The 'five rights' of clinical reasoning: An educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients

8 AUTHORS, INCLUDING:

Tracy Levett-Jones
University of Newcastle
64 PUBLICATIONS 763 CITATIONS

SEE PROFILE

Carol Anne Norton
University of Newcastle
4 PUBLICATIONS 66 CITATIONS

SEE PROFILE

Jan Roche
University of Newcastle
7 PUBLICATIONS 69 CITATIONS

SEE PROFILE

Noelene Hickey
University of Newcastle
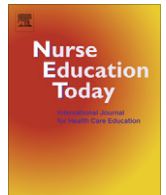7 PUBLICATIONS 36 CITATIONS

SEE PROFILE

The 'five rights' of clinical reasoning: An educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients

Tracy Levett-Jones [a,*], Kerry Hoffman [a,1], Jennifer Dempsey [b,2], Sarah Yeun-Sim Jeong [b,3], Danielle Noble [a,4], Carol Anne Norton [b,5], Janiece Roche [a,6], Noelene Hickey [b,7]

[a] School of Nursing and Midwifery, The University of Newcastle, Callaghan, NSW 2308, Australia
[b] School of Nursing and Midwifery, The University of Newcastle, P.O. Box 127 Ourimbah, NSW 2258, Australia

ARTICLE INFO

SUMMARY

Acute care settings are characterised by patients with complex health problems who are more likely to be or become seriously ill during their hospital stay. Although warning signs often precede serious adverse events there is consistent evidence that 'at risk' patients are not always identified or managed appropriately. 'Failure to rescue', with rescue being the ability to recognise deteriorating patients and to intervene appropriately, is related to poor clinical reasoning skills. These factors provided the impetus for the development of an educational model that has the potential to enhance nursing students' clinical reasoning skills and consequently their ability to manage 'at risk' patients. Clinical reasoning is the process by which nurses collect cues, process the information, come to an understanding of a patient problem or situation, plan and implement interventions, evaluate outcomes, and reflect on and learn from the process. Effective clinical reasoning depends upon the nurse's ability to collect the *right* cues and to take the *right* action for the *right* patient at the *right* time and for the *right* reason. This paper provides an overview of a clinical reasoning model and the literature underpinning the 'five rights' of clinical reasoning.

© 2009 Elsevier Ltd. All rights reserved.

Introduction

Contemporary practice environments are dynamic, unpredictable and reactive. Increasing numbers of adverse patient outcomes are evident in Australia and internationally. Hospitals have a growing proportion of patients with complex health problems who are more likely to be or become seriously ill during their admission (Bright et al., 2004). Although warning signs often precede serious adverse events such as cardiac arrest, unplanned admission to intensive care and unexpected death (Buist et al., 2004), there is evidence that 'at risk' patients are not always identified; and even when warning signs are identified they are not always acted on in a timely manner (Thompson et al., 2008).

Nurses with poor clinical reasoning (CR) skills often fail to detect impending patient deterioration resulting in a 'failure to rescue' (Aiken et al., 2003). CR is an essential component of competence (Banning, 2008). However, contemporary teaching and learning approaches do not always facilitate the development of a requisite level of CR skills. A recent Australian report described critical patient incidents that often involved poor CR by graduate nurses (NSW Health, 2006). This report parallels the results of the Performance Based Development System, a tool employed to assess nurses' CR, which showed that 70% of graduate nurses in the United States scored at an 'unsafe' level (del Bueno, 2005). The reasons for this are multidimensional but include the difficulties novice nurses encounter when differentiating between a clinical problem that needs immediate attention and one that is less acute; and a tendency to make errors in time sensitive situations where there is a large amount of complex data to process (O'Neill, 1994).

These factors provided the impetus for the development of an educational model that has the potential to enhance graduates' CR skills and consequently their ability to identify and appropriately manage 'at risk' patients. This paper begins by providing an overview of the CR model. It then profiles the literature that underpins the model's development, structured as the 'five rights' of CR.

* Corresponding author. Tel.: +61 02 49216559; fax: +61 02 4921 6301.
E-mail addresses: Tracy.Levett-jones@newcastle.edu.au (T. Levett-Jones), kerry.hoffman@newcastle.edu.au (K. Hoffman), Jennifer.Dempsey@newcastle.edu.au (J. Dempsey), Sarah.Jeong@newcastle.edu.au (S.Yeun-Sim Jeong), Danielle.Noble@newcastle.edu.au (D. Noble), Carol.Norton@newcastle.edu.au (C.A. Norton), Jan.Roche@newcastle.edu.au (J. Roche), Noelene.Hickey@newcastle.edu.au (N. Hickey).
[1] Tel.: +61 02 43494533; fax: +61 02 49216301.
[2] Tel.: +61 02 4349 4532; fax: +61 02 4349 4538.
[3] Tel.: +61 02 4349 4535; fax: +61 02 4349 4538.
[4] Tel.: +61 02 4349 4534; fax: +61 02 4349 4538.
[5] Tel.: +61 02 43484017; fax: +61 02 4349 4538.
[6] Tel.: +61 02 2 4921 6230; fax: +61 02 4921 6301.
[7] Tel.: +61 02 43484078; fax: +61 02 4349 4538.

Background

What is clinical reasoning?

In the literature the terms CR, clinical judgment, problem solving, decision making and critical thinking are often used interchangeably (Thompson and Dowding, 2002). Elstein and Bordage (1991) define CR as the way clinicians think about the problems they deal with in clinical practice. It involves clinical judgments (deciding what is wrong with a patient), and clinical decision-making (deciding what to do). Tanner (2006) conceptualises CR as the process by which nurses make clinical judgments by selecting from alternatives, weighing evidence, using intuition and by pattern recognition. In this paper we use the term CR to define a logical process by which nurses (and other clinicians) collect cues, process the information, come to an understanding of a patient problem or situation, plan and implement interventions, evaluate outcomes, and reflect on and learn from the process (Hoffman, 2007). CR is not a linear process but can be conceptualised as a cycle of linked clinical encounters.

Nurses use different but interrelated patterns of CR. Although the cognitive thinking strategies used by nurses in decision-making and clinical reasoning have not been extensively examined, some studies have demonstrated differences between novice and expert nurses as well as between different groups of experienced nurses. Commonly used thinking strategies has been identified as "collection", where patient data and information is obtained; "description", where nurses describe facts and information; "selection", the choosing of appropriate information; "inference", making deductions about information; "synthesis", putting information together; and "verification", testing that information is correct (Jones, 1989; Higuchi Smith and Donald, 2002). In studies using verbal protocol analysis and problem behaviour graphs the identification of cognitive strategies has been accomplished by identification from verbal protocols or *a priori* from the literature, or by a combination of both (Ericsson and Simon, 1984, 1993).

The CR model described in this paper is informed by the work of Alfaro-LeFevre (2009), Andersen (1991) and Tanner (2006). However, the primary foundation for the CR model is Hoffman's (2007) doctoral project which provides detailed and deconstructed exemplars of CR from an examination of how novice and experienced nurses make decisions in the real world of practice. Hoffman used both a literature review and an examination of research data to identify commonly occurring thinking strategies used by both novice and expert nurses while caring for patients in an intensive care unit. The thinking strategies identified through this research and subsequently used by us in the development of the CR model were: describe the patient situation, collect new patient information, review information, relate information, recall knowledge, interpret information, make inferences, discriminate between relevant and irrelevant information, match and predict information, synthesise information to diagnose or identify a problem, establish goals, choose a course of action and evaluate. The study found that both novice and expert nurses used all of the thinking strategies while caring for patients in a real world situation, but that there were some differences between the novice and expert nurses. Expert nurses collected more cues than novice nurses and from a wider range of information than novices (Hoffman et al., in press). Experts also related more cues together than novices, and were better able to predict what may happen to a patient. They often practised proactively, collecting a wide range of cues to identify and prevent possible patient complications. In contrast, novices' practice was more reactive, searching for patient cues and information once they had actually identified a patient problem. These differences may have implications for patient safety, with novice nurses detecting problems later than expert nurses.

The CR model has application for classroom teaching and provides a structure that links well with problem based and enquiry based learning. The phases and steps in the model are appropriate for self-directed learning and can be used to develop computerised learning packages and case studies. The CR model also provides an approach that can be used in simulated learning experiences using human patient manikins or standardised patients (actors). Most importantly, the model has relevance to clinical practice. Although the CR model is appropriate to many patient situations and contexts, the main focus in this paper is on the relevance of CR to the prevention and management of adverse patient incidents in acute settings.

A diagram of the CR model developed from Hoffman's (2007) study is shown in Fig. 1. In this diagram the cycle begins at 1200 h and moves in a clockwise direction. The circle represents the ongoing and cyclical nature of clinical encounters and the importance of evaluation and reflection. There are eight main steps or phases in the CR cycle. However, the distinctions between the phases are not clear cut. While CR can be broken down into the steps of: *look, collect, process, decide, plan, act, evaluate* and *reflect*, in reality, the phases merge and the boundaries between them are often blurred. While each phase is presented as a separate and distinct element in this diagram, CR is a dynamic process and nurses often combine one or more phases or move back and forth between them before reaching a decision, taking action, and evaluating outcomes.

Why do nursing students need to learn how to engage in clinical reasoning?

'Failure to rescue', defined as mortality of patients who experience a hospital acquired complication, is directly related to the quality of nursing care and nurses' CR skills (Needleman et al., 2001). According to the NSW Health Incident Management System (2008), the top three reasons for adverse patient outcomes are: failure to properly diagnose, failure to institute appropriate treatment, and inappropriate management of complications. Each of these is related to poor CR skills.

In practice experienced nurses engage in multiple CR episodes for each patient in their care. An experienced nurse may enter a room and immediately collect significant data, draw conclusions and initiate appropriate management. Because of their knowledge, skill and experience expert nurses may appear to perform these processes in a way that seems almost automatic or instinctive; and they often find it difficult to verbalise their thinking and explain cognitive processes that seem tacit and implicit. This automatic or instinctive processing is believed to occur as memory retrieval becomes faster from repeated practice, with additional instances being stored in the memory until responses are determined entirely by memory retrieval alone, bypassing normal processing (Ericsson and Simon, 1984; Palmeri, 1997). Modelling and explanation of these types of automatic process in decision-making can help students begin to understand what has often been referred to as an unconscious, intuitive reasoning. In order for students to learn to manage complex clinical situations and to identify 'at risk' patients, teaching approaches that make these seemingly automatic or instinctive cognitive processes explicit and clear. Thus, it is essential that students are taught the process and steps of CR. Learning to reason effectively does not happen serendipitously, nor does it occur just through observation of expert nurses in practice. CR requires a different approach to that used when learning more routine nursing procedures. It requires a structured educational model and active engagement in deliberate practice; as well as reflection on activities designed to improve performance (Ericsson et al., 2007).
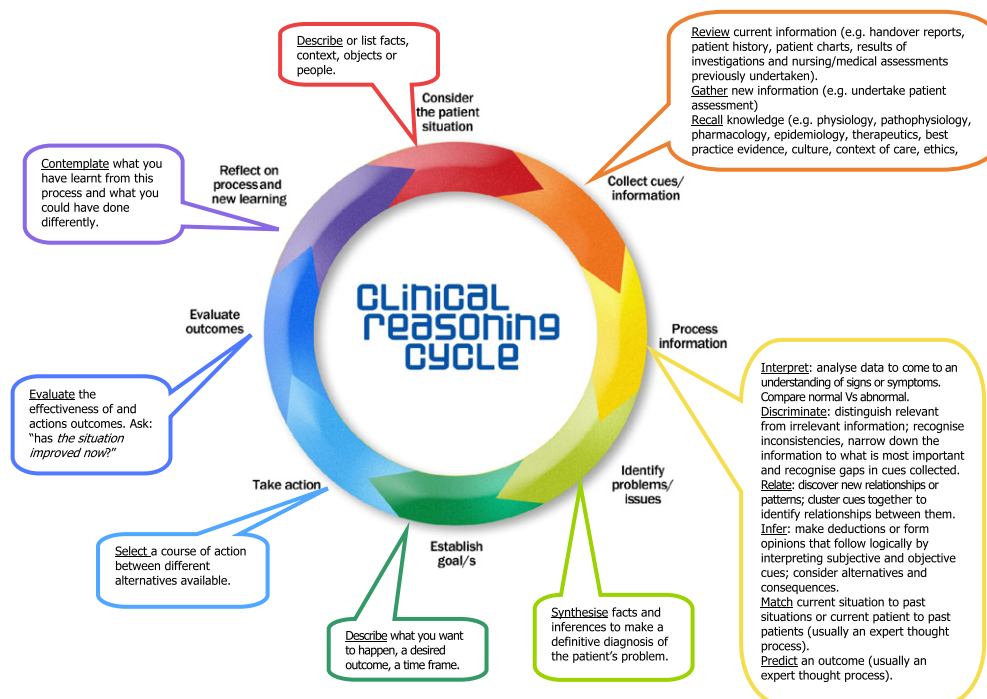
Fig. 1. The clinical reasoning process with descriptors.

The 'five rights' of clinical reasoning

Effective use of the CR model by nursing students and its application in practice by novice nurses is directly linked to the five rights of clinical reasoning, that is, the ability to collect the right cues and take the right action for the right patient at the right time and for the right reason.

The right cues

The recognition of cues and clusters of cues, termed "cue acquisition" by Elstein and Bordage (1991) and "noticing" by Tanner (2006), is the fundamental basis of CR. Cues are identifiable physiological or psychosocial changes experienced by the patient, perceived through history or assessment and understood in relation to a specific body of knowledge and philosophical beliefs. Cues also include the context of care and the surrounding clinical situation.

The acquisition of cues can be influenced by many factors including the expertise and working knowledge of the decision-maker, anxiety, confidence and time pressures (O'Neill et al., 2005). When the correct cues are not acquired all of the actions that follow may be incorrect (Andersen, 1991). Making judgements or decisions based on incomplete information is a leading course of mistakes (Alfaro-LeFevre, 2009); and early subtle cues when missed can lead to a 'failure to rescue'.

Cues refer to available patient information (for example, hand-over reports, patient history, patient charts, results of investigations and nursing/medical assessments previously undertaken), current clinical assessment data, and also the recall of knowledge. This includes a broad and deep knowledge of physiology, pathophysiology, pharmacology, epidemiology, therapeutics, culture, context of care, ethics and law etc. as well as an understanding of evidence based practice. For students this is challenging because it requires the ability to not only recall facts, but to also synthesise and apply their knowledge to clinical situations which are often complex and fluid. For example, CR requires the nurse to both identify oliguria, hypotension and tachycardia, and *recall* that these signs may indicate hypovolaemic shock.

Research has identified a number of differences between how experienced and novice nurses collect cues (refer to Table 1). For these reasons, nursing students must be helped to understand how to pay attention to relevant cues and contextual issues, how cues shape clinical decisions, and the connection between accurate cue collection and patient outcomes (Benner, 2001).

Stereotypes, prejudices and assumptions may impede the cue collection process. Preconceptions such as "elderly people often have dementia", colour the types and range of cues collected as well as their interpretation. For example, McCarthy's (2003) theory of situated CR explains how nurses' overarching philosophies related to ageing impact their cue collection and influence the ways in which they manage older hospitalised patients experiencing symptoms of delirium. Failure to identify delirium and treat its underlying causes can lead to serious consequences, including progression to permanent brain damage and death (Kiely et al., 2009). Conversely, appropriate cue collection which allows for early recognition and management can effectively restore an older person to premorbid health and functioning (Schuurmans et al., 2001). Thus, in preparation for CR nursing students must be provided with opportunities to reflect on and question their assumptions and prejudices; as failure to do so may negatively impact their cue acquitision/CR ability and consequently patient outcomes.

Right patient

The right patient, in this instance, refers to a patient at risk of critical illness and/or a serious adverse event. Nursing students need to learn how to identify and prioritise patients in need of immediate care. Although Tanner (2006) suggests that it is background knowledge and relationships with patients that are the basis upon which nurses initially grasp the clinical situation, definitive physiological parameters also need to be comprehended if the 'right' patient is to be recognised in a timely manner. Nurses are often the first link in the causal chain between identification of

Table 1
The difference between cue collection in experienced and novice nurses.

Experienced nurses	Novice nurses	
Select relevant and specific cues	Less focused in their selection; tend to 'over-select cues'	Lamond and Farrell (1998)
Select cues that are context dependent	Follow rules when collecting cues, ignoring context	Benner (2001) and Arbon (2004)
Collect information on a range of factors in addition to the patient's presenting symptoms	Concentrate on presenting symptoms only	White et al. (1992)
Have a way of 'being with a patient' and instantly knowing the patient after scanning him/her; they know what to pay attention to and what questions to ask	Focus on tasks and technology, rather than the patient, and often miss important cues	Hardy et al. (2002) and Arbon (2004)

complications and eventual rescue; consequently, their ability to recognise clinically 'at risk' patients is crucial (Clarke and Aiken, 2003).

Systems such as early warning scores (EWS) and modified early warning scores (MEWS), use physiological measurements to help identify patients who are, or who may become, critically ill. Jacques et al. (2006) identified and categorised early and late warning signs of patients at risk of serious adverse events (such as death, cardiac arrest, severe respiratory problems or transfer to a critical care area) (refer to Table 2). These types of warning signs are particularly useful for helping novice nurses to recognise deteriorating patients.

Jacques et al. (2006) reported that the likelihood of an adverse outcome was significantly increased in patients who exhibited 2–3 late warning signs. The warning signs of unresponsiveness to verbal commands, hypoxia, oliguria and alteration in blood gases were considered to be the most important warning signs signalling at risk patients. Smith and Poplett (2002) recommend that urgent attention should be given to the education of undergraduate nursing and medicine students about the identification of abnormal values and subsequent management of at risk patients. The CR model helps to facilitate the development of nursing students' ability to recognise deteriorating patients.

Right time

Within clinical contexts that are often complex and unpredictable, nurses engage in multiple CR episodes each day for each pa-

Table 2
Early and late warning signs of adverse events adapted from Jacques et al. (2006).

Early warning signs	Late warning signs
SpO2 90–95%	SpO2 <90%
Urine output <200 mL over 8 h	Urine output <200 mL over 24 h or anuria
PaO2 50–60 mm Hg	Pa02 <50 mm Hg; PaCO2 >60 mm Hg
Glasgow Coma Scale (GCS) <9–11 or a fall in GCS by >2	Glasgow Coma Scale (GCS) ⩽8
Alteration in mentation	Unresponsive to verbal commands
Partial airway obstruction (excluding snoring)	Airway obstruction/stridor
Respiratory rate 5–9 or 31–40 breaths per minute	Respiratory rate >40 or <5 breaths per minute
Systolic blood pressure 80–100 mm Hg or 181–240 mm Hg	Systolic BP <80 mm Hg
Pulse rate 40–49 or 121–140 beats per minute	Pulse rate >140 or <40 beats per minute
Chest pain	Cardiac arrest
Poor peripheral circulation	pH <7.2
Greater than expected fluid loss from drains	
Newly reported pain or uncontrolled pain	
Any seizure activity	
Blood glucose level 1–2.9 mmol/L	

tient in their care. Thompson et al. (2004) observed nurses engaging in up to 50 significant CR encounters in one 8 h shift in a medical admissions unit. Similar patterns of multiple judgements and choices in bounded time frames were identified by Bucknall (2000) who found that intensive care unit nurses faced a clinical judgment or decision every 30 s.

Time is a critical issue in CR. The 'right' time refers to a nurse's ability to identify clinically at risk patients in a timely manner and to undertake nursing interventions at the right time and in the right sequence. Failure to rescue occurs not only when early signs and symptoms fail to be recognised or acted upon, but also when nursing/medical interventions are started too late. Expertise influences the amount of time needed to come to a decision (Hamers et al., 1997) with novice nurses requiring more time to engage in CR (Schmidt et al., 1990) and multiple opportunities to practice CR in real or simulated environments.

Right action

Nursing 'action' is defined as "the behaviour following on from a judgement or decision" (Thompson and Dowding, 2002, p. 14). This stage of the CR cycle is comprised of practical skills, intellectual activities and communication skills. The nurse has to decide which part of the plan takes priority, who is best placed to undertake the nursing action/s, which procedures and policies are involved, who should be notified and when.

Too often documented abnormalities are not followed up by action (Jacques et al., 2006). Thompson et al. (2008) identified that half of avoidable arrests had clinical signs of deterioration recorded in the preceding 24 h but were not acted on. Similarly, Goldhill (2001) reported that even critical alternations to the so called nursing basics such as pulse rate, respiratory rate, and oxygenation are often not acted upon. These undesirable responses to critical situations may be explained, at least in part, by arguing that not all nurses are adequately skilled in CR.

Nursing students need to be taught how to synthesise facts and inferences to make a definitive nursing diagnosis, to identify clinically at risk patients and to select a course of action between different alternatives available. Thompson et al. (2008) suggest that when taking action, such as to call a MET (medical emergency team), nurses must first acquire cues and compare this assessment to their personal decision framework. At this point they weigh up whether or not to take action, and what action to take based upon their estimate of the amount of risk. However, too often nurses do not possess a framework that allows them to confidently distinguish clinical noise from those clinical data that signal risk; this is a crucial causative factor in nursing errors.

At times the 'right' action is for the nurse to relay their concerns about a patient's deteriorating clinical condition to senior staff. Nursing students need to become confident and skilled in communicating with members of the healthcare team so that they can signal their need for immediate action and support when required. Safe healthcare delivery depends on effective communication be-

Table 3
ISBAR adapted from Mikos (2007).

I	Identify	Self – name, position, location. Patient – name, age, gender	"This is …from … ward" "I'm calling about Mr Levi … "
S	Situation	Explain what has happened to trigger this conversation	"The reason I am calling is…" If urgent say so: "This is urgent; the patient's O_2 sats are 90% and systolic BP 90"
B	Background	Admission date, diagnosis, relevant history, investigations, what has been done so far	"He is day 2 post–op after colorectal resection…"
A	Assessment	Give a summary of the patient's condition or situation. Explain what you think the problem is (if you can)	"I'm not sure what the problem is, but the patient is deteriorating. His vital signs are …"
R	Request/ recommendation	State your request	"I need help urgently. Can you come now?"

tween healthcare professionals and a body of literature points to the positive benefits of education about clinical communication. Use of acronyms such as ISBAR (refer to Table 3) have been reported as effective in streamlining the way doctors and nurses communicate during telephone calls and patient handover and in increasing patient safety (Mikos, 2007). Acronyms provide a framework to communicate in a consistent way and are particularly useful for novice nurses.

The right reason

When considering the 'right reason' there are multiple implications. In this context, 'right' does not only mean that the correct reasoning processes have been employed but also that the reasoning is ethical, legal and professional. The 'right' reason does not apply just to the *process* of reasoning; it is about the underpinning rationale. Consequently, when discussing this 'right' these other dimensions must be considered.

"Right" may refer to the result of the reasoning, that is, the right conclusion being reached or it may refer to the process, or preferably both. Accuracy in clinical decision-making is not a pure process that exists in isolation from the person making the judgement. CR depends on the experience and confidence of the decision-maker (Cioffi, 2002). CR can also be influenced by the personal attributes, role orientation, education of the nurse/nursing student and the culture and context of care (Hoffman et al., 2004). The decisions that are made are influenced by the motivation of the nurse and their willingness to put all the data together into a complete picture (Di Vito-Thomas, 2005), as well as how completely the nurse has come to know the patient, not just a source of data to be reasoned through, but as a person with their own unique needs, values and individual response to the situation.

The knowledge that underpins the CR process and the consequent decisions and actions have also been found to have a social context that involves the culture of the unit, the value placed on the actual work and even the power differentials between work groups (Ebright et al., 2003). An example of this may be observed in nurses' CR related to falls prevention where the imperatives of time and completing tasks rather than patient safety were the determining factors in the decision-making (Dempsey, 2004). For the "right reason", the thinking must not only be complete in terms of the CR cycle, it must also be just and compatible with the values and beliefs of the person who is the recipient of care.

Conclusion

Competent professional practice requires not only psychomotor and affective skills but complex thinking processes. Nurses are responsible for a significant proportion of the judgments and decisions made in healthcare (Thompson et al., 2004). Even new graduate nurses are required to make increasingly complex decisions about patients with diverse health needs (Lasater, 2007). Effective CR skills are a key factor in the prevention of iatrogenic harm.

When the "five rights" of CR are not understood and applied, nurses' clinical judgments may be inaccurate and associated with inappropriate interventions that can lead to increased and untimely patient mortality. This paper has profiled a model of CR that has the potential to improve nursing students' CR skills and to increase their preparedness for professional practice.

References

Aiken, L., Clarke, S., Cheung, R., Sloane, D., Silber, J., 2003. Educational levels of hospital nurses and surgical patient mortality. JAMA 290 (12), 1617–1620.
Alfaro-LeFevre, R., 2009. Critical Thinking and Clinical Judgement: A Practical Approach to Outcome-Focused Thinking, fourth ed. Elsevier, St. Louise.
Andersen, B., 1991. Mapping the terrain of the discipline. In: Gray, G., Pratt, R. (Eds.), Towards a Discipline of Nursing. Churchill Livingstone, Melbourne, pp. 95–124.
Arbon, P., 2004. Understanding experience in nursing. Journal of Clinical Nursing 13 (2), 150–157.
Banning, M., 2008. Clinical reasoning and its application to nursing: concepts and research studies. Nurse Education in Practice 8, 177–183.
Benner, P., 2001. From Novice to Expert: Excellence and Power in Clinical Nursing Practice. Prentice Hall, Upper Saddle River, NJ.
Bright, D., Walker, W., Bion, J., 2004. Clinical review: outreach – a strategy for improving the care of the acutely ill hospitalized patient. Critical Care 8, 33–40.
Bucknall, T., 2000. Critical care nurses' decision-making activities in the natural clinical setting. Journal of Clinical Nursing 9 (1), 25–35.
Buist, M., Bernard, S., Nguyen, T., Moore, G., Anderson, J., 2004. Association between clinical abnormal observations and subsequent in-hospital mortality: a prospective study. Resuscitation 62, 137–141.
Cioffi, J., 2002. What are clinical judgments. In: Thompson, C., Dowding, D. (Eds.), Clinical Decision Making in Nursing. Churchill Livingstone, Edinburgh.
Clarke, S., Aiken, L., 2003. Failure to rescue. American Journal of Nursing 103 (1), 42–47.
del Bueno, D., 2005. A crisis in critical thinking. Nursing Education Perspectives (5), 278–283.
Dempsey, J., 2004. Falls prevention revisited: a call for a new approach. Journal of Clinical Nursing 13, 479–485.
Di Vito-Thomas, P., 2005. Nursing student stories on learning how to think like a nurse. Nurse Education 30 (3), 133–136.
Ebright, P., Urden, L., Patterson, E., Chalko, B., 2003. Understanding the complexity of registered nurse work in acute care settings. Journal of Nursing Administration 33, 630–638.
Elstein, A., Bordage, J., 1991. Psychology of clinical reasoning. In: Dowie, J., Elstein, A. (Eds.), Professional Judgment: A Reader in Clinical Decision-Making. Cambridge University Press, New York. 1991.
Ericsson, K., Whyte, A., Ward, J., 2007. Expert performance in nursing: reviewing research on expertise in nursing within the framework of the expert-performance approach. Advances in Nursing Science 30 (1), 58–71.
Ericsson, K., Simon, H., 1993. Protocol Analysis: Verbal Reports as Data, revised ed. The MIT Press, Cambridge, Massachusetts.
Ericsson, K., Simon, H., 1984. Protocol Analysis: Verbal Reports as Data. The MIT Press, Cambridge, Massachusetts.
Goldhill, D., 2001. The critically ill: following your MEWS. QJM: An International Journal of Medicine 94 (10), 507–510.
Hamers, J., van den Hout, M., Halfens, R., Abu-Saad, H., Heijltjes, A., 1997. Differences in pain assessment and decisions regarding the administration of analgesics between novices, intermediates and experts in pediatric nursing. International Journal of Nursing Studies 34 (5), 325–334.
Hardy, S., Garbett, R., Titchen, A., Manley, K., 2002. Exploring nursing expertise: nurses talk nursing. Nursing Inquiry 9 (3), 196–202.
Higuchi Smith, K., Donald, J., 2002. Thinking processes used by nurses in clinical decision-making. Journal of Nursing Education 41 (4), 145–153.
Hoffman, K., Aitken, L., Duffield, C., in press. A comparison of novice and expert nurses' cue collection during clinical decision-making: verbal protocol analysis. International Journal of Nursing Studies. doi: 10.1016/j.injnurstu.2009.04.001.
Hoffman, K., 2007. A Comparison of Decision-making by "Expert" and "Novice" Nurses in the Clinical Setting, Monitoring Patient Haemodynamic Status Post Abdominal Aortic Aneurysm Surgery. Unpublished PhD Thesis. University of Technology, Sydney.

Hoffman, K., Donoghue, J., Duffield, C., 2004. Decision-making in clinical nursing: investigating contributing factors. Journal of Advanced Nursing 45 (1), 53–62.

Incident Management in the NSW Public Health System 2007 July to December, 2008. Clinical Excellence Commission. NSW Health.

Jacques, T., Harrison, G., McLaws, M., Kilborne, G., 2006. Signs of critical conditions and emergency responses (SOCCER): a model for predicting adverse events in the inpatient setting. Resuscitation 69 (2), 175–183.

Jones, J., 1989. The verbal protocol: a research technique for nursing. Journal of Advanced Nursing 14, 1062–1070.

Kiely, D., Marcantonio, E., Inouye, S., Shaffer, M., Bergmann, M., Yang, F., Fearing, M., Jones, R., 2009. Persistent delirium predicts greater mortality. Journal of the American Geriatrics Society 57 (1), 55–61.

Lamond, D., Farell, S., 1998. The treatment of pressure sores: a comparison of novice and expert nurses' knowledge, information and decision accuracy. Journal of Advanced Nursing 27 (2), 280–286.

Lasater, K., 2007. High-fidelity simulation and the development of clinical judgment: students' experiences. Journal of Nursing Education 46 (6), 269–276.

McCarthy, M., 2003. Detecting acute confusion in older adults: comparing clinical reasoning of nurses working in acute, long-term, and community health care environments. Research in Nursing and Health 26, 203–212.

Mikos, K., 2007. Monitoring handoffs for standardization. Nurse Manager 38 (12), 16–20.

Needleman, J., Buerhaus, P., Mattke, S., Stewart, M., Zevinsky, K., 2001. Nurse Staffing and Patient Outcomes in Hospitals. Harvard School of Public Health, Boston.

NSW Health, 2006. Patient Safety and Clinical Quality Program: Third report on Incident Management in the NSW Public Health System 2005–2006. NSW Department of Health, Sydney.

O'Neill, E., Dluhy, N., Chin, E., 2005. Modelling novice clinical reasoning for a computerised decision support system. Journal of Advanced Nursing 49 (1), 68–77.

O'Neill, E., 1994. The influence of experience on community health nurses' use of the similarity heuristic in diagnostic reasoning. Scholarly Inquiry for Nursing Practice 8, 217–261.

Palmeri, T., 1997. Exemplar similarity and the development of automaticity. Journal of Experimental Psychology: Learning, Memory, and Cognition 23 (2), 324–354.

Schmidt, H., Norman, G., Boshuizen, H., 1990. A cognitive perspective on medical expertise: theory and implications. Academic Medicine 65, 611–621.

Schuurmans, M., Duursma, S., Shortridge-Baggett, L., 2001. Early recognition of delirium: review of the literature. Journal of Clinical Nursing 10, 721–729.

Smith, G., Poplett, N., 2002. Knowledge of aspects of acute care in trainee doctors. Postgraduate Medicine Journal 2, 335–338.

Tanner, C., 2006. Thinking like a nurse: a research-based model of clinical judgment in nursing. Journal of Nursing Education 45 (6), 204–211.

Thompson, C., Cullum, N., McCaughan, D., Sheldon, T., Raynor, P., 2004. Nurses, information use, and clinical decision making: the real world potential for evidence-based decisions in nursing. Evidence-Based Nursing 7 (3), 68–72.

Thompson, C., Dalgleish, L., Bucknall, T., Estabrooks, C., Hutchinson, A., Fraser, K., de Vos, R., Binnekade, J., Barrett, G., Saunders, J., 2008. The effects of time pressure and experience on nurses' risk assessment decisions: a signal detection analysis. Nursing Research 57 (5), 302–311.

Thompson, C., Dowding, D., 2002. Clinical Decision Making and Judgement in Nursing. Churchill Livingstone, Sydney.

White, J., Nativio, D., Kobert, S., Engberg, S., 1992. Content and process in clinical decision-making by nurse practitioners. Image – Journal of Nursing Scholarship 24 (2), 153–157.