different occupational fields that study SA required an integrated review which was broad enough to include primary sources using different methodologies from a variety of occupational fields whilst being sufficiently structured to remain focussed on the primary topic (Whittemore & Knafl, 2005). In order to provide methodological rigour, focus and boundaries for the review, the five stages suggested by Whittemore and Knafl (2005) were used. These are comprised of Problem identification: Literature search: Data evaluation: Data analysis: and Presentation. The five stages provided the review framework which was subsequently integrated under the typical research headings of search methods, outcomes, quality appraisal, data abstraction and synthesis for publication and dissemination.

The initial stage of review was to identify the problem to be addressed. Problem identification specifies variables of interest, including the concept, target population and clinical problem, which facilitate the differentiation of information into relevant or extraneous for data extraction. The problem to be addressed by the review was identified as the concept of SA, in nurses, involved in decision making in clinical practice.

Search methods

The second stage, the literature search, was designed to source all relevant literature, reducing limitations caused by inconsistent terminology or over reliance on medical databases (Conn et al. 2003). The search conducted interrogated four bibliographic databases: PROQUEST (combined health and psychology), Web of Science, CINAHL, PUBMED. As previous nursing research was known to have included decision making research from psychology and non-healthcare disciplines from the 1960's onwards, the dates January 1960 to March 2011 were used as parameters, and scoping undertaken in these databases. The University book catalogue was also searched and interfaced with catalogues externally using the same date range. The following search terms and their Boolean combinations were used: situation awareness, decision making, nurse, non-technical skills, decision error, decision dynamics, clinical judgement, deduction, inference, cognitive task analysis. English language literature reviews, primary qualitative and quantitative studies describing situation awareness and decision making by or including nurses were considered.

Search outcome

The third stage, data evaluation, was undertaken for the 27 publications initially retrieved. Following agreed inclusion criteria delineated at problem identification stage from the variables of interest, 20 publications were discounted as they related to nurses and decision making but did not include SA. The remaining seven were identified for initial data evaluation. One study yielded two publications, the second being omitted as it duplicated some, but not all, of the original study. Of these six publications, five were empirical studies and one a literature review. The reference list of the literature review publication was used to substantiate inclusion. The cited references in the literature review included SA studies, however, none related directly to nurses and this publication was omitted from the review. The remaining five primary studies were included in the review.

Quality appraisal

All three authors appraised the retrieved publications using the five stages for integrative review (Whittemore and Knafl 2005). Concern was raised over the inclusion of all five papers as some studied additional factors and a variety of methodologies. However, due to the small number of studies, identifying an additional predefined list to exclude papers further was viewed as counterproductive. The limited numbers of papers were considered on the basis of informational quality, methodological quality and representativeness (Kirkevold 1997). This was considered more appropriate to facilitate data abstraction, synthesis and understanding of the topic. The outcome of the quality appraisal is reported in Table 1.

Data abstraction and synthesis

In order to establish rigorous data abstraction and synthesis, data evaluation and analysis stages followed methods advocated by Whittemore & Knafl (2005). A standardised format to summarise descriptive, methodological data and findings was created. This format was used to inform the summary table outlining descriptive information (author, publication date, country of origin), study description and objectives (sample, aim, design, methods), study findings and limitations. The standardised table format allowed comparative analysis and patterns in the extracted information became apparent. This enabled further comparative analysis and it was possible to identify emergent key themes from the information. In identifying the themes both quantitative and qualitative aspects in the studies were given equal priority (Sandelowski 2000). A synthesis of important elements and conclusions was constructed into an integrated summation to inform the themes. The use of this form of data analysis and tables to present findings adhere to the stages for robust integrative review (Whittemore and Knafl 2005). Additionally, this facilitates ease of data comparison and incorporation of findings from a variety of research methods (Happ et al. 2006, Whittemore and Knafl 2005). The identified key themes were used to further analyse and discuss the findings from the retrieved studies.

RESULTS

Of the five studies that included nurses, three focussed on decision making and SA by nurses as members of inter-professional teams. Three related solely to SA and decision making by nurses. Countries of origin were Australia (n = 2), USA (n= 2), multinational Korea and USA (n=1). Table 1 summarises the five publications reviewed. Of the five retrieved empirical studies, three were inter-professional and include nurses. These three inter-professional publications relate to the high risk, technological clinical environments of intensive care, operating rooms and obstetrics. Samples sizes in these three inter-professional studies range from 30 – 63, with nurses forming the largest proportion of participants. Data collection was undertaken by video monitoring of practice in hospital clinical settings in two of these inter-professional studies and by simulation exercise in the third study. Research focussing explicitly on SA and nurses accounted for two of the original five studies retrieved from the search. Both of these studies were undertaken in universities with final year undergraduate students or graduating anaesthetic registered nurses with a sample range of 51 -71. These two studies use simulated scenarios for data collection.

Defining themes

The general findings from the research were congruent across fields of nursing and note a paucity of SA literature. The attributes and deficiencies associated with SA and effective decision making are the most apparent characteristics reported in the literature. These attributes and deficiencies can be further categorised into three themes – individual factors influencing SA, interpersonal behaviours influencing SA and improved working relationships and patient care.

Individual factors influencing SA

The individual cognitive abilities of nurses are reportedly the best predictors of SA (Wright 2009). Individual personality traits, particularly associated with self-confidence and assertion were closely associated with cognitive abilities and SA in this study. Other attributes previously assumed to have a bearing on SA and decision making, such as memory and automaticity gained through experience, had little positive effect (Cooper et al. 2010, Wright 2009). The study by Cooper et al. (2010) found that SA was not related to age or experience but decision making skills did improve in subsequent scenario exercises once participants were cognizant of SA practices. SA was deficient in graduating students, with knowledge not applied to appropriate patient care and decisions. The researchers suggested that these deficiencies could be improved by undergraduate education incorporating more clinical teaching and practical experience linked to decision making and SA (Cooper et al. 2010).

It appears that nurses strive for a shared understanding of the patient's condition to increase common SA when working with other healthcare disciplines. However, the research findings revealed a cognitive mismatch of professional thinking arising out of differences in professional orientation and perception of SA (Miller and Sanderson 2005). Miller and Sanderson (2005) conclude that healthcare disciplines are the product of their own professional education and remits of practice. That is, educational preparation and occupational socialisation significantly impacts on professional cognition and behaviours. Improvements to SA have been however achieved when inter-disciplinary teams were trained together (MacEachin et al. 2009, Miller and Sanderson 2005).

Interpersonal behaviours influencing SA

Interpersonal behaviours determine the dynamics between nursing and medical staff. Effective interpersonal communication, leadership and positive individual personality traits in nurses are strong indicators of positive team dynamics and highly influence SA in clinical settings (Wright 2009). Nurses were found to be pivotal to effective communication and promoting SA in team working environments particularly in rapid, high acuity work settings (Kim et al. 2009, Wright 2009). Environments where decision making skills are more transparent or scrutinised can cause anxiety for junior nurses (Cooper 2010, Kim et al. 2008). This affects nurses' ability to use SA and negatively impacts on clinical judgements and may cause defensive practice.

Shared SA improving working relationships and patient care

Where differences in professional orientation, thinking and perception of SA exist there is greater staff tension, a higher risk of breakdown in care co-ordination with more likelihood of discontinuity in patient management (Miller & Sanderson 2005). However, in clinical settings where practitioners

have shared understanding of patient care goals and SA is acknowledged there are more cohesive, participatory working practices (MacEachin 2009). This can contribute to shared working protocols or guidelines that have been shown to improve patient safety and care outcomes by reducing reliance on memory and subsequent decision error. Achieving consensus on SA in clinical settings is greatly enhanced by education and training practices that incorporate inter-professional learning. Improving SA can also improve patient management and logistics particularly in areas such as operating rooms (Kim et al. 2009).

DISCUSSION

It is evident that some nurses attain SA skills and incorporate them into decision making in practice. Where examined, the use of SA was most often a consequence of inter-professional team working in critical care areas (MacEachin et al. 2009, Miller and Sanderson 2005, Mitchell and Flin 2008) with the focus on improved SA cognition (Cooper et al. 2010, Wright 2009). Increased efficacy of decision making has been linked to improved SA cognition as a result of altered perception achieved by changes to professional behaviours and thinking (MacEachin et al. 2009, Miller & Sanderson 2005). The importance of SA in enhancing cognition to improve decision making is supported by numerous previous studies (Fletcher et al. 2003, Flin et al. 2008, Guimond et al. 2009, Mitchell and Flin 2008). Lapses in cognition due to lack of awareness or knowledge and the tendency to interpret patient data as single strands rather than collectively has been found to contribute to suboptimal decision making by nurses (Endacott et al. 2010). These findings are similar to outcomes of adverse clinical event inquiries where technical skills and non-technical influences involved in decision making are traditionally scrutinised to find the cause of clinical error (Braithwaite et al. 2005, Mitchell and Flin 2008, Lashoher and Pronovost 2010). These studies indicated that where SA cognition lapses were found, decision making deficits had the potential to occur and result in suboptimal patient care. Consistency in research findings points to the need for nurses to enhance their professional cognition to link patient data collectively to achieve improved SA and more anticipatory, effective decision making (Endacott et al. 2010, Guimond et al. 2009, Miller and Sanderson 2005). Several studies suggest that the use of SA and professional cognition in nurses is often only identified as lacking in practice settings, at post graduate level and when decisions are compromised by other factors such as time pressure (Cooper et al. 2010, Endacott et al. 2010, Guimond et al. 2009, Lauri and Salanterä 2002, Miller and Sanderson 2005).

It is apparent that SA cognition can be influenced by individual personality factors but it is a skill that can be acquired by nurses and improved with learning (Fletcher et al. 2003, MacEachin et al. 2009, Miller and Sanderson 2005). This learning incorporates both technical and non-technical aspects that can promote decision making effectiveness. Guimond et al. (2009) suggested that inter-professional learning is the most effective method of enhancing SA and nurses are pivotal in communicating information for decision making due to structures such as handover and shift rotation. Learning in inter-professional groups promotes confidence and decision autonomy skills in nurses resulting in more assertive, safe decision making particularly in encounters with assertive medical colleagues. Inter-professional SA learning has been effective in promoting more cohesive, participatory working practices, improving care co-ordination and increasing continuity in patient management (Guimond et al. 2009, Fletcher et al. 2003, MacEachin et al. 2009, Miller and Sanderson 2005, Mitchell and Flin 2008). It is, therefore, important that the essential skills set related to SA and nurses are identified

by further research and subsequently incorporated into nurse education programs at both undergraduate and post graduate level to improve decision making and ultimately patient care outcomes.

SA and decision making abilities are identified from the research but it could be that additional factors impact on skills both in critical care environments and other fields of nursing. Investigation of decision making practices using both quantitative and qualitative research methodologies in a variety of clinical settings could possibly identify more examples to assist in determining working processes. Whilst, it is likely that nurses do use additional cognitive and non-technical skills impacting on clinical outcomes, identification of the precise constituents of these aspects remains to be determined.

The goal of this review was to present an analysis of the concept of SA as applied to decision making by nurses but this was limited due to the paucity of empirical studies found that included nurses or focused specifically on nurses . Nonetheless, all publications retrieved that covered the scope of the review were included. This provided a comprehensive view of all of the literature available at that point in time. Despite the limited number of sources available it was evident that emergent themes were consistent. However, the three themes that emerged should be viewed as preliminary as it is acknowledged that additional research may require their revision.

CONCLUSION

Many of the findings from nursing literature relate to those from non-healthcare disciplines and other healthcare research. However, it can be concluded from this review that there is scope for additional work in this area to identify the situation awareness skills that are vital to decision making by nurses. Identification of essential skills could be used to inform educational development practices for nurses at both undergraduate and post graduate level. Further study along with the identification of situation awareness and decision making skills has potential benefit to nurses in terms of effective decision making, inter-professional working, risk management, and patient safety.

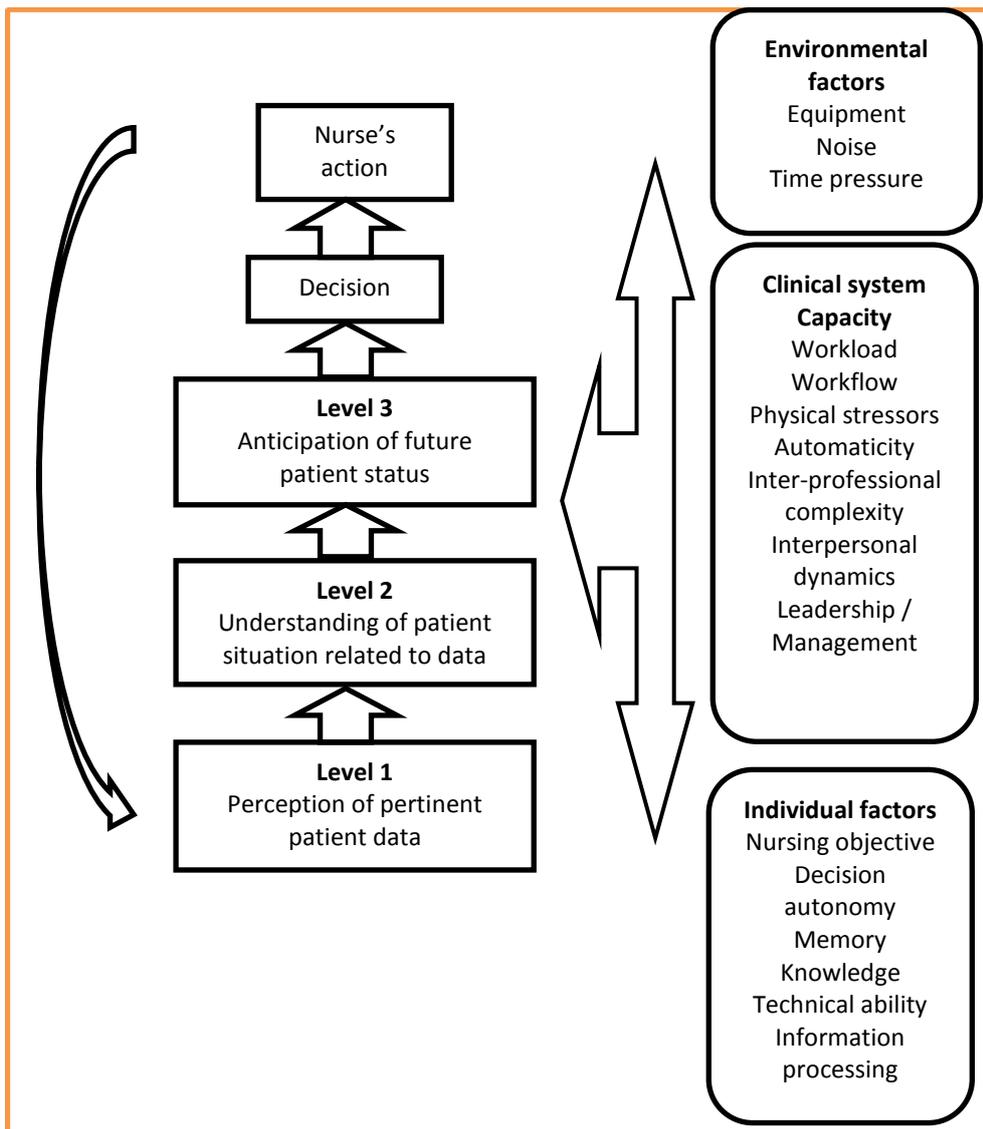


Figure 1. Concept map - Situation Awareness and Decision making by nurses. Adapted from Endsley's Model (1995) with permission from Human Factors and Ergonomics Society.

Table 1 Summary of appraised studies

Author (Year & Country)	Sample	Aim and data collection	Findings	Limitations
Cooper et al. (2010) Australia	51 final semester student nurses	Aim: To examination ability to assess, identify and respond to patient deterioration in relation to knowledge, SA and skills Mixed methods. Quantitative knowledge and performance measures during simulated scenario. Qualitative reflective review stated but not reported in this paper	<ul style="list-style-type: none"> • Focus on physiological parameters • SA perception low, unable to comprehend global data for decision making • Knowledge level good but SA not applied to appropriate decision action • Poor skills ability related to task decisions • Anxiety affected decision making • Subsequent practice improved scores • SA not influenced by age or experience 	<ul style="list-style-type: none"> • Anxiety possibly related to video and observation in simulated environment • May not replicate true performance or transferable findings to RN's • Convenience sample – possible volunteer bias
Kim et al. (2008) International: Korea and USA	63 operating room staff: Nurses (n = 27) Medical (n = 24) Other (n = 12)	Aim: Understanding of staff acceptance of perioperative video monitoring for coordination and supporting SA Mixed methods. Quantitative survey and qualitative interviews	<ul style="list-style-type: none"> • Junior nurse anxiety about staff privacy but expressed through the form of patient privacy • Senior nurses less concerned about SA and decisions being scrutinised • Senior nurses less concerned about patient privacy issues • Video monitoring useful for examination of SA and decision making in patient logistics and workflow 	<ul style="list-style-type: none"> • Study focussed on privacy issues • Data from one point in time - two months after installation • One surgical suite only
MacEachin et al. (2009) USA	Unspecified number (conference participants, included nurses, midwives and physicians)	Aim: Measurement of SA in fetal heart monitoring training program Precise methodology unclear. Quantitative data from module completion following DVD and review of fetal monitoring in practice. Qualitative data from subsequent discussion	<ul style="list-style-type: none"> • Inter-professional group learning improved SA • SA improved fetal monitoring safety and reduced decision error by 10% over project duration of four years • Development of algorithms and clinical guidelines to streamline decisions possible once shared SA acknowledged by all occupations 	<ul style="list-style-type: none"> • Limited study information – time frame, precise participant details, design and measurement tools undefined • Some data collection methods stated but other findings relate to audit of improved practice outcomes, possibly from documentation, yet design of this not mentioned

Author (Year & Country)	Sample	Aim and data collection	Findings	Limitations
Miller & Sanderson (2005) Australia	Intensive care staff in one hospital: Nurses (n = 17) Doctors (n = 8) Patients (n = 5)	Aim: Analysis of clinical information used by medical and nursing staff during shift handover Quantitative analysis of videoed observation of practice in the clinical setting	<ul style="list-style-type: none"> • Nurses and doctors are a 'function' of their training and practice based responsibilities • Mismatch of care goals between professions • Decisions by nurses are tactically orientated and not 'big picture' orientated; doctors more strategic and physiology orientated • Different professional thinking alters perception of SA , causes tension leading to breakdown of coordination of care and discontinuity in patient care 	<ul style="list-style-type: none"> • Sample involved only experienced and senior practitioners • Undertaken in one hospital unit • Inclusion of qualitative data would have enhanced some understanding of some of the findings
Wright, (2009) USA	71 anaesthetic nurse graduates from 3 universities	Aim: To measure relationship between memory, cognition and automaticity in SA Quantitative analysis using computer based aviation assessment tool	<ul style="list-style-type: none"> • Cognitive abilities and SA positive relationship • Memory and SA had little positive relationship • No relationship between automaticity and SA • Older participants more automaticity but poorer memory score (attributed to older nurses having more experience) • Individual cognitive abilities and personality impact on positive SA (suggests 'cultivating' these 'types' as future anaesthetic nurses) 	<ul style="list-style-type: none"> • Aviation measurement tool; not validated for healthcare • Regression analysis produced associations between variables not causal relationships. Author alludes to causation but findings may be due to other unmeasured variables • Possible volunteer bias – subset of randomly selected participants from volunteer convenience sample

Legend: RN – Registered Nurse

SA – Situation awareness

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