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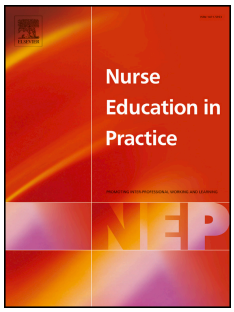

A cross-national study to objectively evaluate the quality of diverse simulation approaches for undergraduate nursing students

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TITLE**: A cross-national study to objectively evaluate the quality of diverse simulation approaches for undergraduate nursing students**

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Abstract

The aim of this paper is to report the results of a cross-national study that evaluated a range of simulation sessions using an observation schedule developed from evidence-based quality indicators.

Observational data were collected from 17 simulation sessions conducted for undergraduate nursing students at three universities in Australia and the United Kingdom.

The observation schedule contained 27 questions that rated simulation quality. Data were collected by direct observation and from video recordings of the simulation sessions.

Results indicated that the highest quality scores were for provision of learning objectives prior to the simulation session (90%) and debriefing (72%). Student preparation and orientation (67%) and perceived realism and fidelity (67%) were scored lower than other components of the simulation sessions.

This observational study proved to be an effective strategy to identify areas of strength and those needing further development to improve simulation sessions.

Key words: Simulation; observational evaluation; quality indicators; nursing students

Highlights:

Although simulation has become a ubiquitous teaching approach in many nursing programs there remains a need for robust studies that evaluate the quality of simulation sessions.

- To date, most simulations have been evaluated from the perspective of students
- Observational methods are an effective way of collecting data to determine the quality of simulation sessions.

- An objective observational schedule provides an appropriate and flexible method to evaluate the quality of diverse simulation sessions.

INTRODUCTION

Nursing education and health care delivery are challenged by an exponential rate of change in patient acuity and health care technologies (Nehring and Lashley, 2010). Engaging and active learning approaches are essential for the preparation of twenty-first century nursing graduates (Nursing and Midwifery Council (NMC), 2010a). For these reasons educators are increasingly using simulation, in a variety of modalities, as an adjunct to, and sometimes a replacement for more traditional teaching approaches (Humphreys, 2013; Nehring and Lashley, 2010). The increasing growth in the use of simulation reflects the need to assure the public that nursing graduates are safe and competent beginning practitioners (Australian Health Practitioner Regulation Agency; Nursing and Midwifery Council (NMC), 2010b; Wilson and Rockstraw, 2012). Several studies have been undertaken to demonstrate the effectiveness of simulation experiences (Adamson et al., 2013; Bray et al., 2011). Although there is an increasing body of evidence about the positive outcomes of simulation, many studies have been limited in scope and approach, and there remains a need for studies that evaluate the quality of simulation sessions.

This paper reports the results of a cross-national study that evaluated the quality of a range of different simulation sessions using evidence-based quality indicators for simulation developed in a previous Delphi study (Arthur et al., 2010, 2012).

BACKGROUND

Simulation is broadly defined as an educational strategy in which elements of the real world are appropriately integrated to achieve specific goals related to learning or evaluation (Gaba, 2004). While fascination with high technology/high fidelity simulation approaches is

understandable, the type of equipment/technology used (as well as all other educational decisions) should be driven by specific learning outcomes and evidence of effectiveness (Brown and Williams, 2015). The use of simulation has advanced at an exponential rate over the last decade (Health Workforce Australia, 2013). DeVita (DeVita, 2009) argued that simulation should be a core education strategy in nursing education because it is "measurable, focused, reproducible, mass producible, and importantly, very memorable" (p 46). However, the evidence base for simulation has not kept pace with the increasing investment in resources and equipment.

In universities in the United Kingdom and Australia self-reported measures of student satisfaction, knowledge acquisition and confidence levels are commonly used to determine the impact of simulation sessions (Kable et al., 2013; Levett-Jones et al., 2011). However more robust methods are needed to determine the quality of simulation sessions and these should include the design and delivery of simulations, review of the learning environment, and assessment of pedagogical principles, briefing and debriefing.

To date, much of the nursing literature on simulation has been more descriptive than critical, often with accounts of the potential of simulation and guidance to incorporate simulation into curricula (Aldridge and Wanless, 2012; Harder, 2009; Jeffries, 2007). Although there is evidence of a growing maturity in the simulation literature along with an awareness of the need for more robust evaluation measures (Adamson et al., 2013), there remains a need for studies that specifically evaluate the quality of simulation sessions beyond learning outcomes and learner perspectives. Some definitions of terms used in association with simulation including modalities used in this study are provided in Table 1 below.

Insert Table 1 about here

In 2011 the International Nursing Association for Clinical Simulation and Learning (INACSL) published standards for best practice in simulation, offering some detail concerning learning outcomes and criteria (The INACSL Board of Directors, 2011a, b, c, d, e, f, g). The standards included terminology, professional integrity of participants, participant objectives, facilitation methods, simulator facilitator, the debriefing process and evaluation of expected outcomes. These standards were revised in 2013 (Borum, 2013; The INACSL Board of Directors, 2013); however the use of these standards for the purpose of evaluating the quality of simulation experiences has not been widely reported.

Few previous nursing studies have been located that directly measured the quality of the design and delivery of simulation activities (Jeffries and Rizzolo, 2006), although many have measured student reaction and learning, and some have evaluated skills and competency attainment (Adamson et al., 2013). Quality indicators for the design and delivery of simulation experiences were developed in 2010 using a Delphi technique to achieve international consensus by an expert panel (Arthur et al., 2010, 2012) (See Table 2). These quality indicators articulate five key elements for effective simulation: pedagogical principles, fidelity, student preparation, staff preparation and training, and debriefing. They emphasise the importance of simulation integration across the curriculum, scaffolding of simulation sessions and adequacy of physical and staff resources to achieve quality learning experiences. These indicators are flexible and can be broadly applied to a variety of different types of simulation activities.

Insert Table 2 about here

Based on the quality indicators a set of evaluation instruments was constructed to evaluate the quality of simulation delivery in undergraduate nursing programs. A study that measured students' perceptions of simulation quality using one of these instruments has previously

been reported (Kable et al., 2013). This paper reports the results of another study using an observation schedule to measure the quality of different simulation sessions.

STUDY DESIGN

The aim of this study was to evaluate a range of simulation sessions using an observation schedule developed from evidence-based quality indicators, and compare differences in the achievement of quality outcomes at participating study sites. This study takes a broad and inclusive approach as the observational instrument comprised four specific observable domains derived from the quality indicators: Pedagogical principles, Student preparation and Orientation, Fidelity and Debriefing (Arthur et al., 2012) (see Table 2). In this study the simulation sessions were objectively appraised by the researchers rather than by examining students' perceptions which typically occurs.

STUDY SITES AND PARTICIPANTS

The study was undertaken at two Australian universities and one in the UK. Approval for the study was provided by the Human Research Ethics Committees at participating universities. A purposive sampling method was used and permission to observe simulations was sought from simulation staff and students in first, second and third year nursing programs. These participants voluntarily consented and were told they could withdraw from the study at any time without prejudice. Seventeen simulation sessions were observed; they included first year (site 2), second year (site 1) and third year (site 3) sessions. The simulation modalities included manikins, Mask-Ed™ (KRS simulation), and standardised patients (See Table 3). The focus and level of immersion of the simulations also varied.

Insert Table 3 about here

First year simulation sessions focused on introductory clinical skills such as: communication, managing patient distress, falls risk and pressure area assessment, stoma care and uridome application. In these simulation sessions the educator was present to facilitate learning and support students.

Second year simulation sessions were fully immersive with the educator in a separate control room, and included four scenarios: mental health assessment and communication with a patient with depression (3 sessions), mental health behaviour management for a patient presenting with symptoms of mania (1 session), older person assessment and management of pain and delirium (2 sessions), and post-operative fluid status assessment and management (hypovolaemia/hypervolaemia) (2 sessions).

The third year immersive simulation sessions involved one clinical scenario: Management and assessment of a patient presenting with sepsis (6 sessions). Additional detail about these simulation sessions is reported in a previous paper (Kable et al., 2013).

THE OBSERVATION INSTRUMENT

The observation instrument (Table 4) consists of 27 questions designed to measure the extent to which the simulation session addressed the following elements (See Table 2 for details):

- **Pedagogical principles** (3 items)
- **Student preparation and orientation** (6 items)
- **Fidelity** (clinical authenticity, relevance and fidelity) (5 items)
- **Debriefing** (7 items)

Additionally six items were used to collect information about the focus of the simulation scenarios, teaching strategies used, simulation modalities, location of simulations, number of students, and student roles (See items 2, 3, 5, 6, 7,and 8 in Table 4).

Insert Table 4 about here

METHODS

Observations were undertaken by trained members of the research team. Items in each domain of the observation instrument were reported as observed (score = 2), partially observed (indicating some evidence of this item) (score = 1), or not observed (score = 0). Inter-rater reliability was ensured by undertaking the first observations in pairs and comparing results for consistency. The statistical program JMP 9.0.0 (SAS Institute, Cary, NC, USA) was used to analyse mean scores and the frequency of items scored in the quality indicator domains. Some comparisons between sites and years were also reported. The non-parametric Kruskal-Wallis test (rank sums) was used to determine differences between categories, and the Wilcoxon test was used to determine significant differences between pairs with *p*-values less than 5% considered statistically significant.

RESULTS

Seventeen simulation sessions with 143 students were observed. The number of students involved in each simulation session ranged from 2-25 (mean=8, median=4). Most (13) sessions were experiential (involving active participation by students); in four of the simulations, students observed or had minimal participation only. Simulation modalities included: actors (4), Mask-Ed™ (KRS simulation) (5) and high fidelity manikins (8). Most simulations were conducted in clinical laboratories (15) and two were conducted in simulation units with audio-visual capability. First year sessions had significantly higher numbers of students in each group (~24) (p= 0.02). See Table 3 for session details.

Results are reported for each of the domains (see Table 5) in the order of the Quality Indicator Statements in Table 2.

For the **pedagogical principles domain**, the overall mean score was 5.4 from a maximum score of 6, indicating that these items were frequently observed. Most sessions provided course AND session objectives (76%); however 24% provided course objectives only (site 1). Most sessions were fully immersive (82%) and the remainder were partially immersive (See Table 1 for the definition of immersion). Most scenarios addressed the stated learning objectives (88%); however, at site 2 not all sessions addressed all of the objectives (p= 0.007).

For the **student preparation and orientation domain**, the overall mean score was 8 from a maximum score of 12, indicating these items were observed in approximately two thirds of the sessions. There was significant variation in the provision of preparatory activities such as lectures, tutorials, online activities and readings between sites. Sites 1 and 2 had extensive preparation compared with Site 3 where limited preparation was required (p=0.002). There was also variation in the teaching and practice of skills prior to the simulation sessions. Forty one percent of sessions were preceded by extensive opportunities to practice psychomotor skills, and 35% of sessions were preceded with limited opportunities for practicing skills. The numbers of skill acquisition sessions prior to simulation was significantly higher at study Sites 1 and 3 compared to Site 2 where no skills preparation was provided (p=0.028).

All simulation sessions were preceded by either a comprehensive orientation (53%) or a brief orientation (47%). Over 40% of simulation sessions briefed students about the manikin/equipment to be used; 30% briefed students about the equipment, environment and student expectations; and 30% had no briefing. The structure of the simulation was outlined briefly for 59% of sessions, and in detail for the others.

For the **clinical authenticity, relevance and fidelity domain**, the overall mean score was 6 from a maximum score of 9, indicating these items were observed in approximately two thirds of the sessions. The scenario AND the manikin, MaskEd character or standardised

patient was clinically realistic for most sessions (59%) and somewhat realistic for others (40%). The simulation modality used supported the learning objectives for 16 of the sessions. Most (16) of the simulation environments included clinically realistic equipment however at Site 3 this was limited as patient charts were frequently (70%) not provided; and at Site 3 none were provided.

For the **debriefing domain**, the overall mean score was 6.5 from a maximum of 9, indicating these items were frequently observed. Debriefing was conducted within 30 minutes of every simulation session and sixteen sessions included debriefing about non-technical skills. Students were encouraged to reflect on, and evaluate their own practice during debriefing after 59% of sessions. The majority (76%) of debriefing sessions included feedback to students about their strengths, 71% included feedback about students' weaknesses, and 59% included both. Only 24% of the debriefing sessions included support for students who were disappointed with their performance during the simulation. This was significantly different for Site 1 sessions where support was provided during half of the sessions ($p= 0.02$).

Insert Table 5 about here.

DISCUSSION

The increasing body of literature about simulation bears testament to the impact that simulation continues to have on nursing education. It is also apparent that the research underpinning simulation is growing in both quantity and quality. There is unequivocal evidence attesting to the fact that exposure to simulation, irrespective of the level of fidelity and modalities in use, is likely to have a positive impact on learner satisfaction and confidence. There is also increasing evidence supporting the premise that simulation improves learners' knowledge, clinical reasoning (Lapkin et al., 2010) communication and teamwork (Lapkin et al., 2013), although these remain somewhat contested areas (Levett-

Jones, 2015). However, to date, there are few studies which examine critical quality elements such as alignment with pedagogical principles, degree of student preparation and orientation, environmental fidelity and debriefing (Arthur et al., 2012).

It is reasonable to assume that higher quality simulations are likely to result in improved learning outcomes as well as higher levels of student satisfaction. In this study many of the scores were similar between the study sites; however some of the results were of concern.

Pedagogical principles were scored higher than all other observed components of the simulations, however the scores were lower at Site 2 for first year students. This indicates the need for improved alignment between learning objectives and simulation sessions. More attention to ensuring that students are aware of and understand learning objectives is also needed.

Preparation, orientation and fidelity achieved the lowest scores; in particular, briefing students about the simulation equipment. This can be partly understood by the fact that third year students at site 3 had participated in simulation activities previously and there was an assumed level of familiarity with equipment. However, it is noteworthy that first year students at site 2, who could reasonably expect an introduction to equipment, were not given this opportunity.

Patient charts were frequently not provided in the simulations, for example at Site 3, during the mental health simulations at Site 1, and falls risk and pressure area assessment at Site 2, no charts were provided. Clearly, in a simulation session where patient assessment is required, one would expect that access to patient notes and the opportunity to document assessment findings would be important. At Site 3 large wall mounted ‘flip-charts’ were used to record patient information as the scenario unfolded. Although a recent study reported that students considered patients notes were not as beneficial for clinical judgement as other aspects of the simulation (Kelly et al., 2014), this

remains an area for improvement as a lack of patient notes can detract from the realism of the simulation (Arthur et al., 2010).

Debriefing was conducted within 30 minutes for all sessions and usually included debriefing about non-technical skills. However, a number of the debriefing sessions did not include reflection on practice or self-evaluation indicating room for improvement. Feedback about students' strengths and weaknesses was evident but few of the debriefing sessions provided additional support for disappointed or distressed students. This is an important area for further consideration as simulation sessions can elicit emotional responses in some students and adequate support is essential at these times (Decker et al., 2013).

The results from in this study are consistent with those of the previous study which evaluated the quality of simulation sessions from students' perspectives (Kable et al., 2013). In both studies pedagogical principles scored highly suggesting that the simulation met the course learning outcomes. Some differences relating to the way in which intended learning outcomes are presented to students have been highlighted and are an area for further development. Student preparedness scored lower in this study than other domains, which is similar to the student evaluation study where 71% stated that they felt well prepared (Kable et al., 2013). There was a significant difference between fidelity in the two studies, with the student evaluation reporting that 95% of participants identified the clinical scenario to be realistic and the observational study identifying that only 59% of the scenarios were realistic. Thus, it seems that academics and students may have differing views on what makes a scenario realistic. As the researchers conducting the observations were experienced educators, they may have had higher expectations than students and consequently identified deficits more often than students. A recent study that used the quality indicators to evaluate simulations for first year nursing students confirmed that student preparation (knowing what to expect) and

authenticity (and preparation for clinical practice) were important to students (Rochester et al., 2012).

Although over the last decade a number of simulation evaluation instruments have been developed (Johnstone, 2005; Merrill et al., 2008), until the development of the instruments used in this study, few objective instruments were designed to measure the quality of simulation as a pedagogical approach in its own right (Kable et al., 2013). Thus this study has proven to be a useful way to advance the evidence base for simulation by providing explicit guidance about specific areas for improvement.

CONCLUSION

Studies focused on design and delivery of clinical simulation are ultimately concerned with providing meaningful learning experiences that have a high impact on clinical practice and patient care (Kelly et al., 2016). This study has provided valuable information about the quality of the simulation sessions observed by identifying components that could be improved (preparation and orientation of students and session fidelity); and components that were of a satisfactory standard (pedagogical principles and debriefing). These components are critical to the quality of pedagogically sound simulation sessions, and will assist educators to ensure they are adequately designed to provide high quality learning experiences. The observation schedule proved to be an effective and objective instrument for measuring the overall quality of different types of simulation sessions from the researcher's perspective. Additional testing of this instrument in other settings and with diverse simulations would be valuable to extend this body of work.

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Table 1: Definitions of terms and simulation modalities

Simulation: is a pedagogical method in which clinical scenarios are represented as close to reality as possible, in order for students to experience "real" clinical situations in a safe learning environment. Simulation in nursing can be defined as "an attempt to mimic essential aspects of a clinical situation" (National League for Nursing, 2010). The choice of simulation modality should relate to the learning objectives and be fully integrated into the curriculum (Arthur et al., 2012). In this study, modalities included standardised patients (actors), human patient simulation manikins, and silicone mask simulation.

Fidelity: The term fidelity is used to describe the degree to which a simulation approaches reality. Simulation fidelity refers to the "physical, contextual and emotional realism" (National League for Nursing, 2010) created, that allows the participant to become immersed in the simulated situation. It includes the clinical realism of the scenario, the laboratory environment and equipment, and the realism of the manikin or actor taking the patient role.

Immersion: In this study, 'immersion' refers to the degree to which a student becomes immersed in the simulated learning experience. A fully immersive simulation session involves the student being required to problem solve and respond to the situation independently, without tutors being present or providing direct support. A partially immersive session might have tutors present but only providing indirect support such as prompts or questions.

Scaffolding: The pedagogical term scaffolding refers to the provision of sufficient support to promote learning when concepts and skills are first introduced, followed by a gradual withdrawal of support as the learner progresses and begins to assume an increasingly independent role (Doolittle, 1997). Scaffolding implies that learners are adequately supported by prior related curriculum learning experiences before fully immersive simulation experiences.

Human patient simulation manikins (HPSM): can be classified as either low, medium or high fidelity based on their technical capacity (Seropian et al., 2004). High fidelity manikins (HFM) include the Laerdal SimMan 3G™ which has the capacity to breathe, blink and speak as well as show altering physiological signs.

Mask-Ed™ (KRS simulation): is a high fidelity silicone mask simulation technique guided by a teaching framework. The technique involves the informed educator donning silicone props, including masks, torsos, hands and feet. The props mask the educator, however the hidden educator then transforms into a character/ person with a history/story which is relevant to the learning experience. The newly developed character serves as a platform for teaching. The character becomes the coach who guides and directs the learner. KRS stands for knowledgeable, realistic and spontaneous simulation (Reid-Searl et al., 2012). See also http://www.cqu.edu.au/masked

Table 2: Quality indicator statements ((Kable et al., 2013) page 237)

Pedagogical principles:

1. **Simulation experiences are aligned with curriculum goals and course objectives.** Simulation experiences should be developed as part of a coherent curriculum structure with the ultimate goal of preparing graduates who are fit for practice.
2. **The curriculum matrix illustrates how simulation experiences are integrated throughout program.** A curriculum matrix provides a way of ensuring alignment between program, course and simulation objectives.
3. **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.** The term scaffolding refers to the provision of adequate support to promote learning. It implies purposefully constructed activities that build towards student mastery, with gradual reduction in staff involvement.
4. **Simulation experiences, in some form, are integrated into every clinical course and progress in complexity throughout the program.** The introduction of simulation from the first year of the students' program provides early experiential learning opportunities within a safe practice environment, as well as familiarising students with simulation activities and building confidence for subsequent more complex activities.
5. **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.** Clear learning objectives should be written prior to simulation design, and should be available to all staff and students prior to simulation activities.

Fidelity:

1. **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 or part-task trainers.** The advantage of more expensive manikin technologies for all levels of skill acquisition has not been demonstrated. Cost as well as suitability to meet required learning objectives should be considered when planning simulation activities and purchasing equipment.
2. **Environmental fidelity is developed in line with the learning objectives of the simulation session.** The fidelity level of the manikin often overshadows consideration of other aspects of fidelity. Providing a realistic environment gives the scenario contextual richness and assists the students to become immersed in the situation.
3. **Contextually appropriate clinical equipment and the availability of hardcopy or electronic patient information and charts support a realistic clinical environment.** Wherever possible equipment and charts should be the same as those used in local clinical venues to increase the transferability of skills.

Student preparation and orientation:

1. **A structured orientation is provided for students prior to the simulation session and, depending on the students' prior exposure to simulation activities, includes: 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 ICT to be used.** Adequate briefing prior to simulation sessions alleviates students' anxiety and improves learning. Additional preparation before the simulation activity in the form of lectures, learning packages or skill training provides the scaffold that assists students to perform in simulated situations.

Staff preparation and training:

1. **Staff who design scenarios, conduct the simulation sessions, facilitate debriefing and manage the technology have each undertaken appropriate training.** Training of staff is an essential to the effective instigation and continuation of simulation within any curriculum, and needs to be considered as an important aspect of the simulation budget.
2. **Staff who design simulation scenarios and program manikins are familiar with curriculum goals, have relevant clinical knowledge and understand the technological capabilities of manikins.** Academic staff who are responsible for simulation activities require a range of skills and may need additional training in new technologies.
3. **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.** The quality of students' simulation experience is largely dependent on the skills and knowledge of those facilitating the simulation sessions. A supportive attitude and effective debriefing skills are at least as important as familiarity with the manikin technology.

Debriefing:

1. **A structured debriefing is provided immediately following the simulation.** Debriefing sessions should be structured to explore key concepts from learning objectives and help consolidate students' learning. Debriefing is most effective when conducted immediately after the simulation while the events and emotions are fresh in students' minds.
2. **The debriefing facilitates students' reflection on practice, self-evaluation and feedback on their perceptions of the experience.** It should encourage students to identify areas for improvement and how to transfer learning into clinical practice.
3. **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.** Research continues to demonstrate the importance of these skills to patient health outcomes, and simulation provides a valuable teaching strategy for the acquisition of non-technical skills.

Table 3: Session details

Clinical Scenario:	Number of sessions	Year (Study site)	Number of students	Teaching Strategy	Modality*	Location*	Student Role
Communication and managing patient distress	1	1 (2)	25	Passive Observation	MaskED	Clinical lab	Both
Elderly falls risk and pressure area assessment	1	1 (2)	24	Interactive Observation	MaskED	Clinical lab	Both
Stoma care and uridome application	1	1 (2)	24	Interactive Observation	MaskED	Clinical lab	Observer
Mental health assessment and communication depression patient	3	2 (1)	13	Experiential	Actor	Clinical lab	Both
Mental health behaviour management for patient with mania	1	2 (1)	12	Passive Observation	Actor	Clinical lab	Observer
Aged care assessment and management of patient with pain and delirium	2	2 (1)	19	Experiential	MaskED	Clinical lab	Both
Surgical fluid status assessment and management	2	2 (1)	4	Experiential	HFM	SLE	Active
Adult nurses systematic assessment of patient presenting with Sepsis	6	3 (3)	22	Experiential	HFM	Clinical lab	Active

* Mask-Ed™ (KRS simulation) http://www.cqu.edu.au/masked
* HFM: High Fidelity Manikin
* SLE: Simulated Learning Environment

Table 4: Simulation observation schedule **(Direct / Video) Delete one option.**

Tick ONE response for each question below

Brief description of the simulation activity:

1. Are there stated learning objectives for the scenario?

   No ☐ Course Objectives only ☐ Yes: Scenario objectives ☐

2. What is the scenario/situation?

   _____

3. What are the teaching strategies being used in this scenario?

   Experiential ☐ Demonstration ☐ Facilitated ☐ Multiple ☐

4. What is the level of immersion in this scenario?

   None ☐ Partial/Facilitator supported ☐ Fully immersive ☐

5. What modality is used?

   Actor ☐ MASK-ED ☐ High Fidelity Manikin ☐ Role Play ☐ Other ____

6. Where is the simulation conducted?

   Clinical laboratory ☐ Tutorial room ☐ Simulated Learning Environment ☐
   Other ☐

7. How many students are involved in the simulation? _____

8. Do all students have an active role, or are some observers?

   Active only ☐ Observer only ☐ Students had both roles ☐

Student preparation:

9. Did students receive a structured orientation?

   No ☐ Brief orientation ☐ Comprehensive orientation ☐

10. Are students orientated to the manikin and/or equipment they are to use?

    No ☐ Brief orientation ☐ Comprehensive orientation ☐ N/A ☐

11. Are students briefed about the structure of the session?

    No ☐ Brief orientation ☐ Comprehensive orientation ☐

12. Are students made aware of the learning objectives?

    No ☐ Brief mention ☐ Yes ☐

The session:

13. Does the scenario address the stated learning objectives?

    No ☐ Somewhat ☐ Yes ☐

14. Is the scenario clinically realistic?

    No ☐ Somewhat ☐ Yes ☐

15. Does the modality used support the learning objectives?

    No ☐ Yes ☐ N/A ☐

16. Is the manikin or standardised patient realistically presented?

    No ☐ Somewhat ☐ Yes ☐

17. Does the environment provide clinically realistic equipment?

    No ☐ Somewhat ☐ Yes ☐

18. Are hard copy or electronic medical charts and records provided?

    No ☐ Some ☐ Yes ☐

Debriefing:

19. Does a debriefing follow immediately after the simulation?

    No ☐ Delayed >30 mins ☐ Yes < 30 mins ☐

20. Are students encouraged to reflect on, and self-evaluate their practice?

    No ☐ Somewhat ☐ Yes ☐

21. Are non-technical skills discussed?

    No ☐ Yes ☐

22. Are students given specific feedback on their strengths

    No ☐ Yes ☐ N/A ☐

23. Are students given specific feedback on their weaknesses?

    No ☐ Yes ☐ N/A ☐

24. Are students given specific feedback on both strengths AND weaknesses?

    No ☐ Yes ☐ N/A ☐

25. Does the debriefing session **support** students who are disappointed with their performance during the simulation?

    No ☐ Yes ☐ N/A ☐

Additional questions (Not observable items)

26. Do students have preparatory materials such as lectures, tutorials, videos, online learning packages, or readings related to the activity?

    No ☐ Some ☐ Yes: extensive preparatory materials ☐

27. Have students been taught/practiced the skills needed prior to the simulation?

    No ☐ Basic skills only ☐ Yes: extensive skills training/practice ☐

Table 5: Quality indicator domains by clinical simulation sessions (mean scores)

Pedagogical Principles (5.4) Max 6.	Study site 1 (Second year) (n=8)	Study site 2 (First year) (n=3)	Study site 3 (Third year) (n=6)	Total (n=17) Mean (SD)	P value
Learning objectives	1.5	2.0	2.0	1.76 (0.44)	0.063
Level of immersion	1.8	1.3	2.0	1.76 (0.56)	0.075
Scenario addressed learning objectives	2.0	1.3	2.0	1.88 (0.33)	0.007*
Student Preparation and Orientation (8) Max 12					
Students received a structured orientation	1.75	1.3	1.3	1.53 (0.51)	0.25
Students were orientated to the manikin and/or equipment to be used	1.0	0.6	1.2	1.00 (0.79)	0.67
Students were briefed about the structure of the session	1.38	1.3	1.5	1.41 (0.51)	0.86
Students were made aware of the learning objectives	1.0	1.3	1.8	1.35 (0.70)	0.08
Students were provided with preparatory materials such as lectures, tutorials, videos, online learning or readings related to the activity	1.88	2.0	1.0	1.59 (0.51)	0.002*
Students have been taught/practiced the skills needed prior to the simulation	1.5	0.00	1.3	1.18 (0.81)	0.028*
Clinical Authenticity, Relevance and Fidelity (6) Max 9					
Scenario was clinically realistic	1.75	1.66	1.3	1.59 (0.51)	0.30
Modality used supported the learning objectives	0.87	1.00	1.00	0.94 (0.24)	0.57
The manikin or standardised patient was realistically presented	1.6	2.0	1.2	1.53 (0.52)	0.56
The environment provided clinically realistic equipment	1.63	1.67	1.00	1.4 (0.62)	0.61
Hard copy or electronic medical charts and records were provided	0.50	0.33	0.00	0.47 (0.80)	0.142
Debriefing (6.5) Max 9					
Debriefing followed immediately after the simulation learning session	2.0	2.0	2.0	2.0 (0)	1.00
Students were encouraged to reflect on, and self-evaluate their practice	1.13	0.67	1.8	1.29 (0.92)	0.18
Non-technical skills were discussed during the debrief session	0.88	1.00	1.00	0.94 (0.24)	0.57
Students were given specific feedback on their strengths	0.75	0.67	0.83	0.76 (0.44)	0.86
Students were given specific feedback on their weaknesses	0.63	0.33	1.00	0.71 (0.47)	0.11
Student were given specific feedback on both strengths and weaknesses	0.50	0.33	0.83	0.59 (0.51)	0.30
Debriefing session supported students who were disappointed with their performance during the simulation learning session.	0.50	0.00	0.00	0.24 (0.44)	0.63

*P values less than 5% considered statistically significant.

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Conflict of Interest Statement

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.