AUSTRALIAN LEARNING & TEACHING COUNCIL

Promoting excellence in higher education

Final Report 2011

Examining the impact of simulated patients and information and communication technology on nursing students' clinical reasoning

Project team

Professor Tracy Levett-Jones
Dr Kerry Hoffman
Dr Jennifer Dempsey
Dr Sarah Jeong
Dr Sharyn Hunter
Dr Sharon Bourgeois
Ms Noelene Hickey
Ms Carol Norton
Ms Carol Arthur
Ms Jan Roche
Mr Samuel Lapkin
Ms Karen Jeffrey

Report author

Professor Tracy Levett-Jones

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

UNIVERSITY OF CANBERRA
AUSTRALIA'S CAPITAL UNIVERSITY

University of Western Sydney
Bringing knowledge to life

http://www.newcastle.edu.au/project/clinical-reasoning/

The Australian Learning and Teaching Council is an initiative of the Australian Government Department of Education, Employment and Workplace Relations.

Support for this project has been provided by the Australian Learning and Teaching Council Ltd., an initiative of the Australian Government. The views expressed in this report do not necessarily reflect the views of the Australian Learning and Teaching Council or the Australian Government.

Australian Learning and Teaching Council
PO Box 2375
Strawberry Hills NSW 2012
Australia

Street address:
Level 14, 300 Elizabeth Street
Surry Hills NSW 2010
Australia

Telephone: 02 8667 8500
Facsimile: 02 8667 8515
Web: www.altc.edu.au

2011

ISBN 978-1-921856-92-1

Contents

Executive Summary

Contemporary clinical practice environments are complex, dynamic and often unpredictable. Increasing numbers of adverse patient outcomes have been reported in Australia and internationally (Buist et al. 2004). Although warning signs often precede serious adverse events, there is evidence that 'at risk' patients are not always identified and even when warning signs are detected they are not always acted on in a timely manner (Thompson et al. 2008). Clinical reasoning ability is key to the recognition and management of the deteriorating patient and an essential component of nursing competence (Banning 2008). Clinical reasoning is defined as:

> 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 (Levett-Jones et al. 2010).

Research indicates that contemporary teaching and learning approaches do not always facilitate the development of nursing students' clinical reasoning skills (del Beuno 2005). Exposure to authentic clinical scenarios using human patient simulation manikins (HPSMs) is one strategy that has the potential to enhance students' clinical reasoning ability. Competence in the use of information and communication technology (ICT) may also have a positive impact on clinical reasoning and improve the quality, safety and efficiency of clinical processes (Goldsworthy, Lawrence & Goodman 2006).

These factors provided the impetus for this project and underpinned our commitment to engage in a systematic and rigorous program of research aimed at examining the effectiveness of using HPSMs and ICT in enhancing nursing students' clinical reasoning skills.

The project is premised on the belief that quality teaching should be based upon the best available evidence. However, in examining if, and to what extent clinical reasoning can be enhanced by the use of HPSMs it became apparent that research has not kept pace with the exponential growth in the investment and use of these technologies in nursing education. A review of the literature indicates that much educational practice related to the use of simulation is based upon anecdotal rather than empirical evidence. That is not to say quality approaches do not exist — they do, and in the course of this project we certainly identified a number of innovative and exciting examples. However, they are not widespread and most have not been empirically tested or widely disseminated.

In regards to the use of ICT in nursing education the issue is somewhat different. In Australia there is minimal use of these technologies to prepare nursing students for clinical practice and many graduates feel ill prepared for the use of ICT in their roles as registered nurses (Levett-Jones et al. 2009). This is ironic when one considers how the use of ICT In health care has escalated and the concomitant need to prepare graduates to work in highly technological clinical environments.

Our project sought to distinguish between anecdotal and empirical evidence in the use of simulation and ICT and to determine what evidence currently existed and what research was needed to progress the use of these technologies as effective teaching and learning methodologies.

There were five interconnected stages in the project; they included:

1. Three systematic reviews that appraised and synthesized international research to provide an evidence base for the use of HPSMs and ICT as strategies to enhance nursing students' clinical reasoning.
2. A cross sectional survey that scoped the current use of ICT and simulation in Australian nursing programs and the pedagogical approaches that underpin their use.
3. A Delphi study that, through consensus, resulted in a set of quality indicators for the use of simulation.
4. A quasi-experimental study that examined the impact of level of HPSM fidelity on nursing students' clinical reasoning, knowledge acquisition and satisfaction with learning.
5. A symposium that aimed to promote and imbed quality teaching practice related to the use of simulation, ICT and clinical reasoning.

Conclusions and Recommendations

As this project draws to a close we can say, with a degree of certainty, that in regard to simulation and ICT, we are at the end of the beginning, but certainly not the beginning of the end. The project answered many important questions but raised a number of issues:

In Australian nursing programs the use of simulation and, to a lesser extent ICT, has increased over the last decade but is currently constrained by the inadequacy of equipment, infrastructure, facilities and, most importantly, staff training.

Nursing students' exposure to simulation improves critical thinking skills and satisfaction with learning. However, there is lack of unequivocal evidence on the effectiveness of using high-fidelity HPSMs in the teaching of clinical reasoning skills to undergraduate nursing students. Similarly, the use of technologies such as personal digital assistants (PDAs) has the potential to provide the information students require at the point of care but students must be taught how to contextualise this information in practice in order to engage in effective clinical reasoning.

A clear and coherent set of quality indicators for the use of simulation has now been developed. The indicators will be beneficial for quality-assurance and quality-improvement processes but would be strengthened by the addition of key statistical measures to help track progress and performance in the development of simulation units and educational approaches.

The results of this project indicate that simulation experiences are highly valued by students, irrespective of the level of fidelity. Similarly, manikin fidelity does not influence knowledge acquisition. By contrast, clinical reasoning appears to be improved by exposure to high fidelity HPSMs. English language ability, as well as interpersonal communication skills, also appear to impact on clinical reasoning, student performance and 'patient' outcomes during a simulation experience. Further research is required to extend upon this work.

Integration of HPSMs and ICT into curricula is costly and time consuming. Both educational strategies require further study in order to provide evidence of learning outcomes and in particular clinical reasoning. The importance of this work is underscored by the potential for patient outcomes to be improved by enhancing the clinical reasoning skills of nursing students and graduates.

List of Acronyms

ALTC	Australian Learning and Teaching Council
BN	Bachelor of Nursing
CALD	culturally and linguistically diverse
CR	clinical reasoning
HPSM	human patient simulation manikin
ICDSF	interactive computerised decision support framework
ICT	information and communication technology
JBI	Joanna Briggs Institute
JBI-QARI	JBI Qualitative Assessment and Review Instrument
JBI -NOTARI	JBI Narrative, Opinion and Text Assessment and Review Instrument
PDA	personal digital assistant
JBI-MAStARI	JBI Meta Analysis of Statistics Assessment and Review Instrument
MCQ	multiple choice question
OSCE	objective structured clinical examination
NOTECHS	Non-technical skills
SSE	Satisfaction with Simulation Experience [scale]

Acknowledgments

The project team would like to thank the following people for their support, advice and collegial generosity during the course of the project:

Reference Group

Professor Leanne Aitken, Professor of Critical Care Nursing, Griffith University and Princess Alexandra Hospital

Dr Helen Bellchambers, Senior Lecturer, The University of Newcastle

Mr Roy Brown, Senior Lecturer, Bachelor of Nursing Programme Coordinator, School of Nursing, Midwifery and Indigenous Health, University of Wollongong

Professor Tracy Bucknall, Chair in Nursing, Cabrini-Deakin Centre for Nursing Research

Professor Elaine Duffy, Head of School, School of Nursing & Midwifery, Charles Sturt University. Representing the Council of Deans of Nursing and Midwifery (Australia and New Zealand)

Professor Christine Duffield, Centre for Health Services Management, University of Technology, Sydney

Professor Gerry Farrell, Head, Division of Nursing and Midwifery, Faculty of Health Science, La Trobe University. Representing the Council of Deans of Nursing and Midwifery (Australia and New Zealand)

Dr Ashley Kable, Deputy Head of School (Research), School of Nursing and Midwifery, The University of Newcastle

Ms Michelle Kelly, PhD candidate, Lecturer, Program Manager, Curriculum Technologies Integration, University of Technology, Sydney

Clint Moloney, PhD Candidate, Lecturer University of Southern Queensland, Associate Director, Australian Centre for Rural and Remote Evidence Based Practice, Toowoomba and Darling Downs Health Service District

Dr Mee Young Park, International Student Support Coordinator, Division of Nursing and Midwifery, School of Health Sciences, RMIT University. Representing the Council of Deans of Nursing and Midwifery (Australia and New Zealand)

Associate Professor Anthony Williams, Head of School, School of Architecture & Built Environment, The University of Newcastle

Mr Geoff Wilson, Director of Clinical Schools, Department of Nursing and Midwifery, Faculty of Science, University of Southern Queensland.

Expert Panel (for review of articles, case studies, surveys and simulation scenarios)

Ms Danielle Noble, Lecturer, The University of Newcastle

Mr Peter Sinclair, Lecturer, The University of Newcastle

Ms Jean Gersbach, Clinical Assessor and Simulation Educator, The University of Newcastle

Ms Sharon Gibbins, Clinical Educator, The University of Newcastle

Ms Jennifer Burrows, Clinical Nurse Consultant, Stroke, Northern Sydney Central Coast Area Health Service

Ms Jaqueline Colgan, Clinical Nurse Consultant, Cardiac Services, Northern Sydney Central Coast Area Health Service

Ms Linda Ritchard, Clinical Nurse Consultant, Hunter Integrated Pain Service, Hunter New England Area Health Service

Dr Ritin Fernandez, Lecturer, University of Western Sydney

Mr Alex Keene, graduate, The University of Newcastle

Ms Gemma Carty, graduate, The University of Newcastle

Ms Kylie Dunstan, graduate, The University of Newcastle

Mr Thomas Quinn, graduate, The University of Newcastle

Ms Rachel Craig, graduate, The University of Newcastle

Financial and Budgetary Support

Ms Penny Mahoney, Executive Officer, The School of Nursing and Midwifery, The University of Newcastle

Statistical Support

Mr Patrick McElduff, Senior Statistician, The University of Newcastle

IT Support

Ms Amanda Morris, E-Learning Officer, The University of Newcastle

Mr Andrew Dunne, Assistant E-Learning Officer, The University of Newcastle

Technical Support (Simulation Unit)

Ms Marian Niddrie, The University of Newcastle

Participants

We would like to acknowledge the nursing students who participated in this project and shared their views about the value of simulation experiences.

Introduction

Competent professional practice requires not only psychomotor skills and knowledge, but also sophisticated thinking abilities. Nurses with effective clinical reasoning skills have a positive impact on patient outcomes. Conversely, those with poor clinical reasoning skills often fail to detect impending patient deterioration resulting in a 'failure-to-rescue' (Aiken, Clarke, Cheung, Sloane & Silber 2003). The top three reasons for adverse patient outcomes are failure to properly diagnose, failure to institute appropriate treatment and inappropriate management of complications (NSW Health 2008). Each of these is related to poor clinical reasoning skills. The Quality in Australian Healthcare Study found that 'cognitive failure' was a factor in 57 per cent of adverse clinical events, this included failure to synthesise and act on clinical information (Wilson 1995). Clinical reasoning and patient outcomes have also been linked to information and communication technology (ICT) competence (Goldsworthy, Lawrence & Goodman 2006). Appropriately used, ICT has a positive impact on patient outcomes by reducing the number of adverse events and improving the quality, safety and efficiency of clinical processes (Staggers, Gassert & Curran 2002). Nurses who have the requisite ICT skills to access diagnostic information online and search for the best available research to inform their clinical decision making, are able to provide a better standard of patient care.

The project outlined in this report examined how nursing students' clinical reasoning skills can be enhanced by the effective use of human patient simulation manikins (HPSMs) and ICT such as personal digital assistants (PDAs). Key outcomes from the project include a range of scholarly resources that will be valuable to those with a vested interest in clinical reasoning, the use of HPSMs and ICT.

Background

Evidence suggests that contemporary learning and teaching approaches do not always facilitate the development of a requisite level of clinical reasoning skills (Cant & Cooper 2009). While universities are committed to the education of nurses who are adequately prepared to work in complex and challenging clinical environments, health services frequently complain that graduates are not 'work ready'. A report by NSW Health Patient Safety and Clinical Quality Programme (2006) described critical patient incidents that often involved poor clinical reasoning by graduate nurses. This report parallels the results of the Performance Based Development System, a tool employed to assess nurses' clinical reasoning, which showed that 70 per cent of graduate nurses in the United States scored at an 'unsafe' level (del Beuno 2005). Although these nurses had good content knowledge and adequate procedural skills, they frequently lacked the clinical reasoning skills needed to respond appropriately in critical situations. Additionally, while clinical reasoning is linked to effective use of ICT (Staggers, Gassert & Curran 2002), research suggests that many students are not confident or competent in the use of clinical ICT applications (Bembridge, Levett-Jones & Jeong 2010; Levett-Jones et al. 2009).

Ideally, opportunities for the development and application of clinical reasoning skills should be provided in 'real' healthcare contexts during the experiential learning that occurs when nursing students undertake clinical placements. In reality, there are a number of barriers to this occurring in a systematic or consistent way (Levett-Jones & Bourgeois 2011):

- Clinical placements are unpredictable and dynamic, providing varied and sometimes chaotic learning experiences.
- Students' exposure to diverse areas of clinical practice is often frustrated by the

constraints imposed by reduced placement availability and large numbers of nursing students.

- Opportunities for nursing students to observe or to be involved in the types of high-risk, low-incidence critical situations that can heighten their clinical reasoning skills are infrequent.
- The rapid acceleration in the pace of scientific knowledge and technological change, when combined with the ethical challenges inherent in contemporary practice, demand that clinical skills are developed without potential detriment to healthcare consumers.

Supplementary and/or alternative approaches for delivering relevant clinical experiences are needed. Universities are focusing increasingly on providing meaningful experiential learning opportunities using HPSMs and ICT in clinical laboratories. The use of simulation is an educational approach that allows for participative and interactive learning by recreating a clinical experience in a clinical laboratory or simulation unit, without exposing patients to the associated risks. Both medium and high fidelity HPSMs have been employed to expose students to 'real life' situations within safe and supportive environments. Medium fidelity manikins have a life-like verisimilitude that replicates the joint movements and anatomy of real human beings. They enable the practice of a range of nursing procedures, such as assessment of blood pressure and pulse, but allow for limited interactivity. High fidelity manikins are technologically advanced simulators that have palpable pulses, breath and bowel sounds, an IV arm, and can be intubated and programmed to speak, grimace and groan. A computer allows for individualised programming of realistic healthcare scenarios.

The use of simulation is not new. The aviation industry has used simulation to enhance the capacity of pilots to react appropriately in critical situations for more than three decades. Simulation has been used extensively in healthcare, particularly with the teaching of anaesthetists and surgeons. In nursing, varying forms of simulation have been used in clinical skills laboratories for many years. It is the increasing levels of sophistication and fidelity and the potential to closely replicate 'real' patient scenarios that is relatively new and, to date, has been inadequately studied. For example, when we commenced this project we identified that:

- The majority of research (95 per cent of papers) evaluating the use of simulation was in medicine; only 15 per cent of articles examined simulation in nursing and most were descriptive accounts of how patient simulation was utilised in a particular setting (Flanagan, Clavisi & Nestel 2007).
- A lack of valid and reliable evaluation instruments was impeding the uptake of simulation in nursing education (Kardong-Edgren, Adamson & Fitzgerald 2010).
- There was a dearth of rigorous research on the use of simulation to enhance nursing students' clinical reasoning skills (Flanagan, Clavisi & Nestel 2007).
- While the potential of simulation was evident, measurements of quality had not been debated or defined (Aliner, Hunt & Harwood 2006).

PDAs, although widely used in the USA, have been introduced into only a small number of nursing programs in Australia. PDAs are hand-held, portable ICT devices that enable rapid access to clinical software and web-based downloadable clinical data. Using PDAs and HPSMs in clinical laboratories has a number of potential benefits to learning, although these benefits are not always realised (Goldsworthy, Lawrence & Goodman 2006; Jeffries 2007). Potential benefits include the following:

- Students can be provided with opportunities for active involvement in challenging clinical situations that involve unpredictable simulated patient deterioration.

- Students can be exposed to time sensitive and critical clinical scenarios that, if encountered in a 'real' clinical environment, they could normally only passively observe.
- Students can access and use clinically relevant data in a structured way.
- Immersion in simulation can provide opportunities to apply and synthesise knowledge in a realistic but non-threatening environment.
- Opportunities for repeated practice of requisite skills and formative and summative assessment can be provided.
- Debriefing and immediate opportunities for reflection can enhance the conditions for learning.
- Remediation can be provided in a supportive environment.

Although there are suggestions that the use of HPSMs and PDAs can improve nursing students' clinical reasoning skills, knowledge acquisition and student satisfaction (Kenny 2002; Larew et al. 2006), these assertions have not been empirically tested. HPSMs have been mainly limited to the teaching and assessment of procedural skills and there are few examples of HPSMs being used to enhance higher order thinking skills such as clinical reasoning. Similarly, although there is some research that indicates that the use of PDAs has the potential to promote clinical reasoning and reduce the incidence of clinical errors (Comer 2005; Feingolg, Calaluce & Kallen 2004), this has not been adequately investigated. This project evaluated how HPSMs and PDAs can be used to complement, replicate and potentially replace some authentic clinical placement experiences. In addition, we examined the conditions under which these technologies enhance nursing students' clinical reasoning, knowledge acquisition and satisfaction.

Project Aims:

- explore the range and types of simulation and ICT currently used in Australian nursing programs and the pedagogical approaches that underpin their use
- investigate how the educational outcomes of simulation and ICT are assessed and the extent to which these technologies are used for formative and/or summative assessment of students' performance
- identify principles and practices related to the use of HPSMs that are indicative of quality learning and teaching approaches
- examine the impact of high and medium fidelity HPSMs and PDAs on nursing students' clinical reasoning, knowledge acquisition and satisfaction with learning
- develop a range of scholarly learning and teaching resources to support nursing students and academics in the effective use of HPSMs and ICT in clinical laboratories.

As the project progressed it became apparent that the depth and breadth of data collected provided the opportunity to explore a range of additional possibilities associated with the use of simulation. Thus, the project team also investigated:

- whether the extra costs associated with high-fidelity manikins can justify the differences, if any, in the outcomes of clinical reasoning, knowledge acquisition and student satisfaction
- relationships between cue acquisition and clinical reasoning outcomes
- the influence of interpersonal communication during simulation sessions on students' clinical reasoning ability and performance
- the impact of culturally and linguistically diverse (CALD) students' language ability on clinical reasoning during simulation
- levels of reflection achieved in the debrief that follows a simulation session.

In the next section of this report we outline the project's approach, methodology, dissemination and impact. A summary of the planned and actual project outcomes is provided on page 66-67. The report concludes with a discussion of the factors that have been critical to the project's success.

Approach and Methodology

The project was planned as five interconnected stages. Each stage addressed one or more of the projects aims. A brief overview of the project stages is provided here, with further details about each of the studies and outcomes provided in the following pages.

Stage One. Systematic reviews
In this foundational stage of the project the purpose was to develop resources, grounded in the evidence related to clinical reasoning, which will benefit academics engaged in the use of HPSMs and PDAs. While a literature review had been undertaken in preparation for the project, the systematic reviews extracted, appraised and synthesised international research, adhering to the guidelines published by the Joanna Briggs Institute (JBI) for Evidence Based Practice. The systematic reviews provided an evidence base and informed the other stages of the project. The reviews were submitted to the internationally renowned Joanna Briggs Institute so that they are available to a wide readership.

Stage Two. Cross sectional survey
In this stage of the project the first and second project aims were addressed by exploring the current use of ICT and simulation in Australian universities and the pedagogical approaches that underpin their use. Representatives from each Australian nursing school were invited to participate in the survey. The results of the survey provided a sound understanding of the contemporary use of HPSMs and ICT and emphasised that the outcomes of our project would be informative, relevant and valuable across the sector. The survey also provided an opportunity to promote the project and actively engage with stakeholders.

Stage Three. Development of quality indicators for the use of HPS and ICT
This stage addressed the forth project aim. Delphi technique was used to survey a panel of international simulation and ICT experts and to reach consensus about quality indicators. This was an appropriate technique as it provided a means by which expert opinion could be sought and synthesised. The Delphi technique used for this project involved three rounds of questionnaires. The survey promoted dialogue across and between the higher education sector and, as a consequence, contributed to dissemination of the project. The quality indicators provide a valuable resource for all academics with an interest in optimising the learning experiences of students through effective use of simulation and ICT. These indicators are available on the project web site and have been distributed via professional networks and workshops.

Stage Four. Quasi experimental study
This stage addressed the third project aim and comprised a major component of the project by identifying the impact of HPSMs and PDAs on nursing students' clinical reasoning, knowledge acquisition and satisfaction with learning. A quasi experimental design was used and the three learning outcomes were measured and comparisons made between students exposed to medium and high fidelity HPSMs. The results from the study are illuminative and have been well received across the sector.

Stage Five. Project symposium
At the completion of the project a two day symposium was conducted. This forum provided the opportunity for educators to meet and discuss the findings, outcomes and significance of the project. In addition, the symposium was strategic in engaging prospective users of the learning resources and in promoting and embedding good teaching practice related to the use of simulation and clinical reasoning.

Stage 1: Systematic Reviews

Two systematic reviews were completed as the foundation to the project. A third review is currently in progress. A synopsis of the three reviews is provided below:

1. The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: A systematic review.

Background
HPSMs are being used extensively both nationally and internationally in the education of health professionals. There is evidence suggesting that these types of technologies are effective in teaching psychomotor skills; furthermore, student satisfaction with simulation is generally high. However, the extent to which HPSMs are effective in the teaching of clinical reasoning skills to undergraduate nursing students is less clear.

Objective
The objective of this systematic review was to identify the best available evidence for the effectiveness of using high-fidelity HPSMs to teach clinical reasoning skills to undergraduate nursing students.

Inclusion criteria
The review included all randomised controlled trials and quasi experimental studies that assessed the effectiveness of high fidelity HPSMs in educating undergraduate nursing students. Studies that included health professionals were excluded unless data for nursing students were analysed separately. The primary outcome measure was clinical reasoning, as assessed by methods such as objective structured clinical examinations (OSCEs) and questionnaires. Other outcome measures included student satisfaction, knowledge acquisition, and psychomotor skill performance.

Search strategy
Using a systematic search strategy designed for each database, the following electronic sources were searched for the period 1999 - 2009: CINAHL, Cochrane Database, Dissertation and Theses, EMBASE, ERIC, MEDLINE, Ovid, Proquest and PsycINFO. Hand searching of the reference lists of included studies and conference proceedings was undertaken to identify further studies.

Methodological validity
Two independent reviewers assessed the methodological quality of each study selected for retrieval prior to inclusion in the review using the Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI).

Data collection and synthesis
Data were then extracted from studies using JBI-MAStARI. Due to the limited quality of available studies, statistical pooling was not possible and the findings were therefore presented in narrative form.

Results
Eight studies were selected for inclusion in this review. The results indicate that the use of HPSMs improves knowledge acquisition, critical thinking and students' satisfaction with the learning. However, there is lack of unequivocal evidence on the effectiveness of using high-fidelity HPSMs in the teaching of clinical reasoning skills to undergraduate nursing students.

Conclusion
Further research is required to ascertain the effectiveness of the use of HPSMs as an educational strategy to improve the clinical reasoning skills of undergraduate nursing students. This research has the potential to improve patient outcomes by enhancing the clinical reasoning skills of nursing students and graduates.

Implications
This systematic review provided a guide to future research priorities which include (a) the development of reliable and valid simulation evaluation instruments for accurately measuring clinical reasoning skills; and (b) the need for a separate systematic review that focuses on qualitative studies.

Dissemination
This systematic review has been disemainated via publications and a conference presentation:

Lapkin, S, Fernandez, R, Levett-Jones, T & Bellchambers, H, 2010, 'The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: A systematic review', *Joanna Briggs Institute Library of Systematic Reviews,* JBI000287 vol. 8, no.16, pp.661–694.

Lapkin, S, Levett-Jones, T, Bellchambers, H & Fernandez, R, 2010, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: A systematic review, *Clinical Simulation in Nursing,* vol. 6, no.6, pp e207– e222.

Lapkin, S, Levett-Jones, T, & Bellchambers, H, 2009, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: a systematic review*,* Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Impact
This review broke new ground by challenging previously accepted assumptions and anecdotal evidence about the use of HPSMs, and generating Level one evidence. Because of this the review was a 'featured article' in the *Clinical Simulation in Nursing* journal and was profiled in the Journal of Advanced Nursing, an international peer reviewed journal:

Xue, Y 2010, Review Summaries: Lapkin, S, Fernandez, R, Levett-Jones, T & Bellchambers, H, 2010, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: a systematic review, *Journal of Advanced Nursing* vol. 66, no.11, pp 2391–2397.

2. The effect of Personal Digital Assistants in supporting the development of clinical reasoning in undergraduate nursing students

Background
Contemporary healthcare systems are dynamic, complex and evolving. In order to manage patient care effectively in these often unpredictable and highly pressured environments, nurses are required to use clinical reasoning skills. PDAs are thought to be useful in the teaching of clinical reasoning skills to nursing students.

Objective
The purpose of this systematic literature review was to determine the effect of PDAs in supporting the development of clinical reasoning skills in undergraduate nursing students. Outcome measures of clinical reasoning included development in theoretical nursing knowledge as well as clinical skills, problem solving and reflection.

Inclusion criteria
Data was retrieved for assessment if it met the pre-specified inclusion criteria. Relevant data were assessed for quality and extracted using JBI-MAStARI. All randomised and quasi-randomised controlled trials were considered for inclusion.

Search strategy
The methodology for this systematic literature review included the retrieval of relevant nursing literature from Medline, CINAHL, Cochrane Library, Meditext and Scopus databases, as well as conference proceedings, digital dissertations, and the manual-searching of reference lists to retrieve grey literature.

Methodological validity
Two independent reviewers assessed the methodological quality of each study selected for retrieval prior to inclusion. Using this process, four studies were extracted for the review.

Results
The review revealed that PDAs increase undergraduate nursing students' accuracy and efficiency in the practical application of clinical reasoning skills during medication administration. PDAs also increase nursing students' self-efficacy in exercising professional nursing judgment. On the other hand, the results indicated that PDAs are not as beneficial as traditional textbooks in improving students' ability to use the provided information for critical thinking, problem solving and clinical decision making.

Conclusion
The methodological quality of the reviewed studies was limited. The need for nursing students to develop competency in clinical reasoning was confirmed by the studies reviewed. PDAs are able to provide nursing students with the information they require at the point of need. However, educators must equip students with the skills required to assess and contextualise this information appropriately in practice.

Implications
The results indicate the need for further research in this field of study in order to validate the increased use of PDAs in nursing education as a means to support clinical reasoning development.

Dissemination
This systematic review has been disseminated via publications and a symposium presentation:

Jeffrey, K, Bourgeois, S, & Hillege, S, (2011), The effect of Personal Digital

Assistants in supporting the development of clinical reasoning in undergraduate nursing students, *Joanna Briggs Library of Systematic Reviews,* JBI000382 vol. 9, no.16, pp.38-68.

Jeffrey, K, Bourgeois, S & Hillege, S 2010, The effect of Personal Digital Assistants on undergraduate nursing students' clinical reasoning, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

3. The meaningfulness and appropriateness of using human patient simulation manikins as a teaching and learning strategy in undergraduate nursing education: A systematic review.

Background
A recent systematic review by Lapkin, Fernandez, Levett-Jones, & Bellchambers (2010) reported that the use of HPSMs improves knowledge acquisition and critical thinking. The results of the review also demonstrated high self-reported levels of learner satisfaction with simulation. However, the review included only randomised control trials and quasi experimental designs. Further exploration from a qualitative perspective is needed to gain a broader understanding of students' and educators' perspectives of HPSMs in order to develop appropriate evidence based recommendations for educational practice.

For the purpose of this review, 'meaningfulness' relates to the personal experiences and opinions of undergraduate students and academics regarding the use of HPSMs as a teaching and learning strategy (Joanna Briggs Institute 2008). 'Appropriateness' refers to the best conditions under which HPSMs can be integrated into nursing education (Joanna Briggs Institute 2008)

Objective
The aim of this review is to identify the best available evidence on the meaningfulness and appropriateness of the use of HPSMs in undergraduate nursing education.

Inclusion criteria
The review includes studies of nursing students and academics who have been involved in the use of simulation in undergraduate education. Studies that consider other allied health care professionals will be excluded unless data for nursing students was analysed separately.

The review includes, as the phenomena of interest, the experiences, values, opinions, beliefs and interpretations of nursing students and academics who have used HPSMs for teaching and learning purposes.

The review includes qualitative research studies that drew on the experiences of nursing students and academics on the use of HPSMs. In the absence of research studies, textual evidence such as opinion papers were considered for inclusion.

Search strategy
Using a systematic search strategy designed for each database, the following electronic sources were searched for the period 1999–2009: AMED, CINAHL, Cochrane Database, Dissertation and Theses, EMBASE, ERIC, MEDLINE, Ovid database, Proquest Nursing Journals, PsycINFO. Manual searching of the reference lists of included studies and conference proceedings was undertaken to identify further studies.

Methodological validity
Two independent reviewers assessed the methodological quality of each study

selected for retrieval prior to inclusion, using a critical appraisal tool from the Joanna Briggs Institute.

Data collection
The qualitative data will be extracted from papers included in the review using the Joanna Briggs Institute Qualitative Assessment and Review Instrument (JBI-QARI). The opinion and other text data will be extracted from papers included in the review using the Joanna Briggs Institute Narrative, Opinion and Text Assessment and Review Instrument (JBI-NOTARI).

Data Synthesis
Where meta-synthesis is possible, qualitative research findings will be pooled. This will involve synthesis of findings to generate a set of statements that represent that aggregation through assembling the findings (Level one findings) rated according to their quality, and categorising these findings on the basis of similarity in meaning (Level two findings). These categories will then be subjected to a meta-aggregation in order to produce a single comprehensive set of synthesised findings (Level three findings) that can be used as a basis for evidence-based practice. Where textual pooling is not possible the findings will be presented in narrative form.

Dissemination
At this time of writing this report this review is incomplete and in progress. The systematic review protocol has been published and is available on the Joanna Briggs Library:

Lapkin, S, Levett-Jones, T, & Bellchambers, H 2010, *The meaningfulness and appropriateness of using human patient simulation manikins as a teaching and learning strategy in undergraduate nursing education: A systematic review*, Joanna Briggs Library of Systematic Review Protocols (no. 378).

Stage 2: Cross-sectional survey

Background
Investment in simulated learning environments has increased at a remarkable pace. The potential for simulation experiences to supplement or replace some required clinical placement hours is a major influence on this investment. In the United Kingdom, in line with recommendations from the Nursing and Midwifery Council Simulation and Practice Learning Project (2007), up to 300 clinical placement hours can be replaced with simulation experiences. Simulation has also been recognised as a partial replacement for clinical placement hours in many parts of the United States (Kardong-Edgren, Lungstrom & Bendel 2009). In Australia, the types of simulation being used, the pedagogical principles that underpin simulation use, and the extent to which simulation is being considered as a replacement for clinical placements is largely unknown. Similarly, information regarding the extent and effectiveness of the use of ICT in Australian schools of nursing is limited. Thus, a national scoping study was considered timely and relevant.

The aims of the cross-sectional survey were to:

- explore the range and types of HPSMs and ICT currently used in Australian nursing programs and the pedagogical approaches that underpin their use
- investigate how the educational outcomes of HPS and ICT are assessed and the extent to which these technologies are used for formative and/or summative assessment of students' performance.

Research Design and participants
Cross sectional surveys are a research method recommended for the collection of data that is descriptive of a situation at a given point in time (Schneider, Whitehead & Elliot 2007). In this project a web-based survey was used to facilitate ease of response.

A review of the literature and consultation with an expert panel were used to inform the development of the survey items. Ninety-eight open and closed questions were structured under the following headings:

- clinical laboratory facilities
- staffing of clinical laboratories
- types and levels of simulation used
- use of simulation for assessment
- pedagogical principles and practices
- use of ICT in clinical laboratories
- potential for simulation to replace clinical placements
- evaluation and research.

Ethics approval was obtained from The University of Newcastle Human Research Ethics Committee. The survey was conducted in April and May 2009. Heads of school from each nursing school were invited to participate in the survey themselves, or to forward the survey to the most appropriate member of staff. An information statement was provided and participants provided consent before accessing the survey.

Of the 32 nursing schools invited to participate, 24 responses were received, giving a response rate of 75 per cent. Responses were received from all states of Australia. The data from the web-based survey was downloaded to an Excel

spreadsheet for analysis. Text responses to open ended questions and comments were thematically analysed.

Results

Clinical laboratory facilities

The number of students at participating schools of nursing ranged from 170 to 5100, with a median of 1137. The number of clinical laboratories available in each school ranged from two to 16. The number of clinical laboratories varied in size from four to 30 beds, with a median of six beds. Class sizes (number of students) within these laboratories also varied considerably, from 12 to 30, with a median of 20. There was no obvious relationship between the number of students in a class and the number of beds available in the clinical laboratory.

Clinical laboratory staffing

While 83 per cent of schools utilised at least some full time academic staff for teaching in clinical laboratories, 75 per cent also employed casual laboratory teaching staff, and 17 per cent had all laboratories staffed by casual staff. While the employment of casual staff may have some advantages in terms of recency of practice, participants felt that casual staff rarely had the skills needed for the use of HPSMs.

An appointed laboratory manager was available in 92 per cent of schools with 54 per cent of these being in administrative positions, and 29 per cent being academic staff members. Laboratory technical support staff numbers ranged from 0 to 10, with a median of 1.25. Participants identified staff related factors as constraints to effective implementation of simulation more often than any other factors. The two highest ranking constraints identified were level of staff training in the use of HPSMs and ICT (*n*=18), and time for staff development (*n*=17).

Types of HPSM used and extent of use for teaching and assessment

A range of HPSMs and equipment were used in participating schools: 91 per cent of schools used part task trainers; 95 per cent used low fidelity manikins; 86 per cent used medium fidelity manikins; and 45 per cent were using high fidelity manikins at the time of the survey.

The extensive use of low fidelity manikins that have no capacity to respond or show physiological signs to teach therapeutic communication and patient assessment skills is a surprising result. Medium fidelity manikins are not being utilised to their full potential it would seem, being more often used to teach basic physical assessment skills such as auscultation of heart and lung sounds, rather than clinical reasoning skills and teamwork.

There was a high level of simulation used for student assessment with 62 per cent of participants (*n*=21) using some form of simulation as an assessment strategy. Simulation was used for both formative and summative assessments and a range of methods were used to grade student performance. The most common methods were: predetermined marking criteria; Australian Nursing and Midwifery Council (ANMC) National Competency Standards for the Registered Nurse (2005); Objective Structured Clinical Examinations (OSCEs); and skills checklists. Simulation was also identified as a strategy for remediation and re-testing following unsatisfactory clinical performance.

Pedagogical principles and frameworks

Eighty three per cent of participants (*n*=23) stated that their simulation sessions had written objectives and that these objectives were embedded in or aligned to specific course or subject outcomes as well as documented curriculum objectives.

Lectures, tutorials, written and computer-based learning packages, psychomotor and communication skills training were used as preparation for the simulation experience. The majority of respondents (95 per cent, *n*=22) stated they provided some form of briefing prior to the simulation.

The level of support provided to students during the simulation varied, with only one participant indicating the use of fully immersive simulations from the first year of the undergraduate program. Forty-one per cent stated that they had a facilitator in the room when a simulation session was taking place, nine per cent used the 'pause and discuss' technique, and 27 per cent stated that the level of immersion was 'ad hoc' or variable, depending on the level of students' experience.

The number of students actively involved in a simulation at any one time ranged from 2 to 30, with a median of 4.5. Those who stated that they had very large numbers involved in a simulation were not explicit about the roles allocated to each student. Most (68 per cent) of participants stated that there were other students present in the simulation room as observers, with numbers ranging from two to 21, with a median of 11. When observers were present they were allocated a specific role 50 per cent of the time. These roles included evaluation of team performance and providing critical feedback during debriefing. Twenty seven per cent of participants stated that they had a separate room for students to view the simulation through video link or one-way glass.

Eighty three per cent of participants stated that their simulation sessions became more complex and immersive as students progressed through the undergraduate program. Some participants commented that in first year they focused on basic skill acquisition, patient assessment and communication; while in the second year they introduced more complex clinical skills and problem solving requirements. Simulation sessions for third year students often involved deteriorating patient scenarios requiring real time responses and clinical reasoning.

Eighty two per cent of participants stated that students engaged in debriefing following simulation, which lasted between 10 and 60 minutes. Ninety four per cent of those who debrief identified reflection on practice as a technique used, while comparison with predetermined best practice criteria, structured questions and learning logs were used less frequently.

Less than half of the participants (48 per cent) indicated that they used a theoretical framework or model as a basis for their simulation teaching and learning. Twenty seven per cent stated that clinical reasoning, clinical decision making or clinical judgement were not specifically addressed as a discrete topic in their undergraduate program. Of those that did teach clinical reasoning; only 25 per cent used a clinical reasoning model.

Use of ICT in clinical laboratories

The use of ICT in clinical laboratories was low overall. While 55 per cent of participants stated that they have ICT available for students to use in clinical laboratories, the actual use of ICT as part of clinical laboratory activities is limited. Most (92 per cent) of those who had ICT in the clinical laboratories used desktop computers only, and very few had laptops, PDAs or other forms of ICT available. Those with computers in laboratories also had internet access to library facilities and nursing journal data bases. One school reported an online pharmacology program which they found ineffective and planned to abandon. Another school reported online access to simulated patients' pathology results during high fidelity simulation and two reported utilising a computer based clinical decision support system. Lack of space for computers and lack of staff with ICT literacy were identified as constraints. This low level of ICT use in laboratories is inadequate for graduates to be confident and competent in the use of point of care technology use.

Potential for simulation to replace clinical placements
Few participants viewed simulation as a viable alternative to clinical placements. Only nine per cent of participants stated that simulation was currently used to replace clinical hours, and this was for additional remediation only. However, 57 per cent stated that they would consider replacing some clinical placement hours with simulation. The factors influencing their decisions included:

- difficulty finding suitable clinical placements
- variable quality of placements
- inadequacy of simulation facilities
- requirements of registration authority
- philosophical position – questioning whether simulation should be used to complement or replace placements
- determining equivalence between placements and simulation hours
- determining the attributes of a 'quality' simulation approach.

Conclusion
Overall the survey results demonstrate that Australian schools of nursing are actively involved in, and committed to, the development of simulation, and to a lesser extent, ICT. The adequacy of equipment and facilities is a major barrier to adoption and staff training was the major constraint on the implementation of simulation and ICT. These findings are consistent with the literature, which identifies the need for significant financial and personal investment and the need for teaching staff to develop new skill sets for effective implementation of simulation (O'Donnell and Goode, 2008). The survey results indicate that the impetus to increase the use of simulation and ICT into nursing programs must be matched with an increase in equipment, infrastructure and staff training.

Dissemination
This study has been disseminated via publications and conference presentations:

Arthur, C, Kable, A & Levett-Jones, T 2010 Human patient simulation manikins and information communication technology use in Australian schools of nursing: A cross sectional survey, *Clinical Simulation in Nursing.* <http://dx.doi.org/10.1016/j.ecns.2010.03.002>

Arthur, C, Levett-Jones, T & Kable, A 2010, Human patient simulation manikins and information communication technology use in Australian nurse education, Paper presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Arthur, C, Levett-Jones, T, & Kable, A 2009, Human patient simulation manikins and information communication technology use in Australian nurse education, Paper presented at the *The Third International Clinical Skills Conference*, Prato, Italy, July 3-5 2009

Arthur, C, Levett-Jones, T, & Kable, A 2009, Human patient simulation manikins and information communication technology use in Australian nurse education, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Linkages and Impact
This study was the first to scope how, and to what extent, simulation is being used in Australian schools of nursing. The results from the cross sectional survey have

generated a great deal of interest in Australia and more broadly. The study is also being replicated at The University of Nagasaki in Japan (personal communication, November 16, 2009). Additionally, the results from the survey were informative in the development of a subsequent project, namely:

National Health Workforce Taskforce Grant, 2010, *Use of Simulated Learning Environments in Nursing Curricula,* Rudd, C, Levett-Jones, T, Stoddart, C, Marriot, R, Starr, L & Driggers, B.

Stage 3: Delphi Study

Background
Simulation is broadly defined as an educational technique in which elements of the real world are integrated to achieve specific goals related to learning or evaluation (Gaba 2004). One of the driving forces for the increasing use of simulation over the last decade is the decreased availability of quality clinical placements and the potential for simulation experiences to supplement or replace some required placement hours. However, the attributes of 'quality simulation' experiences have, until now, not been defined. Therefore the aims of this stage of the project were to:

- specify the principles and practices related to the use of simulation and ICT that are indicative of quality learning and teaching approaches
- develop a set of quality indicators to guide the use of simulation and ICT in undergraduate nursing programs.

Project design
A modified Delphi technique was utilised to achieve consensus of expert opinion regarding quality use of simulation and ICT, and this formed the basis for the development of the quality indicator statements. The Delphi method is defined as a method for the systematic solicitation and collection of judgements on a particular topic through a set of carefully designed sequential questionnaires interspersed with summarised information and feedback of opinions derived from earlier responses (Delbecq, Van de Ven & Gustafson 1975).

Critical aspects of the Delphi technique include:

- anonymity of participants to allow free expression of opinion
- iteration through a number of questionnaire rounds refining participants' views in light of information provided
- controlled feedback informing participants of others' perspectives and providing the opportunity for clarification or change
- statistical aggregation of responses using quantitative analysis of data (Skulmoski, Hartman and Krahn 2007).

While the classical Delphi technique first round questionnaire utilises open ended questions requiring participants to generate responses, this study used a modified approach, in which the participants were provided with a list of potential quality indicators to rank in order of importance (Wiersma & Jurgs 2005). This list was derived from a detailed review of literature and participant responses to the cross sectional survey previously undertaken. The study utilised a web based format, termed a web based Delphi or e-Delphi (Hatcher & Colton 2007; Wiersma & Jurgs 2005).

Sample and recruitment
Following ethics approval, 32 international experts in the use of simulation and ICT were invited to participate in the Delphi study. The sample included academics and simulation specialists who were selected based on publications and leadership positions in professional simulation organisations. Participants were given an information letter outlining the purpose of the survey, and agreement to participate was taken as implied consent. Seventeen experts were recruited from Australia, North America, Europe and Hong Kong.

Structure of the Delphi
The Delphi consisted of three rounds:

Round 1
The Delphi questionnaire was accessed via the project website and participants were emailed the web link and password. The first round questionnaire consisted of a Likert type scale for participants to rank the importance of teaching principles and practices related to the use of simulation and ICT. A free text section was provided for participants to elaborate on issues and make additional suggestions. The first round results were analysed using mean and median scores as well as content analysis of comments. Participants were then sent a detailed report of the results for consideration prior to round two.

Round 2
The analysis of round one results was used to construct the second questionnaire, which used further ranking to achieve convergence towards consensus regarding the identified quality indicators. Statements in this round were constructed to allow participants to confirm important quality indicators, as well as to clarify areas where consensus was not apparent. A free text section was provided for participants to elaborate on issues and make additional suggestions. Statistical means as well as content analysis of qualitative data were again used for analysis. The resulting highest ranking quality teaching statements (mean above 4.45/5), with any modifications indicated by the qualitative analysis, were complied into a list of quality indicators.

Round 3
The list of quality indicator statements derived from round two was then sent to all participants for final comment. The statements were further refined, rationales were provided for each statement and useful links and readings included. An educational brochure was then designed. To further validate the quality indicator statements, panel members were asked for permission to identify and acknowledge their contribution, and the names of those consenting were added to the resource brochure.

Results
A summary of the final set of quality indicator statements structured under the headings of *pedagogical principles*, *fidelity*, *student preparation and orientation*, *staff preparation and training*, and *debriefing*, is provided below:

Pedagogical principles

- Simulation experiences are aligned with the curriculum and course objectives.
- A coherent matrix illustrates how simulation experiences are integrated throughout curriculum.
- There is scaffolding of learning experiences throughout the curriculum and the required knowledge, psychomotor skills, clinical reasoning and reflective thinking skills, and use of health care technologies are taught prior to their implementation into simulation experiences.
- Simulation experiences, in some form, are integrated into all clinical courses and progress in complexity throughout the program.
- Learning objectives guide all aspects of simulation design including: student preparation activities, clinical scenario, group size, inclusion of observers or students from other disciplines, selection of manikin fidelity and other equipment, level of student support during the simulation, and method of debriefing.

Fidelity

- The range of simulation technologies and approaches used are consistent with learning objectives, resource availability and cost-effectiveness. These include but are not limited to, low, medium or high fidelity human patient simulation manikins or part-task trainers.
- Environmental fidelity is developed in line with the learning objectives of the simulation session.
- Contextually appropriate clinical equipment and the availability of hardcopy or electronic patient information and charts are used to enhance the realism of the simulation experience.

Student preparation and orientation

- A structured orientation is provided for students prior to the simulation session and, depending on the students' prior exposure to simulation activities, includes the following: introduction to and an opportunity to become familiar with the learning objectives, structure, timing and process of the session; the simulation environment, equipment, manikin, monitoring devices and information and communication technology to be used.

Staff preparation and training

- Staff who design scenarios, conduct the simulation sessions, facilitate debriefing and manage the technology have each undertaken appropriate training.
- Staff who design simulation scenarios and program manikins are familiar with curriculum and course objectives, have relevant clinical knowledge and understand the technological capabilities of manikins.
- Staff who facilitate simulation sessions have relevant clinical knowledge, understand course objectives, and possess expert clinical teaching skills to enable students to relate theory to practice during debriefing.

Debriefing

- A structured debriefing is provided immediately following the simulation.
- The debriefing facilitates students' reflection on practice, self evaluation and feedback on their perceptions of the experience.
- Depending on the simulation objectives, opportunities for discussion of students' non-technical skills such as clinical reasoning, situation awareness, communication, leadership and teamwork are included in debriefing.

The quality indicator statements provide a coherent, evidenced based overview of the key elements of effective simulation design and implementation. These indicator statements will be useful to academics, simulation educators and those planning to invest in simulated learning environments. An interesting finding from the Delphi study was that the integration of ICT technologies into clinical laboratories and simulation activities was rated by the participants as beneficial, but not critical.

Dissemination

The resource brochure: *Quality Indicators for the Design and Implementation of Simulation Experiences* is provided as Attachment I and an electronic copy is available from the project website: <http://www.newcastle.edu.au/project/clinical-reasoning/>

This study has been disseminated at the following conferences:

Arthur, C, Levett-Jones, T. & Kable, A. 2010. The simulation "pot of gold": How

should we spend it? Poster presented at the *SimTec Health 2010 Conference*, Melbourne, Australia, 30 August – 2 September 2010.
Awarded best poster prize.

Arthur, C, Levett-Jones, T. & Kable, A. 2010. Quality indicators for the design and implementation of simulation experiences. Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Arthur, C., Levett-Jones, T., & Kable, A. 2011. Quality indicators for the design and implementation of simulation experiences. Paper presented at *The Fourth International Clinical Skills Conference*, Prato, Italy, 22-25 May, 2011.

Arthur, C., Levett-Jones, T., & Kable, A. 2011. Quality indicators for the design and implementation of simulation experiences. Paper presented at *The International Nursing Association for Clinical Simulation and Learning (INACSL) Conference*, Orlando, Florida, USA, June 15-18, 2011.

A paper reporting the study findings will be submitted to *Nurse Education Today* in 2011.

Linkages and Impact
The use of simulation has rapidly increased in nursing education, but primarily in an 'ad hoc' manner. The quality indicators developed in this project are the first to articulate the key aspects of simulation necessary for optimising its effectiveness in nursing education. Not surprisingly, this work has been applauded. For example, a poster and short presentation at the 2010 SimTec conference received the best poster/presentation prize.

The quality indicators will be further developed and tested by the addition of key statistical measures to help track progress and performance in the development of simulation units and educational approaches. In this way the quality indicators will provide a foundation for both external and internal quality-assurance and quality-improvement activities.

Stage 4: Quasi Experimental Study

Preface
The outcomes from the previous stages of the project helped to inform the quasi experimental study. One of the key results from the cross sectional survey was that only 25 per cent of universities used a clinical reasoning to model to structure their simulation activities. For this reason, and in preparation for the quasi experimental study, we decided to develop and test a set of resources that could support academics and students in learning about clinical reasoning. This included development of a clinical reasoning model (see Figure 1) and the linked instructor guides (refer to Attachment II); alsoavailable from the project website: <http://www.newcastle.edu.au/project/clinical-reasoning/>

Impact
This model and the related resources have now been integrated as an underpinning curriculum framework in the BN program at The University of Newcastle. A number of staff development sessions for academics, casual staff and clinical educators have been held. Students from first to third year use the model in tutorials, lectures, clinical skills laboratories and simulation experiences. Third year students are assessed on their application of the model in practice. Students have made the following comments about this approach:

- *Going step by step through the clinical reasoning cycle was a good way to learn. I found it made me research a lot of things I did not know and look into other conditions I was unfamiliar with.*
- *It was a good way of learning. I felt like an investigator trying to put all the clues together to find the problem.*
- *It showed me how I jump to conclusions before considering the information given; I learnt that some things aren't always what they seem.*

Nursing and midwifery students at our partner institution, University of Canberra, also use, and are assessed, on their ability to apply the clinical reasoning model to a series of clinical cases (see Appendix I). Academic and clinical staff at that university have also attended sessions on the model's use and application as a teaching methodology. Feedback from students includes the following comments:

- *The cycle is useful in all parts of my life*.
- *I enjoyed learning a systematic way of organising my thinking*.
- *The cycle was very useful when working through my client assessment on clinical placement.*

Linkages
The clinical reasoning model has generated a great deal of interest with educators and clinicians from Australia and internationally. Colleagues from the disciplines of nursing, physiotherapy and medicine have requested the clinical reasoning resources and many attended the project symposium. Other examples of impact include its used by The Univerity of Notre Dame Australia (personal communication, January 24, 2011) and University of Tasmania (personal communication, December 8, 20010) who are both integrating the clinical reasoning model into their nursing programs, as well as its implementation in some clinical venues. A book titled "Clinical reasoning: Learning to think like a nurse" is in progress and will be published by Pearson. This book will extend on our clinical reasoning project and disseminate it more broadly.

Dissemination
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. The paper listed below provides an overview of the clinical reasoning model and the literature underpinning the 'five rights' of clinical reasoning.

Levett-Jones, T, Hoffman, K, Dempsey, Y, Jeong, S, Noble, D, Norton, C, Roche, J, & Hickey, N 2010, The 'five rights' of clinical reasoning: an educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients, *Nurse Education Today*, vol. 30, no. 6, pp. 515–520.

The following paper was a collaborative project with five of the co-authors being third year nursing students reflecting on their experiences of using the clinical reasoning model in clinical practice:

Levett-Jones, T, Sundin, D, Bagnall, M, Hague, K, Schumann, W, Taylor, C & Wink, J 2010, Learning to think like a nurse, *Handover - Hunter New England Nursing Journal,* vol. 3, no.1, pp. 15–20.

Additional dissemination activities:
Levett-Jones, T 2011, 'Nursing Education and Research in Australia: Qualitative and quantitative approaches to clinical reasoning', Webinar presented for the *National League for Nursing*, USA, March 29, 2011.

Hunter, S, Norton, C, Levett-Jones, T, Dempsey, J & Hoffman, K. 2010, 'The 5 R's of Clinical Reasoning', Poster presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Dempsey, J, Levett-Jones, T & Hoffman, K 2009, The 5 R's of Clinical Reasoning, Poster presented at *The Third International Clinical Skills Conference*, Prato, Italy, July 3-5 2009

Dempsey, J & Levett-Jones, T, 2009, The 5 R's of Clinical Reasoning, Poster presented at *The Royal College of Nursing Conference*, Melbourne, Australia, September 14-16 2009.

Noble, D, Levett-Jones, T, Hoffman, K, Dempsey, Y, Jeong, S, Norton, C, Roche, J & Hickey, N, 2009 How can clinical skills improve patient safety? - The 5 R's of Clinical Reasoning, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

The project resources are hosted on the project website which also provides information about the survey results, and acts as a type of 'clearing house' with links to simulation resources, courses and other projects. The website averages 1000 hits per month with peaks immediately after each conference and symposium: <www.newcastle.edu.au/projects/clinical-reasoning>

The clinical reasoning model has been integrated into curricula at University of Wollongong and Univerity of Tasmania as a result of a linked ALTC Extension grant.

Interactive computerised decision support framework (ICDSF)

An ICDSF was also developed as an adjunct to the project. The framework enables nursing students to learn to 'think like a nurse'. It is based on the clinical reasoning model and is designed to promote deep learning and transferabiltiy of knowledge, either in preparation for the simulation exprience or as a stand alone activity. The content of the scenarios is informed by contemporary educational and healthcare imperatives including Australia's National Health Priorities, Nursing Sensitive Indicators and the NSW Health 'Essentials of Care Project'.

The principles of active student participation, situated cognition, authenticity, and cognitive rehearsal were used to develop the ICDSF. It is structured in such a way that students move through it in a step-wise fashion and are required to achieve accuracy at each step before proceding to the next. The ICDSF was evaluated using a questionairre survey. Overall, students were highly satisfied with the ICDSF and believed this approach was a useful way to engage in authentic clinical learning and prepare for simulation activities. They also believed the ICDSF was useful in developing cognitive skills such as clinical reasoning, problem solving and decision-making:

- *The feedback I received helped me to recognise how I jump to conclusions before considering all the information given*.
- *I found the scenarios excellent! They allowed for mistakes which meant there was less pressure to "perform".*
- *The online scenarios improved my knowledge and I had fun doing them. They made learning interesting and useful. I now feel more prepared to become an RN.*

Additionally, the majority of students either 'agreed' or 'strongly agreed' with the following statements:

- *The ICDSF motivated me to learn.* (94 per cent, n = 650)
- *The ICDSF helped me to recognise gaps in my knowledge.* (95 per cent, n = 663)
- *The ICDSF reflected a real clinical situation.* (90 per cent, n = 618)
- *As a result of the ICDSF I can clearly see how clinical reasoning relates to becoming a RN.* (94 per cent, n = 653)

Dissemination

We initially planned for the ICDSF to be available for use by other universities. We soon realised that different software applications and systems would prohibit this. However, the concepts in the framework are transferable to other educational contexts as are the design principles. Therefore the principles, a guide to implementation and the evaluation results are outlined in the following paper and have also been presented at a number of conferences. A workshop, provided as a part of the project symposium, gave participants the opportunity to use the design principles and the structure of the clinical reasoning model to create a scenario that was relevant to, and usable in, their own curriculum. An example of a text-based ICSDF is also available on the project website:
<www.newcastle.edu.au/projects/clinical-reasoning>

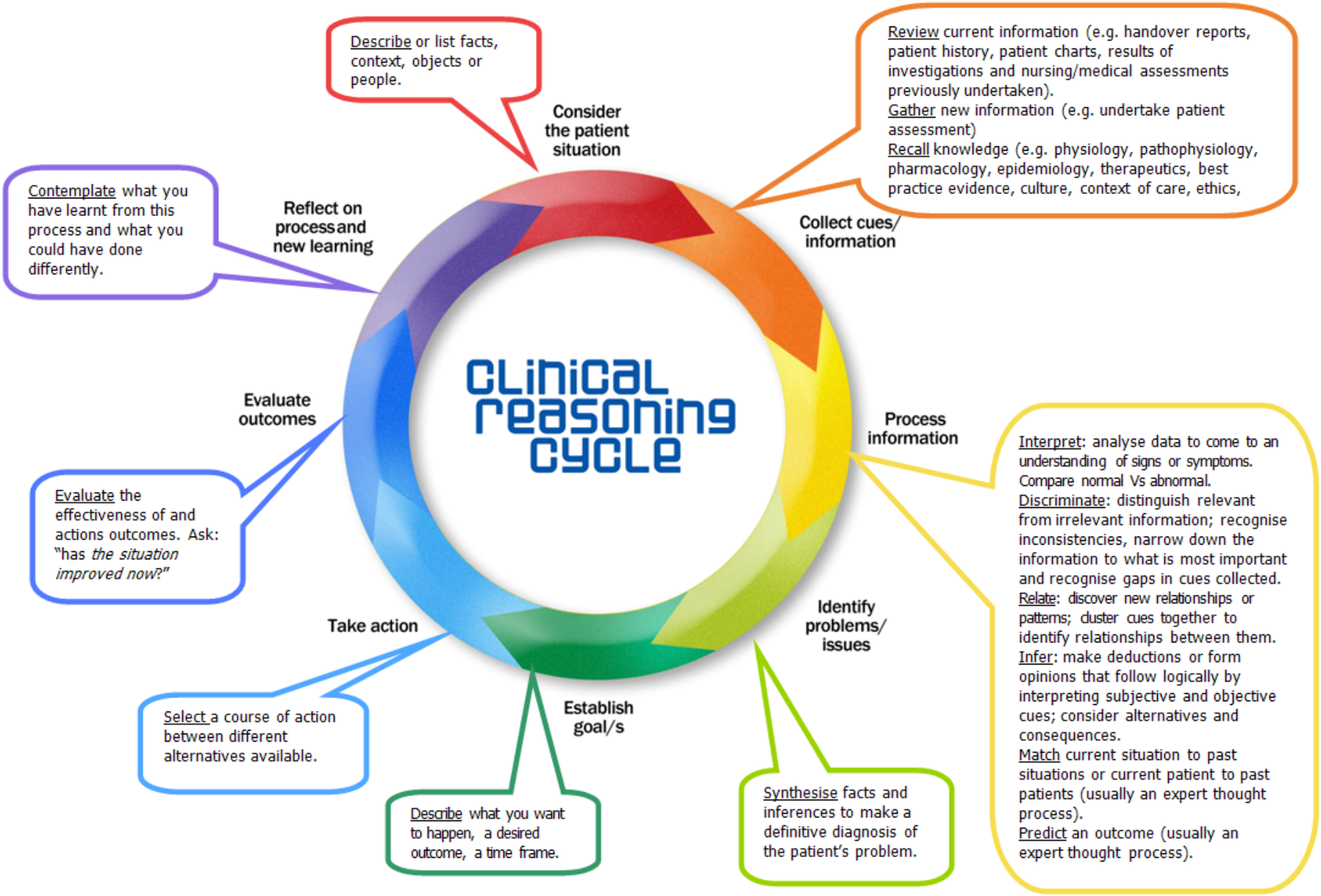
Hoffman, K, Dempsey, J, Levett-Jones, T, Noble, D, Hickey, N, Jeong, S, Hunter, S & Norton, C. 2010, *The design and implementation of an interactive computerised decision support framework (ICDSF) as a strategy to improve nursing students' clinical reasoning skills*, Nurse Education Today, *31*(6), 587-594.
<http://dx.doi.org/10.1016/j.nedt.2010.10.012>

Levett-Jones, T, & Hoffman, K 2010, Turning case studies into online clinical reasoning scenarios using a set of generic design principles. Workshop presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Levett-Jones, T, Hoffman, K, Dempsey, Bourgeois, S, Hunter, S, Jeong, S, 2010, Enhancing nursing students' clinical reasoning skills through their engagement with interactive computerised case studies, Paper presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Hickey, N, Norton, C, Hoffman, K, Dempsey, J & Levett-Jones, S, 2009, Enhancing nursing students' clinical reasoning skills through their engagement with computerised simulation, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Figure 1: The clinical reasoning process with descriptors



Aim of the quasi experimental project
This stage of the project aimed to examine how nursing students' clinical reasoning skills, knowledge acquisition and satisfaction can be enhanced by the effective use of HPSMs and PDAs.

Method and participants
A quasi experimental design was used to evaluate the effect of the level of fidelity of HPSMs on clinical reasoning, knowledge acquisition and student satisfaction. The term 'fidelity' refers to how authentic or life-like the manikin and/or simulation experience is. In this study the medium fidelity manikin used was Laerdal's Megacode Kelly™ with VitalSim capability. This is a full body manikin with embedded software. It is controlled by an external, hand held device and has limited physiological responses such as palpable pulse and blood pressure on one arm, and verbal noises limited to breath sounds, coughing, vomiting and one syllable words. The high fidelity manikin used was Laerdal's 3G SimMan™ a 'life-like' manikin with embedded software that can be remotely controlled by computer (usually in a separate control room) to allow for individualised, programmed scenarios so that operators can set physiological parameters and respond to participants' interventions with changes in voice, heart rate, respiratory rate, blood pressure, oxygen saturation level and other physiological signs.

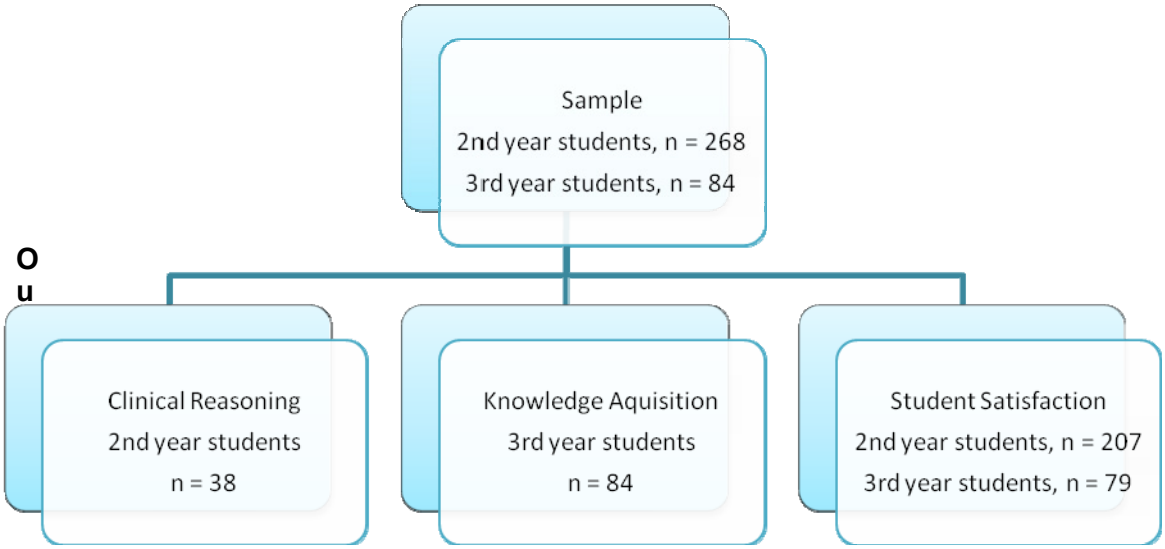
Following ethics approval, second year (*N* = 353) and third year (*N* = 203) nursing students were informed about the study by advertisements placed on Blackboard™, a web-based platform, and invited to participate by undertaking a simulated learning experience. An information statement was provided and students were asked to sign a consent form prior to participating. Students were provided with the opportunity to revise their knowledge of clinical reasoning and fluid balance (the focus of the simulation) using either a paper based case study or the ICDSF (previously discussed) prior to commencing the simulation.

A total of 268 second year and 84 third year students participated in the simulation. Participants' ages ranged from 20 to 54 years. Recent school leavers (19–22 year-old age group) comprised 45 per cent of the participants and mature age students (23 years and older) made up the remaining 55 per cent. Most (85 per cent) were women. The majority of participants (74 per cent) identified Australia as their country of birth. The remainder were from Korea, China, Canada, England, Philippines, Singapore, Botswana, Zambia or New Zealand. None of the participants identified as being of Aboriginal or Torres Strait Islander descent.

The participants were randomly assigned to either the control group (medium fidelity HPSMs) or the experimental group (high fidelity HPSMs). Students allocated to the experimental group were also provided with a PDA that provided access to the Australian Medicines Handbook. Students allocated to the control group had access to a hard copy of this resource. For each of the outcomes of interest, data were collected from either the entire participant group or from specific sub-groups (each included a control and an experiential group) (Refer to Figure 2).

All simulation sessions were undertaken in a two bed simulation unit. A fully immersive approach was used with the educator either located in a control booth (high fidelity) or in the same room (medium fidelity). Irrespective of location, the educator did not provide instruction to the participants during the scenario, apart from an orientation to the environment and equipment. A 20 minute scenario required participants to work in pairs and to use their clinical reasoning ability to identify and respond to clinical deterioration in an 'elderly man' with hypervolaemia and early stage pulmonary oedema. A 20 minute debrief session followed the simulation session. The validity and authenticity of the scenario were assessed by an expert panel comprised of four academics and three clinicians. The simulation and debriefing sessions were video recorded.

Figure 2: Sample and sub-groups



Clinical Reasoning

A check list was used to score second year students as they demonstrated specific behaviours and thinking processes (using a 'think-aloud' approach) that evidenced clinical reasoning. Such behaviours included cue collection (for example: assessment of blood pressure, pulse rate, respiratory rate, oxygen saturation level, urine output, and IV rate); cue clustering (for example: commenting that "his cognitive changes could be related to hypoxia and hypervolaemia") and also taking appropriate actions (for example: administering oxygen, sitting patient in high Fowler's position, reducing IV rate and contacting medical officer). Participants received one point for every item on the checklist performed correctly and in the correct sequence. They received a score of zero for any item not performed, performed out of sequence or performed incorrectly. The highest possible score on the checklist was 94. The checklist was reviewed by an expert panel to ensure face and content validity. Inter-rater reliability was established by comparing levels of agreement between researchers for ten of the observations.

Results

Participants' clinical reasoning scores ranged from 10 to 74 with a mean of 19.222 (*SD* = 11.090) for the control group (medium fidelity) and 42.900 (*SD* = 15.784) for the experimental (high fidelity) group. An Independent *t*-test indicated a statistically significant difference in clinical reasoning scores between the control and the experimental groups $t\ (36) = -5.293$, $p < 0.05$.

Discussion

For some pairs of students the audible alarm and visual display on the bedside monitor of the high fidelity HPSM indicating decreasing oxygen saturation levels and increasing blood pressure appeared to create a sense of urgency and provoked immediate action. The medium fidelity did not have either the monitor or the alarms. Although the patient deterioration was evident in the manikins laboured breathing for many students this did not signal the need for immediate action.

The high fidelity manikin's appearance and presentation enhanced the reality of the simulation experience, engaged students, and allowed them to suspend disbelief; this appeared to influence their immersion in the simulation and imperative to action.

Although we planned to analyse the number and types of ‘hits’ on the PDAs to determine what clinical information students accessed during the simulation experience and how it influenced their clinical reasoning, it became apparent early in the study that (a) most students did not use the PDAs; and (b) the few that did were not confident in its use (despite being provided with training). The majority of students accessed no resources to support their decision making or preferred the paper based resources they were familiar with. Thus, the amount of data generated from the PDAs was insufficient for meaningful analysis and for any reliable conclusions to be drawn. This outcome aligns with the systematic review by Jeffery et al. (2011) (previously discussed) where it was identified that effective use of PDAs is limited unless students have adequate and ongoing opportunities for practice in non critical situations so that PDAs become familiar and useful ‘tools of trade’.

In this stage of the project we became aware that, in addition to fidelity level, other factors seemed to influence individual student’s engagement in clinical reasoning during the simulation. These factors included the ability to collect and interpret clinical cues, language ability and interpersonal communication skills. Although not included in the original project proposal, analysis of these factors added value to the project and were therefore examined (refer to pages 49-60).

Knowledge acquisition

Knowledge acquisition is the process of elicitation, collection, analysis, modelling and validation of knowledge (Velásquez et al. 2009). Knowledge tests have been used for decades to provide a quantifiable measure of learning. Assessment of knowledge acquisition with multiple choice questions (MCQs) is currently the most common approach used to determine the effectiveness of simulation sessions (Laschinger et al. 2008). Although studies in nursing and medical simulation have produced varying results (Alinier et al. 2006; Birch et al. 2007; Hoadley 2009; Linden 2008; Scherer, Bruce & Runkawatt 2007), two recent systematic reviews (Cant & Cooper 2009; Lapkin, Levett-Jones, Bellchambers & Fernandez 2010) suggest that exposure to simulation experiences may influence knowledge acquisition and result in statistically significant improvements in knowledge scores. It should be noted however, that many studies also show deterioration in knowledge following the simulation experience, indicating the need for repetition and reinforcement of students' learning (Bruce et al. 2009; Kardong-Edgren, Lungstrom & Bendel 2009).

In this project, knowledge acquisition was measured using a pre-test and post-test consisting of 21 MCQs. The test was administered to participants prior to their simulation experience (Test 1), immediately after the simulation (Test 2) and again two weeks later (Test 3). The questions were drawn from TestGen®, a validated commercial item bank and elicited students' recall and application of information related to the simulation scenario with questions specific to fluid and electrolyte balance and the deteriorating patient. The questions were reviewed by an expert panel to ensure face and content validity.

Results

Mean pre-test knowledge scores (Test 1) for the control group (medium fidelity) and the experimental group (high fidelity) were 11.833 and 12.523 respectively. An independent *t*-test indicated no statistically significant difference in these scores, $t(82) = -1.233$, $p > 0.05$; this ensured a relatively equal starting point for the study.

Mean knowledge scores for Test 2 were 11.763 and 12.667 for the control group and experimental group respectively. The differences in these scores were not statistically significant, $t(75) = -1.386$, $p > 0.05$.

Finally, mean knowledge scores for Test 3 were 12.806 for the control and 13.212 for the experimental group; although this indicated a moderate difference between groups it was not statistically significant, $t(67) = -0.0644$, $p > 0.05$. Thus, there was no statistically significant difference identified between the control group (medium fidelity) and experimental group (high fidelity) in either Test 1, 2 or 3 (Table 1).

Table 1: Knowledge test scores for the control and experimental groups, Tests 1, 2 and 3

	Test 1			Test 2			Test 3		
	M	SD	S. Error Mean	M	SD	S. Error Mean	M	SD	S. Error Mean
Control group	11.833	2.347	0.362	11.763	2.443	0.396	12.806	2.776	0.463
Experimental group	12.523	2.770	0.427	12.667	3.215	0.515	13.212	2.434	0.242

Analysis of covariance (ANCOVA) was conducted to determine whether changes in knowledge scores occurred over time. Although there appeared to be some improvement in knowledge scores in both groups this was not significant. Differences in mean knowledge scores for Test 2 adjusted for Test 1 were not

statistically significant $F(2, 74) = 11.01$, $p > 0.05$; similarly differences in mean knowledge scores for Test 3 adjusted for Test 1 were not significant, $F(2, 66) = 3.29$, $p > 0.05$.

Discussion

In this project knowledge acquisition scores were not influenced by manikin fidelity. This raises questions about the value of investing in expensive simulation modalities when the increased costs associated with high fidelity manikins may not be justified by a concomitant increase in learning outcomes. While these results should be factored into decision-making by those investing in simulated learning environments, they do need to be considered with a degree of caution as the project also raised questions about the validity and appropriateness of using MCQs as a method of assessing the effectiveness of simulation experiences. Although the most common approach used to determine the effectiveness of simulation sessions (Laschinger et al. 2008), few academics have adequate experience and training in developing quality MCQs (Tarrant, Knierim, Hayes & Ware 2006). Questions taken from commercial test banks, including those taken from text books, are not without problems however. A study by Masters et al. (2001) identified that nearly half of the questions taken from 17 nursing text books assessed lower levels of cognitive processing. A similar study by Tarrant and Ware (2008) found that of the 2,770 MCQs written by nursing academics at one institution, 90 per cent assessed lower levels of cognitive processing. We propose that in seeking to validate the effectiveness of simulation sessions it may be counter-intuitive to use MCQs that focus most often on lower-order cognitive processing (Bloom 1975), when simulation experiences are designed to promote higher order thinking skills such as critical thinking, clinical judgement and clinical reasoning.

Where knowledge attainment is viewed as an important indicator of simulation effectiveness we suggest that more in depth and holistic, although labour intensive, approaches be considered. For example, objective structured clinical examinations (OSCEs) have been identified as a holistic measure when used to examine clinical skills and knowledge with validated checklists or evaluation scales (Bartfay, Rombough, Howse & Leblanc 2004). Verbal protocol analysis has also been be used effectively in understanding the clinical decision making capabilities of nurses engaged in simulation sessions (Whyte, Cormier & Pickett-Hauber 2010). One framework that is used less often but that offers the potential for the assessment of learning outcomes in simulation is the Structure of the Observed Learning Outcome (SOLO) (Biggs, 1995). The SOLO taxonomy illustrates students' understanding of a concept or topic area and is helpful in identifying a superficial or deep learning approach.

The equivocal results of this stage of the study and a number of previous studies suggests that assessment of knowledge acquisition using MCQs, although relatively convenient, may not be an appropriate method for measuring the effectiveness of simulation experiences. We propose that evaluation methods should be more closely aligned with the learning objectives of simulation sessions and directly target the assessment of higher order skills such as clinical reasoning.

Dissemination

This study has been disseminated in the following publications:

Levett-Jones, T, Lapkin, S, Hoffman, K, Arthur, C, & Roche, J, 2011, 'Examining the impact of high and medium fidelity simulation experiences on nursing students' knowledge acquisition', *Nurse Education in Practice.* doi:10.1016/j.nepr.2011.03.014

Student satisfaction

Student satisfaction refers to the favourability of a student's subjective evaluations of the simulation experience. Satisfaction is important to engaged and meaningful learning and facilitates active and purposeful participation in simulation experiences (Prion 2008). There are also suggestions that student satisfaction may have some correlation with performance (Bremner, Aduddell, Bennett, & VanGeest 2006). Psychologists have found that student satisfaction helps to build self-confidence which in turn helps students develop skills and acquire knowledge. Pike (1991) suggests that satisfaction exerts a greater influence on academic performance than performance exerts on satisfaction.

While many studies have evaluated student satisfaction in relation to simulation experiences, most have tended to be small scale or localised studies using instruments that have not been psychometrically tested for reliability or validity. For the purpose of this study a new scale was developed - the Satisfaction with Simulation Experience Scale (SSE). It was designed to measure and compare differences in satisfaction levels between nursing students exposed to medium and high fidelity HPSMs.

The items for the SSE Scale were identified following a critical review of the literature. Content validly was established by use of an expert panel. Exploratory factor analysis with varimax rotation was used to determine construct validity and Cronbach's coefficient alpha determined the scale's internal consistency reliability.

Results

In this component of the study, data from all third year and second year participants was included. The final 18 item Likert scale demonstrated satisfactory internal consistency (alpha 0.77). Exploratory factor analysis yielded a three-component structure termed Debriefing and Reflection, Clinical Reasoning, and Clinical Learning; each subscale demonstrated high internal consistency: 0.94; 0.86; 0.85 respectively. Mean SSE scores and standard deviation of each component are presented in Table 2.

Table 2 Mean SSE scores and standard deviation

Items	*M*	*SD*	*N*
Debrief and reflection			
The facilitator provided constructive criticism during the debriefing	4.402	0.108	344
The facilitator summarised important issues during the debriefing	4.498	0.073	344
I had the opportunity to reflect on and discuss my performance during the debriefing	4.453	0.110	344
The debriefing provided an opportunity to ask questions	4.437	0.096	344
The facilitator provided feedback that helped me to develop my clinical reasoning skills	4.448	0.087	343
Reflecting on and discussing the simulation enhanced my learning	4.474	0.098	344
The facilitator's questions helped me to learn	4.504	0.118	344
I received feedback during the debriefing that helped me to learn	4.514	0.071	344
The facilitator made me feel comfortable and at ease during the debriefing	4.525	0.076	344
Clinical reasoning			
The simulation developed my clinical reasoning skills	4.369	0.099	344
The simulation developed my clinical decision making ability	4.286	0.089	344
The simulation enabled me to demonstrate my clinical reasoning skills	4.236	0.092	344
The simulation helped me to recognise patient deterioration early	4.283	0.159	344
This was a valuable learning experience	4.638	0.059	343
Clinical learning			
The simulation caused me to reflect on my clinical ability	4.657	0.102	343
The simulation tested my clinical ability	4.586	0.093	343
The simulation helped me to apply what I learned from the case study	4.186	0.347	343
The simulation helped me to recognise my clinical strengths and weaknesses	4.748	0.124	343

To determine whether there were any differences in SSE scores between groups independent *t*-tests were conducted. The second year high fidelity (experimental) group appeared to have higher SSE scores (Mean = 4.515) than the second year medium fidelity (control) group (Mean = 4.415); however this difference was not statistically significant $t\ (208) = -1.586$, $p > 0.05$. (Refer to Table 3).

Table 3: SSE scores second year medium and high fidelity groups

	N	M	SD	S. Error Mean	t-test
Medium fidelity	43	4.415	0.370	0.564	t (208) = −1.586, p > 0.05
High fidelity	167	4.515	0.372	0.029	

Similarly, the third year high fidelity (experimental) group appeared to have slightly higher SSE scores (Mean = 4.472) than the third year medium fidelity (control) group (Mean = 4.415). However, once again the differences between the means were not statistically significant t (74) = −0.586, p > 0.05 (refer to Table 4).

Table 4: SSE scores third year medium and high fidelity groups

	N	M	SD	S. Error Mean	t-test
Medium fidelity	36	4.415	0.447	0.079	t (74) = −0.586, p > 0.05
High fidelity	40	4.472	0.360	0.057	

Open-ended questions

The open ended question on the SSE asked participants if they wished to make any further comments about their simulation experiences. This very general question was revealing as it allowed participants to share their perspectives and comment on aspects of the simulation experience that they felt were most important. One hundred and sixty-six participants answered this question and responses were collated and categorized. This allowed for inferences to be made about the characteristics and meaning of participants' responses. The categories are reported in order of frequency in Table 5 and illustrated with verbatim quotes.

From the participants' responses it is evident that they highly valued the simulation experience. They described it as "*brilliant", "fantastic", "awesome and motivating"*; perhaps somewhat influenced by the fact that this was a novel experience and the first time each had been exposed to a simulation session. The most frequently occurring comment was that because the simulation provided a highly valued learning experience it should be integrated into every clinical course and be timetabled weekly. It is noteworthy that although the experience was valued by all of the participants who responded, none believed that simulation should be used as a replacement for clinical placement hours; although many did view it as more valuable than the time spent in clinical skills laboratories. The participants acknowledged that the simulation caused them to accept responsibility for 'patient' care rather than being a passive observer and they saw the experience as an opportunity to apply their knowledge and skills and make independent clinical decisions — opportunities that most placements did not afford. Many of the participants commented on how the simulation allowed them to apply what they had learned about clinical reasoning and they described how the simulation reinforced the importance of accurate and timely patient assessment, careful interpretation of cues and interprofessional communication.

The participants also saw the simulation as a 'safe' and supported opportunity to make and learn from their mistakes. The debrief was identified as a valuable learning opportunity facilitated by educators who challenged students, provided valuable feedback, supported them to learn and grow, and helped them to feel more confident of their abilities. However, a number suggested that both the debrief and the simulation should be longer.

Table 5: Categories identified from content analysis

Category	*Participant quotes*
Need for more simulation experiences	*We should have simulations much more often - at least once per week.*
Simulation should complement but not replace clinical placements	*It should not replace the valuable clinical placement hours but should definitely be incorporated throughout the program in every clinical course.*
More valuable than clinical laboratory experiences	*I learnt more in this hour than I ever did in the clinical labs just practicing skills*
Stress	*It was a stressful experience but well worth it.* *Working in pairs made it less stressful*
Application of knowledge and skills to the simulation	*The simulation helped to bring everything together - knowledge, skills and clinical reasoning*
Clinical reasoning	*The simulation helped me to think like a nurse* *The simulation helped me to put into practice what I have learned about clinical reasoning*
Importance of cue collection and interpretation	*I learned the importance of collecting cues and other assessments - not just vital signs* *Now I know how and why to interpret fluid balance charts properly*
Fidelity	*The high fidelity manikin mimicked a real-life patient very well*
Value of learning experience	*This was a brilliant learning experience. I learnt more in the simulation than in hours and hours of tutorials and lectures.*
Preparation for practice	*It helped me to see where and how I need to develop my clinical skills to become an registered nurse* *I think I could manage a similar situation in practice now*
Safe environment to learn	*The simulation mirrored a 'real-life' situation where you knew your mistakes were learning opportunities that could not affect a real patient.*
Clinical learning	*I gained more from this simulation than placement because I had to do the thinking and make the decisions - I couldn't just watch* *The simulation motivated me to learn more about the deteriorating patient* *I learned that to intervene effectively one must do a thorough assessment first* *I learned how to communicate effectively with doctors using ISBAR (introduction, situation, background, assessment, recommendation)*
Value of debriefing	*The educator provided valuable feedback and the debrief made me more confident in my clinical ability*

Conclusion
The results of the SSE survey indicate that simulation is highly valued by students, irrespective of the level of fidelity. This raises questions about the value of investing in expensive simulation modalities. The SSE Scale was reliable and valid for this cohort. Further research in different contexts would be valuable in extending upon this work.

Dissemination
This study has been disseminated in the following publication:

Levett-Jones, T, McCoy, M., Lapkin, S, Noble, D, Hoffman, K, Roche, J, Arthur, C, & Dempsey, J, 2011, The development and psychometric testing of the Satisfaction with Simulation Experience Scale, *Nurse Education Today*.
< http://dx.doi.org//j.nedt.2011.01.004>

Cost utility analysis

Despite the growth in the use of simulation in healthcare education over the last decade, there is limited research and a dearth of published work that analyses the feasibility and cost-effectiveness of these technologies. Investment in simulated learning environments and HPSMs is constrained by a number of factors. Costs for HPSMs can range from $AU10,000 to $AU200,000 depending on the level of fidelity. Additional expenses include physical space, accessories such as video recording equipment, consumables and realistic equipment required to replicate the hospital environment, the cost of training academic and technical staff to competently use the technology, and the time required to develop scenarios (Howard 2007; Nehring, Ellis, & Lashley 2001; Peteani 2004). It is important for decision makers to have an analysis that considers both costs and outcomes in order to identify the approach that has the lowest cost for any particular outcome measure or the best outcomes for a particular cost (Alinier, Hunt, Gordon, & Harwood 2006; Ravert 2002).

The primary aim of a cost-utility analysis is to compare two or more alternatives based on the cost of inputs and to weigh these against objectively measured outcomes (Hummel-Rossi & Ashdown 2002). In order to make recommendations regarding the efficacy and feasibility of HPSM use the results from the quasi experimental study were extended and a cost utility analysis undertaken to determine whether the extra costs associated with high-fidelity manikins can justify the differences, if any, in the outcomes of clinical reasoning, knowledge acquisition and student satisfaction.

Costs associated with the use of medium and high fidelity manikins were calculated to determine the total cost for each. A cost-utility analysis using multi-attribute utility function was used to quantify and combine utilities from the various outcomes of interest to arrive to an overall measure of utility. Costs common to both interventions (for example the simulated ward) were excluded from analysis and only the additional or incremental costs required for the two interventions of interest (medium and high fidelity HPSMs) were included. Examples included the cost of manikins and programming of the scenarios (in terms of time). For the purpose of the analysis, market prices were used since they were easily available and therefore offer the simplest way to derive cost data. Other estimates were obtained through direct observation during the quasi-experimental study. All costs were added to obtain the total cost of each intervention, using a cost worksheet. The average cost per student was determined by dividing the total cost for each separate intervention by the total number of students (n = 352) involved in the simulation. All costs in this analysis are given in Australian Dollars (AU$). The calculations are shown in Table 6.

Table 6: Cost worksheet

Category	MegaCode Kelly with VitalSim™	SimMan 3G™
Market value of manikin	$ 11,995.00	$ 95,490.00
VitalSim Vital Signs Simulator	$3,995.00	N/A
Installation SimMan3G	N/A	$ 1,990.00
SimMan 3G on-site training	N/A	$2,490.00
*Scenario development and programming	$121.54 (2 hrs)	$364.62 (6 hrs)
**Staff Extra set up time	N/A	$ 2,188.20 (60hrs)
Total	$ 16,111.54	$ 102,522.82
Total participants (students)	352	352
Cost per student participant	$45.77	$291.26

*Based on salary of Academic Level B - Step 1, $60.77/hr (includes on costs)
**Based on salary of Technical Officer-HEW 4, Step 1, $36.47/hr (includes on costs)

Multiattribute Utility Theory
The multiattribute utility theory is the preferred method for educational interventions because of the potential for combining various outcomes; clinical reasoning, knowledge acquisition and student satisfaction for example. This approach uses the multiattribute utility function to quantify and combine utilities from the various outcomes of interest to arrive at an overall measure of utility. The multiattribute utility function is given by the following formula:

$$U(x_1,\ldots x_m) = \sum_{i=1}^{m} w_i U_i(x_i)$$

(Dyer, 2006)

Notation:
$U_i(x_i)$ is the single attribute utility function attribute for *i*
$U(x)$ is the utility for outcome measure *x*, represented by an m-element vector
W and W_i are model parameters
∑ is the summation sign

Data from the quasi experimental study was used to quantify the variables of interest to determine their overall utility.

Clinical reasoning
Mean clinical reasoning scores for high and medium fidelity HPSMs were divided by the maximum possible score on the checklist (94) and multiplied by 100 to obtain the percentage points (refer to Table 7).

Table 7: Clinical reasoning scores and percentages points

	Fidelity	Mean	Percentage Points
Clinical Reasoning Score	Medium	19.222	20.449
	High	42.900	45.638

Knowledge acquisition
Since the knowledge acquisition scores were measured pre and post simulation, the overall effect differences between the control and experimental groups were determined by calculating the differences between Test 1 and Test 3. The changes were then converted into percentage points by dividing by the maximum possible score of 21 and multiplying by 100. These calculations are shown as shown in Table 8.

Table 8: Knowledge acquisition scores and percentages points

Fidelity	Test 1	Test 3	Change (T3 – T1)	Percentage Points
Medium fidelity	11.833	12.806	0.973	4.633
High fidelity	12.523	13.212	0.689	3.281

Student satisfaction
Mean SSE scores were divided by the highest possible satisfaction response (5 = strongly agree) and multiplied by 100 to obtain the percentage points (refer to Table 9):

Table 9: SSE scores and percentage points

	Fidelity	N	Mean	Percentage Points
SSE Scores	Medium	79	4.416	88.320
	High	207	4.508	90.160

Results of cost utility analysis
Since clinical reasoning, knowledge acquisition and student satisfaction were considered to be equally important outcome measures they were given equal weight. The overall utility for medium fidelity and high fidelity HPSMs was obtained by averaging the means of the three separate utilities to give the overall utility as in Table 10. From the table below the overall utilities were 37.800 and 46.360 for the medium and high fidelity HPSMs respectively.

Table 10: Overall Utility

Fidelity	Clinical Reasoning	Knowledge acquisition	Student Satisfaction	Overall utility
Medium	20.449	4.633	88.320	**37.800**
High	45.638	3.281	90.160	**46.360**
Importance weight	0.33r	0.33r	0.33r	1.0

The average cost of the medium and high fidelity HPSM per student was then divided by the overall utility to yield a cost-utility ratio (Table 11):

Table 11: Cost Utility Ratios

	MegaCode Kelly	SimMan 3G
*Average cost per student	$45.77	$291.26
Overall Utility	37.800	46.360
Cost-utility ratio	**$1.21**	**$6.28**

*From Table 6: Cost worksheet

Discussion

The above results indicate that medium fidelity HPSMs produced similar results for knowledge acquisition and student satisfaction at a lower cost than those obtained by high fidelity HPSMs. However, statistically significant differences in clinical reasoning scores between the control and experimental group were identified and factored into the cost analysis. The results from the cost-utility analysis indicate that in order to obtain a unit improvement in clinical reasoning, knowledge acquisition and student satisfaction it will cost (for each student) $1.21 using medium fidelity and $6.28 using high fidelity HPSMs. This is an important finding and should be factored into decision making by those planning or utilising simulated learning environments. However, it should be noted that a number of other factors must also be taken into consideration when investing in simulation facilities and equipment, for example:

- The study outcomes were assessed based on short term measurements and did not take into consideration the long term impact on clinical reasoning, knowledge acquisition and student satisfaction. This warrants additional research in order to provide a stronger basis for economic analysis.
- The use of HPSMs results in a broad range of benefits; foremost amongst these is the potential to improve patient safety. However in this study the value of simulation was measured in monetary terms and using the three outcomes of interest only.
- The costs used for this analysis are based on the differences in the costs for the two interventions and did not take into account the additional associated costs such as setting up simulation units and ongoing staff training.
- This study used a scenario that was appropriate for both medium and high fidelity HPSMs. Not all scenarios can be used in this way and many are only appropriate for high fidelity HPSMs.

Conclusion

While economic analysis on its own is not sufficient to inform decision-making, it is nevertheless an important consideration in the decision-making process. Integration of simulation into curricula is costly and time consuming and requires both cost-benefit analysis and evidence of learning outcomes; both aspects of simulation require further study. It should also be noted that limiting the focus to cost-utility analysis does not suggest that alternative economic analysis models are not suitable. Discounted cash-flow analysis, for example, would have analysed expected revenues and cash savings against the total cost of the simulation project. One approach is not necessarily superior to the other, but rather they serve different purposes in economic evaluations (Harlow & Windsor, 1988).

Dissemination

This study has been disseminated via a publication and a conference presentation: Lapkin, S. & Levett-Jones, T (in press). A cost-utility analysis of medium versus high fidelity human patient simulation manikins in nursing education, *Journal of Clinical Nursing*.

Lapkin, S. & Levett-Jones, T (2010). A cost-utility analysis of medium versus high fidelity human patient simulation manikins in nursing education, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

How does cue acquisition influence clinical reasoning ability during simulation experiences?

Central to clinical reasoning is the identification and collection of relevant cues and cue clusters. Early subtle cues, when missed, can lead to adverse patient outcomes and making judgments or decisions based on incomplete information is a leading cause of mistakes (Alfaro-LeFevre 2009). It is therefore important to understand nursing students' skills in cue acquisition and interpretation. Cues are signs and symptoms that indicate a patient's condition; they consist of objective and subjective data perceived by a nurse's senses and analysed to reach a diagnosis; they are the basis for subsequent nursing actions.

Aim
To examine how students collected, clustered, interpreted and used to them discriminate between alternative problem identifications (diagnoses); and the extent to which they informed subsequent nursing actions.

Methodology
Information processing theory and 'think aloud' (TA) were used to examine clinical reasoning in video recordings of students exposed to HPSMs during the quasi experimental study. Thirty four pairs of third year nursing students participated. Students 'thought aloud' while caring for a simulated post-operative 'patient' with hypervolaemia and early stage pulmonary oedema. The simulated patient presented with a number of signs and symptoms (cues) that students were expected to collect, analyse and respond to (see Table 12).

Table 12: Cues and actions specific to the clinical scenario

Patient presents with … (Cues)	Cue interpretation	Appropriate actions
Increased respiratory rate	→	Sit patient up
Short of breath	→	Apply O_2
Decreased O_2 saturation level	→	Continue to monitor
Lung sounds - crackles	→	Continue to monitor
Increased blood pressure	→	Continue to monitor
Increased pulse rate	→	Continue to monitor
IV rate 125	→	Reduce IV rate to TKVO (to keep vein open)
Positive fluid balance + Decreased urinary output	→	Ring medical officer using ISBAR (identify, situation, background, assessment and recommendation) to obtain order for diuretic (frusemide)

Data analysis and results
To examine cue collection, concurrent protocol analysis of videos was conducted. This involved verbal protocol analysis of vocalised thoughts and behaviours. Cues were identified and consisted of both confirming and disconfirming cues (see Table 13 and 14). Cues were then quantified (Table 15). Aspects of clinical reasoning such as cue interpretation and cue clustering as well as actions and outcomes were also identified.

Table 13: Average number of confirming cues collected

Cue	Average total cues collected	Total collected and problem solved	Total collected and problem not solved
O_2 saturation level	2.02	2.69	1.68
Blood pressure	1.57	1.76	1.24
Lung sounds	0.92	1.30	0.72
Pulse rate	0.82	1.00	0.72
Shortness of breath	0.63	0.53	0.68
Respiratory rate	0.60	0.86	0.48
Urine output	0.55	0.92	0.36
Daily fluid balance	0.50	1.30	0.08
IV rate	0.44	0.3	0.52
Other	0.05	0.11	0.04
Total	8.89	13.49	6.52

Table 14: Average number of disconfirming cues collected

Cue	Average total cues collected	Total collected and problem solved	Total collected and problem not solved
Other	1.16	1.79	0.84
Pain	0.82	1.15	0.68
Medications	0.39	0.38	0.04
Temperature	0.34	0.54	0.24
Cough	0.23	0.38	0.16
Abdominal wound	0.15	0.15	0.16
Level of consciousness	0.15	0.23	0.12
Heart	0.13	0.15	0.12
Blood glucose level	0.10	0.23	0.04
Total	3.32	5	2.4

Table 15 provides examples of cues clusters used by students who solved the clinical problem and those who did not solve the problem.

Table 15: Average number of cue interpretations, including cue clustering and making inferences

Problem solved	Problem not solved
9.7	3.57
Post op, crackles, temp, BP up, pulse up, no prn meds, positive fluid balance, urine output down	Short of breath, coughing, oxygen saturation down
Wheeze, oxygen saturations down, 2 fluid challenges overnight, urine output down, IV rate up, urine concentrated, Jugular vein distension.	BP up, oxygen saturation down, no pain, respirations up, pulse up, coughing
?pitting oedema, respiratory rate up, crackles, ? Distended jugular, BP up, ?pain, ?LOC, ?asthma, short of breath, ?fluid from stoma, urinary output down, positive FBC	Short of breath, BP up, Oxygen saturation down, no pain
?asthma, oxygen saturation down, positive FBC, crackles, pulse rate up	BP up, pulse up, short of breath

Conclusion

The appropriate clinical actions included the collection, clustering and interpretation of cues in order to come to the nursing diagnosis of hyervolaemia and early stage pulmonary oedema. The correct actions following on from that were to reduce the IV rate, administer oxygen, phone the medical officer, communicate effectively and obtain an order for the diuretic frusemide. Data analysis indicated that:

- Of the 34 student pairs, 13 pairs solved the clinical problem and 21 did not.
- The average number of different cues collected overall was 8.84.
- Overall, more confirming cues than disconfirming cues were collected.
- Students who were able to correctly obtain an order for the diuretic collected a higher average number of both confirming and disconfirming cues than those who were not able to obtain the order.
- Those who obtained an order for the diuretic also had a higher average score for cue interpretation than those who did not obtain the order.
- Those who obtained an order for the diuretic often had larger and more complex cue clusters.
- Of the students who did not obtain an order for the diuretic, most made a medical emergency team (MET) call. However a number made this MET call very early without collecting or interpreting cues; others waited longer and collected more cues - thus making a more informed decision to make a MET call.

Dissemination

This study has been disseminated at thr following conferences:

Roche, J, Levett-Jones, T, Hoffman, K. & Hazelton, M 2009, Is cue acquisition and clinical reasoning influenced by the use of high fidelity human patient simulation?, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Roche, J, Levett-Jones, T, Hoffman, K & Hazelton, M 2009, Is cue acquisition and clinical reasoning influenced by the use of high fidelity human patient simulation? Paper presented at T*he Third International Clinical Skills Conference*, Prato, Italy, July 3-5 2009

Hoffman, K, Levett-Jones, T & Roche, J 2010, Is Cue Acquisition and Clinical Reasoning Influenced by the Use of High Fidelity Human Patient Simulation Manikins? Paper presented at the *2010 Beijing International Nursing Conference*, Beijing, China, August 3-5 2010.

Examining the impact of interpersonal communication on nursing students' clinical reasoning ability

Analysis of critical patient incidents have shown that teamwork and communication failures, as well as clinical reasoning failures, are linked to adverse patient outcomes. Deficiencies in communication between health professionals and recommendations for improvement are major findings in many health care quality improvement investigations (Office of Safety and Quality in Healthcare, WA Department of Health 2008) with communication errors identified as the root cause of 70 per cent of sentinel events in health care settings (Joint Commission 2004). There is a lack of research that examines the impact of communication and teamwork on clinical reasoning.

Whilst viewing the videos collected during the quasi experimental study it became apparent that in addition to level of fidelity, communication skills may influence students' clinical reasoning ability. We therefore decided to examine this phenomenon more closely.

Aim
To examine the impact of interpersonal communication skills on nursing students' clinical reasoning ability.

Objectives
- To develop a scoring taxonomy for examining nursing students' interpersonal communication and teamwork skills based on the Oxford NOTECHS scale (Anderson & Leflore 2008).
- To examine nursing students interpersonal communication/ teamwork skills using the taxonomy developed from the Oxford NOTECHS scale and to measure the relationship between communication and clinical reasoning.

Methodology
A literature review was conducted to determine the interpersonal characteristics of successful and unsuccessful teams. The Oxford NOTECH scale (Table 16) was modified and used to examine a sample of 10 of the video recordings of the simulation sessions. The taxonomy was further refined by identifying both effective and ineffective interpersonal communication behaviours evidenced in the recordings (see Table 17).

A correlational study was then used to examine the relationship between communication/ teamwork scores and clinical reasoning scores. Data was collected from the video recordings and analysed using the modified version of the Oxford NOTECHS scale (see Table 18). Student pairs (teams) were scored for positive and negative behaviours in the categories of leadership, teamwork, communication, and situation awareness. Students' scores for communication/teamwork were then correlated with their clinical reasoning score. Data was collected from recordings of 39 pairs/teams of third year participants. Inter-rater reliability for scoring on interpersonal skills was determined using Kappa analysis.

Table 16: Oxford NOTECHS representing successful team communication behaviours

Dimensions	Elements
Leadership and management	Leadership Maintaining of standards Planning and preparation Workload management Authority and assertiveness
Teamwork and co-operation	Team building and maintaining Support of others Understanding team needs Conflict solving
Problem solving and decision-making	Definition and diagnosis Option generation Risk assessment Outcome review
Situation awareness	Noticing Understanding Thinking ahead

Table 17: Negative and positive behaviours identified in the sample

Positive behaviours	Negative behaviours
Discussing together	One participant initiating all interactions with patient
Working collaboratively	Ordering/directing the team member to do tasks
Maintaining eye contact/smiling	Limited consultation
Taking charge when needed	No discussion or limited discussion between participants
Asking for others opinion/talking to each other	Both doing 'own thing'/little interaction
Turn taking - neither taking overall lead but sharing it and deciding on what to do	Watching over/checking on
Making eye contact and sharing information	Minimal eye contact
Taking initiative to institute interventions	Not facing each other/back to each other
Effective and appropriate delegation	Body language, eg. hands on hips
Open communication/open body language	Talking about separate issues
Being polite to each other /smiling	

Table 18: Taxonomy used for the study

Positive behaviours	Negative behaviours
Teamwork	
Worked together, e.g talked to each other and did tasks together, worked in unison, and accepted help from the other person	Worked independently of each other e.g. tasks not coordinated, both doing 'own thing", not talking to each other, not working in unison
Supported other person e.g. takes notice of what other person is saying ask for their help	Not supporting other person e.g. ignored team member or took no notice of what they were saying
Establishes atmosphere of open communication - supportive and considerate	Open communication not established, not supportive or considerate
Communication and Interaction	
Maintained eye contact	Did not look at each other, no eye contact
Facing each other- uses open body language	Closed body language, not facing each other, turned back on each other
Polite and friendly to other	Not polite nor friendly
Looking to each other for answers - discussing tasks	Talking about separate issues, not interacting
Coordinated actions	Uncoordinated actions
Situation awareness	
Agreeing to roles e.g. agreeing to one doing observations while other read notes	No role division, both unsure of who should do what, or one doing everything while other not sure what to do
Thinks ahead, identifies future problems, discusses contingencies	Not thinking ahead nor discussing contingency plan
Contacts outside sources when necessary e.g. medical officer	Not contacting outside source when necessary
Understands - knows capabilities, cross-checks, and speaks up when unsure	Not understanding, does not know capabilities, does not cross-checks, does not speak up when unsure
Leadership	
Takes initiative e.g. organised team member to do tasks	Ordered other team member to do tasks
Takes charge if required	Does not take charge even if required, waits to be told what to do
Allocates tasks appropriately	Does not allocate tasks
Sharing of planning and task delegation	Took control and did not share
Valued other's contribution	Did not value others contribution

A score of −1 was allocated for negative behaviours in each category and + 1 for positive behaviours in each category. The overall score for each pair was calculated and assigned either a negative or positive score for communication/interpersonal behaviour/teamwork.

The student groups were then sorted into successful and unsuccessful pairs based on outcomes of clinical reasoning. The desired outcome of effective clinical reasoning was obtaining an order for Frusemide (a diuretic used to treat hypervolaemia/pulmonary oedema). This order could only be obtained after the student pairs had:

- collected and correctly interpreted clinical cues
- formed a cue cluster
- come to the correct nursing diagnosis of hypervolaemia/pulmonary oedema
- phoned the medical officer providing accurate and adequate information so he/she could confirm the patient's diagnosis.

The relationship between the communication/interpersonal behaviour scores and the clinical reasoning scores was then examined using Chi square analysis.

Results
More pairs had an incorrect clinical reasoning outcome than a correct outcome (see Table 19)

Table 19: Frequency of clinical reasoning

Clinical reasoning	Frequency
Correct outcome	31.4
Incorrect outcome	68.6

More student groups had effective communication (positive score) than ineffective communication (negative score) (see Table 20)

Table 20: Frequency for communication behaviours of groups

Clinical reasoning	Frequency
Ineffective (negative score)	26.7
Effective (positive score)	73.3

A significant correlation between clinical reasoning and communication scores was obtained, Pearson Chi Square = 3.967, df =1, $P<0.05$. The null hypothesis was therefore rejected.

Discussion
This study indicates that there may be a relationship between interpersonal communication and clinical reasoning ability. However, further research with different cohorts and contexts would be beneficial in progressing this work. It appears that a lack of collaboration/consultation, and teams in which one member dominates and the other does not speak up, can lead to failures in clinical reasoning. It has been suggested that collective agency and assertiveness skills are important in preventing patient adverse events (Cooper et al. 2010). A better understanding of the non-technical behaviours that lead to effective clinical reasoning outcomes will allow educators to develop appropriate teaching strategies to target communication and teamwork skills.

Conclusion
Even when health professionals have the cognitive skills and knowledge to handle a crisis situation, they don't always perform at their best. Teaching interpersonal skills may improve performance in such situations.

Dissemination
This study has been disseminated at teh following conferences:

Hoffman, K, Dempsey, J., Levett-Jones, T, Jeong, S, Noble, D, Kenney, R, Norton, C, Hickey, N 2010, Examining the impact of interpersonal communication on nursing students' clinical reasoning ability. Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Hoffman, K, Dempsey, J, Levett-Jones, T, Jeong, S, Noble, D, Kenney, R, Norton, C, Hickey, N 2011, Quality Indicators for the Design and Implementation of Simulation Experiences. Paper presented at *The Fourth International Clinical Skills Conference*, Prato, Italy, 22-25 May, 2011.

A manuscript is currently under review:

Hoffman, K., Levett-Jones, T., Dempsey, J., Noble, D. & Kenny, R. (under review). Examining the impact of interpersonal communication and teamwork skills on nursing students' clinical reasoning ability and decision outcomes. *Nurse Education Today*.

Linkage
In recognition of the impact of interprofessional communication on patient outcomes a second and related ALTC project is currently in progress. It is titled:

'*Interprofessional education: enhancing the teaching of medication safety to nursing, pharmacy and medical students*'.

In addition, the project team successfully submitted an ALTC Extension grant to extend on the study described above.

Examining the impact of language ability on culturally and linguistically diverse (CALD) students' clinical reasoning during simulation

Background
The growth in numbers of CALD students entering nursing programs in Australia presents challenges for academic and clinical staff and most importantly for the students themselves. Whilst universities are committed to the education of CALD students, health services and registration authorities often complain that these students are not ready to practise because of their limited English language proficiency. In a study by Jeong et al. (2008) it was reported that clinical and academic staff claim that many CALD students "are not safe to practise". With respect to CALD students, the emphasis in the literature has often been the students' language deficiency (Kim 2005; Konno 2008; Omeri & Atkins 2002; Xu & Kim 2008) and this has become interpreted as 'unsafe practice' and likely to result in 'poor standards of care'.

Whilst analysing the videos recorded during the quasi experimental study it became apparent that the language skills of CALD students influenced their ability to respond effectively to deteriorating patients, even though a number appeared to have sound clinical reasoning skills. We therefore decided to study this issue more closely.

Aims of the study
To determine whether the language ability of third year CALD BN students impacts their clinical reasoning ability when responding to critical patient situations.

Methodology
The project team retrospectively analysed video recordings of CALD students' performance during simulation sessions using a validated protocol. Inter-rater reliability was enhanced by cross checking each video and protocol analysis.

Sample
A total of 23 third year CALD students participated in the study. Most (n = 20) were women. Their ages ranged from 20 to 44 years; two were under 21; 2 were in the 22–24 year-old age group; 16 were in the 25–34 year-old age group; and two were aged 35–44. The majority (n = 8) identified China as their country of birth. The remainder were from Korea (n = 3) and Africa (n = 2); 10 specified that they were CALD but did not provide their country of birth.

Findings
The majority of CALD students demonstrated a poor understanding of their scope of practice, a lack of independent decision making, and a tendency to defer to medical orders whenever possible, for example:

- "I think it's too much fluid. We need doctor's order don't we?"
- "Can we change the mask or do we need doctor's order?
- "I'm not comfortable giving oxygen without doctor's order. No."
- "Do we call the doctor? Can we increase the O_2 from 6 to 8?"

A number of the CALD students demonstrated poor English language skills and a lack of confidence in their own knowledge and clinical ability. However, it was also apparent that many of the students understood the reasons for the 'patient's' deterioration, were able to conduct a thorough and appropriate patient assessment, and were able communicate somewhat effectively with the medical officer, for example:

> I just thought it was, maybe some fluid in the lung or something because his respiration sound was wheezing, it is unusual, his respiration rate was high but his O_2 level low and keep dropping and wheezing although he had O_2 mask. When I listened to patient's chest we heard some fluid. Maybe fluid retention with wheezing. We checked the fluid balance chart. We calculated and it was imbalance at the moment, urine and intaking, how much the patient intaking and small amount of urine output, about 120ml IV infusion but only about 15ml urine so it should be hypervolemia.
>
> He still short of breathing. His also O_2 sat is 70. I'm thinking, because of his fluid intake, I thinking we need to reduce his IV intake. And if you can prescribe medication that will be great.

Student:	This is Mei in the ward. I just want to tell you patient how was she. He just a post-op and he is short of breath and cough a lot. And I listened to her lung. And seems little of fluid in her lung, and his O_2 Sat is 90 and he is a febrile. So I'm just wondering what you're going to do with him.
Medical Officer:	What do you think we should do?
Student:	We should need, try to like to get the excess wees out. Probably I think something will help him to fluid out like Laxisos?
Medical Officer:	You mean diuretics?
Student:	Oh yes, diuretics.
Medical Officer:	Good idea. Frusemide 20 mg IVI bolus.

The CALD students were, almost without exception, dominated by the Australian students they were paired with. This was despite the CALD students often appearing to have a clear understanding of the patient's condition and the appropriate nursing actions. Many of the Australian students were dismissive of the CALD students' contribution and tended to make decisions with little consultation, for example:

Australian student:	What do we do? What do we do? His O_2 Sats dropping. I really don't know what to do?
CALD student:	OK, I'll do his pulse and I think we need to do his urine output. When was the last time it was emptied? (Checking patient's chart). It was emptied at 6 o'clock this morning.
Australian student:	Well, that's not helping our decision. I think he doesn't have enough oxygen. So do we increase his oxygen?

There was one interesting and notable exception to the above and that was when a male Asian student was paired with an Australian female student. In that situation the male student dominated, delegated and instructed the female student throughout the entire session, for example:

Male student:	What's his O_2 Sat (asking her to check O_2 Sat)? Where is the mask for O_2?' (indicating that the female student should put the mask on).

Discussion
This summary of the findings is representative of the entire sample of CALD participants. However, given the small sample size is not generalisable to other populations or contexts. It is concerning that the clinical experience and acumen of CALD students, many of whom were registered nurses prior to commencing the BN in Australia, was often dismissed by their fellow students. However, CALD students' clinical experience and knowledge sometimes became evident when they communicated with medical officers, even though their English language skills were often poor. It is also interesting that so many of the CALD students were unwilling to challenge, contradict, initiate care or speak up when working with Australian students, even when the 'patient's' condition was rapidly deteriorating.

These findings are worthy of further investigation as the implications for both educators and for clinical practice are significant. The project team plans to seek funding to progress this research.

Dissemination
This study has been disseminated at the following symposium:

Jeong, S, Hickey, N, Noble, D, Norton, C & Hoffman, K 2010. What impact does language ability have on international students' clinical reasoning during simulation? Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety symposium*, Hunter Valley NSW, November 25-26, 2010

Debriefing and Reflection

The metacognitive skills inherent in reflection are essential for working in complex and dynamic clinical environments where nurses are often presented with novel situations that require higher order clinical reasoning and decision making skills (Parker & Myrick 2009). Metacognition is also necessary in order to generalise concepts when caring for patients with multiple co-morbidities.

In the clinical reasoning model developed as part of the ALTC project the final step is "to reflect on and process new learning" (Levett-Jones et al. 2010). This requires metacognition that enables abstraction and conceptualisation. It was recognised that this was an area that required further development in students as in an evaluation of a previous written assessment item, only 51 per cent of students' demonstrated reflective thinking indicative of a higher order. It was therefore resolved to investigate other ways to improve this skill in students and we began by analysing the recorded videos from the debriefing sessions that followed the simulation experiences undertaken in the quasi experimental study. The debriefing process has the potential to stimulate higher order reflection, however it is often poorly addressed without clear strategies to teach the skills required (Fanning & Gaba 2007).

Aims of the study

To investigate the presence of higher order thinking through reflection that may occur during the debriefing stage of simulation.

There is significant expert opinion that this stage of the simulation learning event is vital to maximise the learning experience. It is recognised that reflective skills are innate with some people, however there is limited evidence to support the choice of the most effective model for debriefing that leads to deep learning, when this is not innate (Fanning & Gaba 2007). The results of this study can be used to build a model for reflection to guide debriefing following simulation.

Methodology

Data from the video recordings of 33 third year students was included in the analysis. All students completed a signed consent form. The debriefing session consisted of a discussion with pairs of students and the session was facilitated by one of the project team. The debriefing sessions were recorded and the recordings transcribed.

Although there is a general consensus that debriefing is an essential process in the simulation experience (Dreifuerst 2009), there is very limited literature that identifies the most effective method to enhance metacognition (Bond et al. 2007). The components of debriefing generally include re-examining the experience, obtaining emotional release and obtaining feedback (Dreifuerst 2009; Fanning & Gaba 2007). The model for debriefing may be explained according to the level of engagement from the facilitator (Fanning & Gaba 2007). Paradoxically, *high* level facilitation involves *low* level of facilitator involvement, as participants essentially debrief themselves with the facilitator acting as a resource, assisting with gentle guidance only where necessary. This was the debriefing model used in this study.

Analysis

The transcriptions were analysed using a tool developed from Mesirow's levels of reflectivity (1994) that was adapted for use in nursing by Powell (1989). This tool describes six levels of reflective thinking, in an escalating order from one to six, with levels one to three indicating lower level reflectivity and levels four to six indicating higher order reflectivity. Evidence of achievement of a level was recorded from each of the transcripts. Each level only had to be achieved once to demonstrate that the student was able to reflect at that level. The analysis was performed by groups

within the project team. Inter-rater reliability was achieved through the use of standard definitions of each level, trial analysis, and the primary researcher being a member of each group.

Results and discussion

Mesirow (1994) described the first four levels of reflectivity, those of 'consciousness', as being of a lower level of metacognition as compared to levels five and six where thinking reached a 'critical consciousness'. In the studies conducted by Powell (1989) and Richardson and Maltby (1995), it was demonstrated that the reflective activity of most students occurred in the lower levels. The results of our study show similar trends with the highest activity being for level one (91 per cent) [reflectivity level] where students described and discussed their experience; and level three (91 per cent) [discriminant reflectivity] where students assessed and evaluated their nursing actions and rationales (refer to Table 1).

Our study, like those of Powell (1989), and Richardson and Maltby (1995), found one of the lowest levels of activity in Level two [affective reflectivity]. As dealing with the emotions of the experience is held to be one of the most important components of the debriefing process, this result was somewhat concerning. Richardson and Maltby (1995) also found this level to be low and noted this as a concern as "a sense of inner discomfit is recognised as the beginning of a reflective episode and the trigger for the reflective process" (p 240). This reticence to reveal feelings may have occurred, in part, because students were aware that the debriefing was being recorded. However, given the importance of dealing with the emotions that arise from the simulation experience (Dreifuerst 2009), if debriefing is to realise its full potential as a means of developing reflective skills, this issue will need to be overcome in the future.

The two previous studies (Powell 1989; Richardson and Maltby 1995) found that the poorest performing level was Level four [Judgmental reflectivity]. In contrast, our study found this level to be higher (52 per cent).

The lowest scoring level in our study was Level six (33 per cent) [Theoretical reflectivity), as it was in Powell's (1989) and Richardson's and Maltby's (1995) research. However, Powell noted that the unstructured nature of the questions may influence results. There were also suggestions of this occurring in our study, for example where a student indicated that they had learnt from the experience but this was not followed up by the facilitator. In addition, there were a number of instances where the debrief became a de facto tutorial. In these circumstances students may have been capable of higher order reflectivity, but did not have the opportunity to demonstrate this. It has been noted by other researchers that domination by a facilitator may result in stagnation at the lower order levels of reflection (Dreifuerst 2009; Parker & Myrick 2009).

Table 21: Student achievement of levels of reflectivity, L1, L2 etc are levels of reflectivity

Interview code/ student code	L1 Reflectivity	L2 Affective	L3 Discriminant	L4 Judgmental	L5 Conceptual	L6 Theoretical
1/1	√		√	√	√	
1/2	√	√	√	√	√	
2/1	√		√	√	√	
2/2	√		√	√	√	
4/1	√	√	√	√	√	
4/2	√	√	√			
6/1	√		√		√	
6/2	√		√	√		√
7/1	√	√	√			
7/2	√	√	√	√	√	√
9/1	√		√	√		√
9/2	√		√			
10/1	√		√	√		√
10/2	√	√	√			
16/1	√	√	√	√	√	√
16/2	√			√	√	√
17/1	√	√	√	√	√	√
17/2	√		√	√	√	
18/1	√					
18/2	√	√	√	√		√
19/1			√	√	√	
19/2	√	√	√		√	
21/1	√		√			
21/2	√		√		√	
23/1	√		√		√	
24/1	√		√		√	
24/2	√		√	√	√	√
27/1	√				√	√
27/2	√	√	√		√	√
28/1			√			
28/2			√			
29/1	√	√	√			
29/2	√	√	√	√	√	
Total	30	13	30	17	20	11
% total	91%	39%	91%	52%	61%	33%
% lower/higher order reflection	91%				61%	

Limitations
The results of this study are limited by the small sample size. Problems with data capture may have resulted from students debriefing in pairs, as the most dominant student sometimes monopolised the discussions. The largely unstructured nature of the debriefing may have influenced the results, however, the conversational nature of the debriefing may be why a number of students (61 per cent) demonstrated higher achievement of Levels five and six when compared to previous written assessments where only 51 per cent achieved higher levels. Evidence suggests that students value the meaningful collaboration that forms part of the debriefing experience (Lasater 2007; Parker & Myrick 2009) and this may have underpinned this result. Despite these limitations, this study revealed sufficient information to make a number of recommendations regarding the use of debriefing as a means of developing higher order reflective skills in students.

Recommendations
The most important recommendation is that the debriefing should align with the stated objectives for the simulation experience. If the objective is to harness the transformative power of the simulation experience, then the debrief needs to be purposeful and structured within a framework. This framework must enable each student to have the opportunity to explore the experience for the purpose of developing the full range of reflective skills.

In the same way that the simulation experience was based upon a clear model for developing clinical reasoning, the metacognition skills inherent in the debriefing should also be structured on a global model for developing reflective skills. In recognition of this fact, it is recommended that a debriefing framework be developed that can be used to guide the teaching of critical reflective skills throughout the nursing program. Transformative learning principles must underpin this model and would maximise the potential of the simulation experience to encourage deep learning and application to other learning experiences and contexts (Dreifuerst 2009). This would help to develop the problem solving and clinical decision making capacity needed for future nursing practice.

In addition to a structured framework, it is imperative that the facilitator is experienced and skilled in assisting students to reflect on their experience. The results from this study support the quality indicators developed through the Delphi study conducted as part of the ALTC project. The facilitator must be able to give constructive feedback, enable students to find the meaning in the experience and develop reflective skills that are the evidence of the deep learning that is possible. This skilled facilitation will enable students to develop those higher order levels of reflectivity that will allow them to transpose the learning achieved and equip them for new and challenging situations. By developing a 'critical consciousness' in students, the potential for debriefing to act as an affective teaching tool for reflectivity may be realised.

Dissemination
This study has been disseminated at the following conferences:

Dempsey, J 2010, Simulation, reflection, cognitive errors and clinical reasoning, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety symposium*, Hunter Valley NSW, November 25-26, 2010

Dempsey, J, Levett-Jones, T, Hoffman, K 2011, 'Simulation, reflection, cognitive errors and clinical reasoning' Paper presented at *The Fourth International Clinical Skills Conference*, Prato, Italy, 22-25 May, 2011

A manuscript is being developed for submission to a peer reviewed journal and an ALTC Extension Grant is in progress to extend this work.

Project symposium. Simulation and Beyond: Creative teaching approaches for improving patient safety symposium, Hunter Valley NSW, November 2010.

Rationale

Both consultative and collaborative strategies were used to disseminate the plans, progress and outcomes of this project. However, feedback from stakeholders, including reference group members, university partners and attendees at conferences, indicated the need for a two day symposium. It was believed that this type of forum would provide an opportunity where academics and educators with a shared commitment to improved teaching could come together to discuss the findings, outcomes and significance of the project. In addition, it was felt that the symposium would be strategic in engaging prospective users of the learning resources and in promoting and embedding good teaching practice related to the use of simulation and clinical reasoning.

The symposium was open to academics from all health disciplines and 107 people attended. It was held on the 25th and 26th of November, 2010. This was an opportune time as the project was nearing completion and the findings could be presented. By this time the learning and teaching resources had also been tested and were ready for distribution. At the symposium an overview of the project was presented and the learning resources demonstrated (refer to program - Attachment III). Workshops given by team members supported the utilisation, adoption and adaptation of the project outcomes.

Plenary and concurrent sessions were given each morning and workshops each afternoon. International and nationally renowned experts were also invited to present on topics such as clinical decision making, adverse patient outcomes, curriculum integration, pedagogical approaches to the use of simulation, effective debriefing, and interprofessional communication. This symposium was described as "outstanding and inspiring". The evaluation scores are provided in Table 21.

Table 22: Symposium evaluation scores

Overall score	4.5/5.
Plenary sessions	Range: 3.5 – 4.7 Mean 4.0/5
Concurrent sessions	Range: 3.8 – 4.9 Mean 4.0/5
Workshops (guest presenters)	Range: 3.2 – 4.8 Mean 4.1/5
Workshops (project team)	Range: 4.1 – 4.8 Mean 4.3/5
Symposium organisation, facilities, accommodation and catering	4.3/5
The content of the meeting was of interest and relevance to me	4.2
I was able to contribute expert advice during the meeting	2.3
I intend to share information from this meeting with other colleagues in my organisation/discipline/network	3.6
I will recommend actions arising from this meeting and/or further discussion of issues identified to appropriate groups/colleagues in my organisation/discipline/network	4.8

Table 23: Summary of Project Outcomes

Planned Outcomes	Actual Outcomes	Dissemination
Systematically review, appraise and synthesise published research related to HPSMs, ICT and clinical reasoning, into a concise evidence based document.	3 systemic reviews undertaken; two published, one in progress	**Systematic review #1** JBI systematic reviews x 2, one in progress JBI systematic review protocols Publication x 2 Conference presentation x 1 Project symposium presentation x 1
Scope the ways in which HPSMs and ICT are currently used in Australian nursing programs, the pedagogical principles that underpin their use and the extent to which these technologies are used for formative and/or summative assessment.	Cross sectional survey conducted to scope the use of ICT and HPSM in Australian nursing programs	Publication x 1 Conference presentation x 4
Provide the first set of nationally agreed quality indicators for the use of HPSMs and ICT/PDAs in nursing programs	Delphi study conducted to develop quality indicators	Publication x 1 (in progress) Conference presentation x 3 Project symposium presentation x 1 Hard copies of 'Quality Indicators' brochure distributed at the project symposium, workshops and conferences. Electronic copy available on the project website.
Differentiate between the impact of high and medium levels of HPSM fidelity on learning outcomes including clinical reasoning, knowledge acquisition and student satisfaction with learning	Quasi experimental study undertaken	Publication x 3 Conference presentation x 4 Project symposium presentation x 1
Make recommendations regarding the efficacy and feasibility of HPSM use.	Cost utility analysis undertaken and recommendations developed.	Publication x 1 Project symposium presentation x 1

Summary of Project Outcomes Continued

Planned Outcomes	Actual Outcomes	Dissemination
Evaluate the conditions under which HPSM and PDAs can enhance nursing students' clinical reasoning skills.	**A series of studies undertaken to determine:** #1 Impact of interpersonal communication on clinical reasoning outcomes #2 Impact of language ability on clinical reasoning #3 Debriefing/reflection #4 Impact of cue collection on clinical reasoning Note: Data re PDAs insufficient for analysis	Conferences presentations x 6 Symposium presentations x 3
Develop and disseminate a range of scholarly learning and teaching resources to support nursing students and academics in the use of HPSM and PDAs in clinical laboratories.	**Resources developed:** Clinical Reasoning model, learning and teaching guides, poster Satisfaction with Simulation Experience (SSE) Scale Design principles for the development of clinical reasoning interactive computerised decision support framework ALTC Report	Journal publications x 5 Conferences presentations x 8 Symposium workshops x 2 Project Website: http://www.newcastle.edu.au/project/clinical-reasoning/
Conduct a project symposium to provide an opportunity for educators to (a) discuss the findings, outcomes and significance of the project; and (b) promote and imbedding good teaching practice related to the use of simulation and clinical reasoning.	Symposium conducted in November 2010 – 107 attendees	Presentations available on the project website

Critical success factors

This project was conducted by a large project team. Undoubtedly this created some challenges for efficient project management. However, the size, commitment and expertise of the team was beneficial to the project in many ways. The large project team did require effective communication processes, as well as clarification and negotiation regarding the roles and responsibilities of team members. The elements of the project that would comprise research higher degree studies also needed to be determined and agreed upon.

In this project capacity building was seen as an important outcome of the project. Two masters students and two honours students formed part of the team and their contributions were invaluable. Contingency plans were developed early in the project in the event that one of the students was unable or unwilling to complete their work within required time frame — this did occur with one of the students so this proved to be an important strategy. Allowing adequate time for unforeseen delays and technical problems was also important, as was access to people with appropriate technical expertise.

Perhaps most important to the success of projects such as ours is ensuring the provision of adequate support from the organisation (school, faculty and university). For us this has been a key factor in the success of our project. The commitment to complete the construction of the simulation unit in time for the project to commence, the provision of IT, administrative, technical, financial and statistical support, as well as workload release for some of the team members, are some of the indicators of the in-kind support we have had. In addition, a number of the members of the project team have been fully funded by the University to attend conferences and this has ensured that dissemination has been ongoing.

Engaging colleagues both within our organisation/s and across the sector was essential to the uptake of the teaching and learning initiatives and to educational practice change. We found that having team leaders and reference group members with positional authority and professional credibility was important for progressing the project, accessing the required support, and ensuring practice change.

Evaluation

Formative feedback on each stage of the project was provided by the reference group at face-to-face meetings and by email communication. Individual members of the reference group also met with the project team to address specific stages of the research and provided valuable insights and critical feedback. The insights of the members of the reference group, all experienced researchers in the field of clinical decision making and adverse patient outcomes, has helped to ensure that our project adds to this body of work in a substantial way without replicating previous work. The advice and support of a reference group who believed in the worth of the project and who were committed to its success was an ongoing source of encouragement and contributed to the quality and dissemination of the project outcomes.

Presenting the project at a number of conferences, seminars and workshops provided opportunities for peer feedback. Submitting our work for publication also allowed for blind review and feedback. Feedback from peers at our respective universities has been encouraging and helped us to appreciate the potential impact of our project on teaching and learning approaches in undergraduate nursing and other health disciplines. Widespread adoption at The University of Newcastle and University of Canberra, as well as other universities, further affirms this.

Meetings with the project evaluators have been conducted and email communication maintained. This enabled the evaluators to monitor progress and to provide feedback to the team. Feedback from the project evaluators caused us to carefully consider aspects of the project that may present potential risks to the project's success and to develop appropriate risk management strategies. A summative project evaluation was conducted and is available as Attachment IV.

Of significant importance was the ongoing feedback we received from students, both from The University of Newcastle and from University of Canberra. Their feedback provided via anonymous surveys (as previously described) and as unsolicited feedback has been consistently positive and affirms the importance of not only our project but also the importance of investing in and continuing to examine clinical reasoning and simulation experiences:

> Thank you for the opportunity to attend the simulation lab. I found the experience to be far above anything I could have possibly perceived. The simulation scenario was amazing. The clinical reasoning cycle came together. To be placed in a situation where you could assess and reassess your actions helped it all make sense. (student email, 2010)

Publications from the project

Arthur, C, Kable, A & Levett-Jones, T, 2010, Human patient simulation manikins and information communication technology use in Australian schools of nursing: A cross sectional survey, *Clinical Simulation in Nursing.* <doi.org/10.1016/j.ecns.2010.03.002>

Hoffman, K, Dempsey, J, Levett-Jones, T, Noble, D, Hickey, N, Jeong, S, Hunter, S & Norton, C, 2010, The design and implementation of an interactive computerised decision support framework (ICDSF) as a strategy to improve nursing students' clinical reasoning skills, *Nurse Education Today.* <doi.org/10.1016/j.nedt.2010.10.012>

Jeffrey, K, Bourgeois, S, & Hillege, S, (2011), The effect of Personal Digital Assistants in supporting the development of clinical reasoning in undergraduate nursing students, *Joanna Briggs Library of Systematic Reviews,* JBI000382 vol. 9, no.16, pp.38-68.

Lapkin, S, Fernandez, R, Levett-Jones, T & Bellchambers, H, 2010, 'The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: A systematic review', *Joanna Briggs Institute Library of Systematic Reviews,* JBI000287 vol. 8, no.16, pp.661–694.

Lapkin, S, Levett-Jones, T, Bellchambers, H & Fernandez, R, 2010, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: A systematic review, *Clinical Simulation in Nursing,* vol. 6, no.6, pp e207– e222.

Lapkin, S, Levett-Jones, T, & Bellchambers, H 2010, *The meaningfulness and appropriateness of using human patient simulation manikins as a teaching and learning strategy in undergraduate nursing education: A systematic review*, Joanna Briggs Library of Systematic Review Protocols (no. 378).

Lapkin, S. & Levett-Jones, T (in press). 'A cost-utility analysis of medium versus high fidelity human patient simulation manikins in nursing education', *Journal of Clinical Nursing*.

Levett-Jones, T, Hoffman, K, Dempsey, Y, Jeong, S, Noble, D, Norton, C, Roche, J, & Hickey, N, 2010, 'The 'five rights' of clinical reasoning: an educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients', *Nurse Education Today*, vol. 30 no.6, pp. 515-520 <doi.org/10.1016/j.nedt.2009.10.020>

Levett-Jones, T, Lapkin, S, Hoffman, K, Arthur, C & Roche, J, 2011, Examining the impact of high and medium fidelity simulation experiences on nursing students' knowledge acquisition, *Nurse Education in Practice.* <doi:10.1016/j.nepr.2011.03.014>

Levett-Jones, T, McCoy, M, Lapkin, S, Noble, D, Hoffman, K, Roche, J, Arthur, C & Dempsey, J, 2011, The development and psychometric testing of the Satisfaction with Simulation Experience Scale, *Nurse Education Today*. <doi.org/10.1016/j.nedt.2011.01.004>

Levett-Jones, T, Sundin, D, Bagnall, M, Hague, K, Schumann, W, Taylor, C & Wink, J, 2010, Learning to think like a nurse, *Handover - Hunter New England Nursing Journal,* vol. 3 no.12, pp. 15–20.

Levett-Jones, T. (in press). *Clinical reasoning: Learning to think like a nurse.* Sydney, Pearson.

Xue, Y, 2010, Review Summaries: Lapkin S, Fernandez R, Levett-Jones, T & Bellchambers, H, 2010, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: a systematic review, *Journal of Advanced Nursing,* vol. 66 no.11, pp. 2391–2397.

Conferences, workshops and symposium presentations

Arthur, C, Levett-Jones, T, & Kable, A 2009, Human patient simulation manikins and information communication technology use in Australian nurse education, Paper presented at *The Third International Clinical Skills Conference*, Prato, Italy, July 3-5 2009

Arthur, C, Levett-Jones, T, & Kable, A 2009, Human patient simulation manikins and information communication technology use in Australian nurse education, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Arthur, C, Levett-Jones, T. & Kable, A. 2010. The simulation "pot of gold": How should we spend it? Poster presented at the *SimTec Health 2010 Conference*, Melbourne, Australia, 30 August – 2 September 2010.
Awarded best poster prize.

Arthur, C, Levett-Jones, T & Kable, A 2010, Human patient simulation manikins and information communication technology use in Australian nurse education, Paper presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Arthur, C, Levett-Jones, T. & Kable, A. 2010. Quality indicators for the design and implementation of simulation experiences. Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Arthur, C., Levett-Jones, T., & Kable, A. 2011. Quality indicators for the design and implementation of simulation experiences. Paper presented at *The Fourth International Clinical Skills Conference*, Prato, Italy, 22-25 May, 2011.

Arthur, C., Levett-Jones, T., & Kable, A. 2011. Quality indicators for the design and implementation of simulation experiences. Paper presented at *The International Nursing Association for Clinical Simulation and Learning (INACSL) Conference*, Orlando, Florida, USA, June 15-18, 2011.

Dempsey, J & Levett-Jones, T, 2009, The 5 R's of Clinical Reasoning, Paper presented at *The Royal College of Nursing Conference,* Melbourne, Australia, September 14-16 2009

Dempsey, J, Levett-Jones, T & Hoffman, K, 2009, The 5 R's of Clinical Reasoning, *The Third International Clinical Skills Conference*, Poster presented at *The Third International Clinical Skills Conference*, Prato, Italy, July 3-5 2009

Dempsey, J, 'Simulation, reflection, cognitive errors and clinical reasoning', 2010, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Dempsey, J, Levett-Jones, T & Hoffman, K, 2011, Simulation, reflection, cognitive

errors and clinical reasoning, Paper presented at *The Fourth International Clinical Skills Conference*, Prato, Italy, 22-25 May, 2011.

Hickey, N, Norton, C, Hoffman, K, Dempsey, J & Levett-Jones, S, 2009, Enhancing nursing students' clinical reasoning skills through their engagement with computerised simulation, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Hoffman, K, Dempsey, J, Levett-Jones, T, Jeong, S, Noble, D, Kenney, R, Norton, C & Hickey, N, 2010, Examining the impact of interpersonal communication on nursing students' clinical reasoning ability, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Hoffman, K, Levett-Jones, T & Roche, J 2010, Is Cue Acquisition and Clinical Reasoning Influenced by the Use of High Fidelity Human Patient Simulation Manikins? Paper presented at the *2010 Beijing International Nursing Conference*, Beijing, China, August 3-5 2010.

Hoffman, K, Dempsey, J, Levett-Jones, T, Jeong, S, Noble, D, Kenney, R, Norton, C & Hickey, N, 2011, Examining the impact of interpersonal communication on nursing students' clinical reasoning ability during simulation sessions, Paper presented at *The Fourth International Clinical Skills Conference*, Prato, Italy, 22-25 May, 2011.

Hunter, S, 2010, Is there a relationship between scores on the Health Sciences Reasoning Test, grade point average and the clinical reasoning ability of nursing students? Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Hunter, S, Norton, C, Levett-Jones, T, Dempsey, J & Hoffman, K, et al ,2010, The 5 R's of Clinical Reasoning The 5 R's of Clinical Reasoning, Poster presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Jeffrey, K, Bourgeois, S, & Hillege, S, 2010, The effect of Personal Digital Assistants on undergraduate nursing students' clinical reasoning, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Jeong, S, Hickey, N, Noble, D, Norton, C & Hoffman, K, 2010, 'What impact does language ability have on international students' clinical reasoning during simulation?' Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Lapkin, S, Levett-Jones, T & Bellchambers, H, 2009, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: a systematic review, Paper presented at the *Australasian Nurse Educators' Conference*, Christchurch, New Zealand, September 30 – October 2 2009

Lapkin, S & Levett-Jones, T, 2010, A cost-utility analysis of medium versus high fidelity human patient simulation manikins in nursing education, Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Levett-Jones, T 2011, Nursing Education and Research in Australia: Qualitative and quantitative approaches to clinical reasoning, Webinar presented for the *National League for Nursing*, USA, March 29, 2011.

Levett-Jones, T, Hoffman, K, Dempsey, Bourgeois, S, Hunter, S, Jeong, S, 2010, Enhancing nursing students' clinical reasoning skills through their engagement with interactive computerised case studies Paper presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Levett-Jones, T & Hoffman, K, 2010, Turning case studies into online clinical reasoning scenarios using a set of generic design principles, Workshop presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Levett-Jones, T & Dempsey, J, 2010, 'Using video simulations to teach students to predict, prevent and manage patient (PPMP) deterioration and promote safe practice, Workshop presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

Levett-Jones, T, 2010, What is the most important thing you need to do to recognise and respond to clinical deterioration? Key note presentation at the *Australian Commission for Quality and Safety in Heath Care Conference*, Adelaide, November 8-9, 2010.

Noble, D, Levett-Jones, T, Hoffman, K, Dempsey, Y, Jeong, S, Norton, C, Roche, J, & Hickey, N, 2010, How can clinical skills improve patient safety? - The 5 R's of Clinical Reasoning, Paper presented at *The Australasian Nurse Educators' Conference,* Christchurch, New Zealand, September 30 - October 2, 2009.

Roche, J, Levett-Jones, T, Hoffman, K, & Hazelton, M, 2010, Interpersonal communication and the effect on nursing students' clinical reasoning, Poster presented at the *3rd International Nurse Education Conference,* Sydney, Australia, April 11-14, 2010

Roche, J, Levett-Jones, T, & Hoffman, K, 2010, Interpersonal communication and the effect on nursing students' clinical reasoning, Poster presented at the *SimTec Health 2010 Conference*, Melbourne, Australia, 30 August – 2 September 2010.

Roche, J, Levett-Jones, T, Hoffman, K & Hazelton, M, 2009, Is cue acquisition and clinical reasoning influenced by the use of high fidelity human patient simulation? Paper presented at *The Australasian Nurse Educators' Conference,* Christchurch, New Zealand, September 30 - October 2, 2009.

Roche, J, Levett-Jones, T, Hoffman, K, & Hazelton, M, 2009, Is cue acquisition and clinical reasoning influenced by the use of high fidelity human patient simulation?' Paper presented at *The Third International Clinical Skills Conference*, Prato, Italy, July 3-5 2009

Roche, J, 'High or medium fidelity patient simulation? Does it make a difference?' Paper presented at the *Simulation and Beyond: Creative teaching approaches for improving patient safety Symposium*, Hunter Valley NSW, November 25-26, 2010

References

Aiken, LH, Clarke, SP, Cheung, RB, Sloane, DM & Silber, JH 2003, Educational levels of hospital nurses and surgical patient mortality, *Journal of the American Medical Association,* vol. 290 no.12, pp.1617–1620.

Alfaro-LeFevre, R 2009, *Critical thinking and clinical judgement: A practical approach to outcome-focused thinking*, 4th end, Elsevier, St Louise.

Alinier, G, Hunt, B, Gordon, R & Harwood, C 2006, Effectiveness of intermediate-fidelity simulation training technology in undergraduate nursing education, *Journal of Advanced Nursing,* vol. 54 no.3, pp. 359 – 369.

Anderson, M & Leflore, J 2008, playing it safe: simulated team training in the OR, *American Operating Room Nurses Journal,* vol. 8, no. 4, pp. 772–779.

Australian Nursing and Midwifery Council 2005, *National Competency Standards for the Registered Nurse*, viewed 9 October 2010, <http://www.anmc.org.au>.

Banning, M 2008, Clinical reasoning and its application to nursing: Concepts and research studies, *Nurse Education in Practice* vol. 8, pp. 177–183

Bartfay, W, Rombough, R, Howse, E & Leblanc, R 2004, Evaluation. The OSCE approach in nursing education, *The Canadian Nurse*, vol.100, no.3, pp. 18–23.

Bembridge, E, Levett-Jones, T & Jeong, S 2010, The transferability of information and communication technology skills from university to the workplace: A qualitative descriptive study, *Nurse Education Today* <http://dx.doi.org/10.1016/j.nedt.2010.10.020>

Birch, I, Jones, N, Dole, P, Green, P, McLaughlin, A, Champney, C, Williams, D, Gibbon, K & Taylor, K 2007, Obstetric skills drills: Evaluation of teaching methods, *Nurse Education Today,* vol. 27, no. 8, pp. 915–922.

Bloom, R 1975, Stating Educational Objectives in Behavioral Terms, *Nursing Forum*, vol. 14, no.1, pp. 31–42.

Bond, W, Lammers, RL, Spillane, L, Smith-Coggins, R, Fernandez, R, Reznek, M, Vozenilek, J & Gordon, J, 2007, The use of simulation in emergency medicine: A research agenda, Academic Emergency Medicine', vol. 14, no. 4, pp. 353–363.

Bremner, M, Aduddell, K, Bennett, F & VanGeest, J 2006, The use of human patient simulators: Best practice with novice nursing students, *Nurse Educator*, vol. 31, no. 4, pp. 170–174.

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*, vol. 62, pp. 137–41.

del Bueno, D 2005, A crisis in critical thinking, *Nursing Education Perspectives,* vol. 26, no. 5, pp. 278–283.

Cant, R & Cooper, S 2009, Simulation-based learning in nurse education: Systematic review, *Journal of Advanced Nursing,* vol. 66, no. 1, pp. 3–15.

Comer, SK 2005, Patient care simulations: role playing to enhance clinical understanding, *Nursing Education Perspectives,* vol. 26, no. 6, pp. 357–362.

Cooper, S, Kinsman, L, Buykx, P, McConnel-Henry, T, Endacott, R & Scholes, J 2010, Managing the deteriorating patient in a simulated environment: nursing students' knowledge, skill and situation awareness, *Journal of Clinical Nursing*, vol. 19, 15–16, pp. 2309–2319.

Delbecq, A, Van de Ven, A & Gustafson, D 1975, *Group techniques for program planning: A guide to nominal group and Delphi process*, Scott Foresman: Glenview, Illinois.

Dreifuerst K 2009, The essentials of Debriefing in simulation earning: A concept analysis, *Nursing Education Perspectives,* vol. 30, no. 2, pp.109–114.

Fanning RM & Gaba DM 2007, The role of debriefing in simulation-based learning, *Simulation in Healthcare,* vol. 2, pp.115–125.

Feingold, CE, Calaluce, M & Kallen, MA 2004, Computerised patient model and simulated clinical experience: Evaluation with Baccalaureate nursing Students, *Journal of Nursing Education,* vol.43, no.4, pp. 156–163.

Flanagan, B, Clavisi, O & Nestel, D, 2007, Efficacy and effectiveness of simulation based training for learning and assessment in health care, viewed 6 October 2010, <http://www.health.vic.gov.au/__data/assets/pdf_file/0015/372120/DHS-REPORT_sim-efficacy_150807.pdf>.

Gaba, D 2004, The future vision of simulation in health care, *Quality and Safety in Health Care,* vol.13, (Suppl 1):i2–i10.

Goldsworthy, S, Lawrence, N & Goodman, W 2006, The use of personal digital assistants as the point of care in an undergraduate nursing program, *Computers, Informatics, Nursing,* vol. 24, no. 3, pp. 138–143.

Harlow, K & Windsor, D 1988, Integration of cost-benefit and financial analysis in project evaluation, *Public Administration Review,* vol. 48, no. 5.

Hatcher, T & Colton, S 2007, Using the internet to improve HRD research: the case for the web based Delphi research technique to achieve content validity of a HRD orientated measurement, *Journal of European Industrial Training,* vol. 31, no. 7, pp. 70–587.

Hoadley, T 2009, Learning advanced cardiac life support: a comparison study of the effects of low- and high-fidelity simulation, *Nursing Education Research,* vol. 30, no. 2, pp. 91–95.

Hoffman, K, Dempsey, J, Levett-Jones, T, Noble, D, Hickey, N, Jeong, S, Hunter, S & Norton, C 2010, The design and implementation of an interactive computerised decision support framework (ICDSF) as a strategy to improve nursing students' clinical reasoning skills, *Nurse Education Today*, <http://dx.doi.org/10.1016/j.nedt.2010.10.012>

Howard, V 2007, A comparison of educational strategies for the acquisition of medical-surgical nursing knowledge and critical thinking skills: human patient simulator vs. the interactive case study approach, *Unpublished doctoral dissertation*. University of Pittsburgh.

Hummel-Rossi, B & Ashdown, J 2002, The state of cost-benefit and cost-effectiveness analyses in education, *Review of Educational Research,* vol. 72, no.1, pp. 1–30.

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

Jeffrey, K, Bourgeois, S, & Hillege, S, (2011), The effect of Personal Digital Assistants in supporting the development of clinical reasoning in undergraduate nursing students, *Joanna Briggs Library of Systematic Reviews,* JBI000382 vol. 9, no.16, pp.38-68.

Jeffries, P, 2007, *Simulation in nursing education*, National League for Nursing, New York.

Jeong, S., Hickey, N., Levett-Jones, T. Pitt, V., Hoffman, K., Norton, C., & Ohr, S. (2010). Understanding and enhancing the learning experiences of international Bachelor of Nursing students at The University of Newcastle. *Nurse Education Today* <http://dx.doi.org/10.1016/j.nedt.2010.10.016>

Joint Commission 2004 Sentinel Events Statistics, in Leonard, M, Graham, S & Bonacum, D, (eds.) The human factor: The critical importance of effective teamwork and communication in providing safe care, *Quality and Safety in Health Care,* vol. 13, pp. i85–i90.

Kardong-Edgren, S, Adamson, KA & Fitzgerald, C 2010, A review of currently published evaluation instruments for human patient simulation, *Clinical Simulation in Nursing*, vol. 6, pp. e25 – e35.

Kardong-Edgren, S, Lungstrom, N, & Bendel, B, 2009, VitalSim versus SimMan: A comparison of BSN student test scores, knowledge retention and satisfaction, *Clinical Simulation in Nursing,* vol. 5, pp. e105–e111.

Kenny, A, 2002, Online learning: Enhancing nurse education, *Journal of Advanced Nursing*, vol. 30, no. 2, pp. 127–135.

Kim, EY 2005, The experience of Korean registered nurses in Queensland, Australia : A grounded theory approach, School of Public Health, Brisbane, Queensland University of Technology.

Konno, R 2008, Lived Experience of Overseas Qualified Nurses from Non-English-Speaking-Backgrounds in Australia, Faculty of Health Sciences, Adelaide, Australia, The University of Adelaide, Unpublished PhD thesis.

Lapkin, S, Levett-Jones, T, Bellchambers, H & Fernandez, R 2010, The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: A systematic review, *Clinical Simulation in Nursing,* vol. 6, no .6, pp. e207–e222.

Larew, C, Lessans, S, Spunt, D, Foster, D & Covington, B 2006, Innovations in clinical simulation: Application of Benner's theory in an interactive patient care simulation, *Nursing Education Perspectives,* vol. 27, no. 1, pp. 16–21.

Laschinger, S, Medves, J, Pulling, C, McGraw, D, Waytuck, B, Harrison, M, & Gambeta, K 2008, Effectiveness of simulation on health profession students' knowledge, skills, confidence and satisfaction, *International Journal of Evidence-Based Healthcare,* vol. 6, no. 3, pp. 278–302.

Lasater, K 2007, High-fidelity simulation and the development of clinical judgment: Students' experiences, *Journal of Nursing Education,* vol. 46, pp. 269–276.

Levett-Jones, T & Bourgeois, S 2011, *The clinical placement: An essential guide for nursing students,* 2nd edn. Elsevier, Sydney.

Levett-Jones, T, Hoffman, K, Dempsey, Y, Jeong, S, Noble, D, Norton, C, Roche, J & Hickey N 2010, The 'five rights' of clinical reasoning: an educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients, *Nurse Education Today*, vol. 30, no. 6, pp. 515–520.

Levett-Jones, T, Kenny, R, Van der Riet, P, Hazelton, M, Kable, A, Bourgeois, S & Luxford 2009, Exploring the information and communication technology competence and confidence of nursing students and their perception of its relevance to clinical practice, *Nurse Education Today*, vol. 29, no. 6, pp. 612–616

Linden, I 2008, The effect of clinical simulation and traditional teaching versus traditional teaching alone on critical thinking of nursing students, EdD thesis, College of Saint Mary, Orlando, NE.

Lyndon, A 2006, Communication and teamwork in patient care: how much can we learn from aviation, *JOGNN*, vol. 35, no. 4, pp. 347–353.

Masters, J, Hulsmeyer, S, Pike, M, Leichty, K, Miller, M & Verst, A 2001, Assessment of multiple choice questions in selected test banks accompanying text books used in nursing education, *Journal of Nursing Education*, vol. 40, no.1, pp. 25–32.

Mesirow J 1994, Understanding transformative learning theory, *Adult Education Quarterly*, vol. 44, pp. 222–232.

Nehring, W., Ellis, W., & Lashley, F 2001. Human patient simulators in nursing education: an overview', *Simulation Gaming,* vol. 32, no. 2, pp. 194–204.

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.

Nursing and Midwifery Council 2007, *Simulation and practice learning project*, London: Nursing and Midwifery Council.

Office of Safety and Quality in Healthcare, Department of Health (WA), 2008, accessed 28.8.10 from: <www.safetyandquality.health.wa.gov.au/programs/liaison.cfm>

Omeri, A & K, Atkins 2002, Lived experiences of immigrant nurses in New South Wales, Australia: searching for meaning, *International Journal of Nursing Studies*, vol. 39, pp. 495–505.

Parker B & Myrick F 2009, Transformative learning as a context for human patient simulation, *Journal of Nursing Education,* vol. 49, no. 6, pp. 326–332.

Peteani, L 2004, Enhancing clinical practice and education with high-fidelity human patient simulators, *Nurse Educator,* vol. 29, no. 1, pp. 25–30.

Pike, G 1991, The effects of background, coursework, and involvement on students' grades and satisfaction, *Research in Higher Education,* vol. 32, no. 1, pp. 15–31.

Powell JH 1989 The reflective practitioner in nursing, *Journal of Advanced Nursing,* vol. 14, pp. 824–832.

Prion, S 2008, A practical framework for evaluating the impact of clinical simulation experiences in prelicensure nursing education, (electronic version), *Clinical Simulation in Nursing,* vol. 4, no. 5, pp. e69 – e78.

Ravert, P 2002, An integrative review of computer-based simulation in the education process, *Computers Informatics Nursing,* vol. 20, no. 5, pp. 203–208.

Richardson, G, & Maltby, H 1995, Reflection-on-Practice: enhancing student learning, *Journal of Advanced Nursing,* vol. 22, pp. 235–242.

Scherer, Y, K, Bruce, SA & Runkawatt, V 2007, A comparison of clinical simulation and case study presentation on nurse practitioner students' knowledge and confidence in managing a cardiac event, *International Journal of Nursing Education Scholarship,* vol. 4, no. 1, article 22.

Schneider, Z, Whitehead, D & Elliot, D 2007, *Nursing and midwifery research: Methods and appraisal for evidence based practice,* (3rd edn), Elsevier, Sydney.

Skulmoski, G, Hartman, F & Krahn, J 2007, The Delphi method for graduate research, *Journal of Information Technology Education,* vol. 6, pp. e1–21.

Staggers, N, Gassert, C & Curran, C 2001, Informatics competencies for nurses at fours levels of practice *Journal of Nursing Education,* vol. 40, no. 7, pp. 303–316.

Tarrant, M, Knierim, A, Hayes, S & Ware, J 2006, The frequency of item writing flaws in multiple choice questions used in high stakes nursing assessments, *Nurse Education Today*, vol. 26, pp. 662–671.

Tarrant, M & Ware, J 2008, Impact of item writing flaws in multiple choice questions on student achievement in high-stakes nursing assessments, *Medical Education*, vol. 42, pp.198–206.

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,* vol. 57, no. 5, pp. 302–311

Velásquez, J, Ríos, S, Howlett, R, Jain, L, Zanni-Merk, C, & Bouché, P 2009, Dialectics-based knowledge acquisition - a case study *Knowledge-based and intelligent information and engineering systems,* vol. 5711, pp.219–226, Heidelberg: Springer Berlin.

Wiersma, W, & Jurgs, S 2005, *Research method in education: An introduction*, Pearson Education, Boston.

Wilson, R 1995, The Quality in Australian Health Care Study, *Medical Journal of Australia*, vol.163, pp. 458–471.

Whyte, J, Cormier, E & Pickett-Hauber, R 2010, Cognitions associated with nurse performance; A comparison of concurrent and retrospective verbal reports of nurse performance in a simulated task environment, *International Journal of Nursing Studies*, vol. 47, no. 4, pp. 446–451.

Xu, Y. & S. Kim, 2008, Adaptation and Transformation Through (Un) Learning: Lived Experiences of Immigrant Chinese Nurses in US Healthcare Environment, *Advances in Nursing Science*, vol. 31, no. 2, pp. 33–47.

Appendix I

UNIVERSITY OF CANBERRA
AUSTRALIA'S CAPITAL UNIVERSITY

24 January 2010

Associate Professor Tracy Levett-Jones
Faculty of Nursing and Midwifery
University of Newcastle

RE: ALTC Project CG8-679 'Examining the impact of simulated patients and information and communication technology on nursing students' clinical reasoning'.

Dear Tracy,
An outcome from the above project, the resources detailing the clinical reasoning cycle for students and lecturers was introduced to students in the Bachelor of Nursing program and to staff in the Disciplines of Midwifery and Nursing at the University of Canberra in 2010.
For students, the clinical reasoning cycle became a core component of the learning in the unit, Developing Clinical Judgement -8047 Bachelor of Nursing. Students received lectures on components of the cycle and applied the elements of the cycle to client scenarios in tutorials every week in conjunction with other concepts. The students were encouraged to use the cycle during their clinical placement experience and were required to implement the cycle during self directed learning clinical skills sessions. A reflection based assessment required students to apply the clinical reasoning cycle and several exam questions were included to assess students understanding and use of the cycle for a client based scenario.
For staff in the disciplines of nursing and midwifery, an in-service session was provided on the ALTC project and the clinical reasoning cycle with copies of the lecturers' and students' resources presented to all staff. An additional session was provided to facilitators of students who were employed by the Faculty to support students in the Bachelor of Nursing during clinical learning placements.
Anecdotal feedback to the unit convener from students about the clinical reasoning cycle has been extremely positive with student verbal comments including:

> "The cycle is useful in all parts of my life"
> "I enjoyed learning a systematic way of organising my thinking"
> "The cycle was very useful when working through my client assessment on clinical placement".

The handout was provided to students as a booklet, in colour with encouragement from staff teaching in the unit to use the cycle in all aspects of their clinical life.

From another perspective that illustrates dissemination of this resource; during an international visit from Chinese Nursing Professors who experienced the Developing Clinical Judgement 8047 tutorial class in 2010, one of the international students in the class provided the visitors with a copy of his Clinical Reasoning Cycle resource to take back to China, saying in their language that he found the resource extremely helpful. A fellow lecturer in the unit also provided the visitors with a copy of the lecturer's resource to take back to China with the comments that they may wish to implement this into their teaching as well.
For clarification of any of the illustrations regarding use of the resource, the clinical reasoning cycle as detailed in this letter, please do not hesitate to me on the number below.
Yours sincerely

Dr Sharon Bourgeois
Assistant Professor, BN Course Convener, 8047 Unit Convener 2010
T: 61 2 6201 5131; E: Sharon.Bourgeois@canberra.edu.au

AUSTRALIAN LEARNING & TEACHING COUNCIL

Promoting excellence in higher education

PO Box 2375 Strawberry Hills NSW 2012 Australia
Telephone 02 8667 8500 Facsimile 02 8667 8515
www.altc.edu.au
ABN 30 109 826 628