



## Development of non-technical skills through virtual patients for undergraduate nursing students: An exploratory study

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### ABSTRACT

**Introduction:** Non-technical skills (NTS) are fundamental requirements for health professional graduates for safe and competent practice. Technology enhanced simulation, including virtual patients (VPs), is suggested to be effective in developing NTS.

**Purpose:** The purpose of this paper is to explore what participants learnt about NTS following interactions with the VPs in the case study.

**Design:** Case study methodology was used to explore learning by undergraduate nursing students related to NTS following interactions with VPs. First- (n = 40) and third-year (n = 31) undergraduate nursing students from two universities in Victoria, Australia agreed to participate in focus groups and interviews. These were audio-recorded, transcribed and then underwent framework analysis. A priori codes in the framework used NTS categories including communication, situation awareness, teamwork, decision-making skills, leadership, managing stress and coping with fatigue.

**Findings:** Overall, students in both years and universities reported that interactions with VPs developed knowledge and skills across all categories of NTS to varying degrees. Third-year students suggested that interactions with VPs enabled development of knowledge and skills, as well as practise of selected NTS in the clinical setting.

**Conclusion:** Interactions with VPs across the curriculum may assist undergraduate nursing students in developing knowledge, skill and practice of NTS categories including communication, situation awareness, teamwork, decision-making skills and duty, advocacy and empathy.

### 1. Introduction

Non-technical skills (NTS) are the cognitive, social and interpersonal skills associated with technical skills that contribute to safe and efficient clinical performance (Flin et al., 2013). Although their name has been contested, there is no single word that describes the cluster of essential skills (Nestel et al., 2011). Breakdowns in NTS such as teamwork, decision-making and leadership are related to adverse events in healthcare (Hobgood et al., 2010) resulting in unintentional, but at times, serious harm to patients. Traditionally, the evolution of these skills happened over time in clinical practice as the practitioner developed from novice to expert (Josephsen and Butt, 2014). However, current clinical practice environments necessitate health professionals learning these foundational abilities prior to graduation (Josephsen and Butt, 2014).

Technology enhanced simulation is suggested to be effective in developing NTS in health professionals (Unsworth et al., 2014). One form of technology enhanced simulation is the 'virtual patient'. Virtual patients (VPs) can be defined as "interactive computer simulations of real-life clinical scenarios for the purpose of healthcare and medical training, education, or assessment" (Ellaway et al., 2008, p. 1). VPs offer advantages over traditional simulation approaches, including consistent and predictable progression with outcomes driven by algorithms and feedback provided on performance (Cant and Cooper, 2014). VPs are flexible, can be repeated at times convenient to the learner (Cant and Cooper, 2014) and can be disseminated across large student populations enabling access to critical clinical scenarios for learning and practice (Posel et al., 2009). VPs build on existing learning frameworks of the millennial learner, while preparing them to engage with technology, central to nursing practice (Foronda et al., 2013).

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Further, VPs can reduce face to face teaching time and utilisation of costly resources (Cant and Cooper, 2014). However, VPs can be costly to develop and may require specific skills, expertise and resources to build and maintain. Additionally, VPs can be subject to security issues including malicious attacks and are reliant on solid and dependable internet services (Cant and Cooper, 2014).

VPs involve a variety of formats including single or multiuser environments with synchronous or asynchronous engagement. They can be situated in 3D web-based communities, text-based virtual reality systems (Foronda et al., 2013) or use gaming strategies with outcomes determined by cascading decisions (Cant and Cooper, 2014). Literature reports the dominant VP approach for developing NTS involves text interspersed with video vignettes (Peddle et al., 2016). Avatars in 3D virtual worlds and life-sized projection of digital avatars with speech recognition are also prevalent (Peddle et al., 2016).

Historically, VPs were integrated into undergraduate health professional curricula to develop knowledge and diagnostic reasoning (Cook et al., 2010). Recently, positive findings have been reported regarding use of VPs methods to develop NTS including communication, teamwork and decision-making skills in undergraduate health professionals (Foronda et al., 2013; Peddle et al., 2016). However, many studies focus on isolated categories rather than NTS as a whole, with limited studies focusing on undergraduate nursing students. Professional nursing practice is complex and most often practised as part of an interprofessional team (McKenna et al., 2014), demanding effective NTS for safe and competent practice. Therefore, it is important that students are prepared for the demands of clinical practice in relation to NTS prior to graduation. However, there is a paucity of evidence regarding application of VPs and NTS in undergraduate nursing students.

## 2. Purpose

The purpose of this paper is to explore what undergraduate nursing students learnt about specific NTS following interactions with VPs.

### 2.1. Virtual Simulated Patient Resource (VSPR)

The Virtual Simulated Patient Resource (VSPR) ([www.vspr.net.au](http://www.vspr.net.au)) is a web-based resource comprising a selection of online, interactive learning modules and VPs that can be integrated across a learning continuum. The aim of the VSPR is to develop knowledge, skills, attitudes and practice of NTS in undergraduate health professionals. The categories and elements of NTS developed by Flin et al. (2013) were used as a guide in developing the resource. The VSPR design was informed by constructivist learning theory, supporting an individual's reconstruction of knowledge and meaning, developed through prior experiences, based on new learning experiences (Grapczynski et al., 2015). Learning was designed to be student-centred, promoting learner engagement, interaction and reflection (Grapczynski et al., 2015). The research reported in this paper focuses on the VPs in the VSPR.

The VPs in VSPR belong to the narrative category portraying a patient's story as it evolves over time with a cause-and-effect approach to demonstrate consequences of actions and decisions (Bearman, 2003). This approach is suggested to depict the patient as a person, enabling representation of the psychosocial aspects of the human interaction experienced in the clinical setting (Bearman, 2003). The VPs use a “choose your own adventure game” approach. Participants are presented with a series of choices, each branching into different possibilities (Friedman, 1995). While the outcomes of decisions are predetermined by a decision tree with branching algorithm, every choice made by participants in the simulation impacts future options (Friedman, 1995). The VPs use video vignettes set in genuine clinical environments, with realistic clinical situations and representative human actors as characters. Videos are produced using a storytelling approach, enabling multiple interpretations of one situation (Saldes, 2005).

Simulation activities using VPs can be completed as self-directed or group learning activities supported by facilitator-guided, peer discussion after each video vignette and final debriefing. Participants engage in the simulations as themselves. Briefing, provided by text-based documents, presents the relevant evidence-base, along with patient history and current situation. At the conclusion of each video vignette, participants select, from two choices appearing on the screen, an appropriate option to progress the simulation. Triggered by the participant's selection, the branching algorithm determines the next video vignette in the simulation. Decisions made by participants lead to a positive or negative patient outcome. Feedback is provided from visualisation of the consequences of decisions and final patient outcomes, along with peer and facilitator discussion and debriefing when completed in group activities.

VSPR is distinguished from other web-based simulation activities, as the resource focuses on developing participants' awareness of the impact of NTS on patient outcomes along with knowledge, skill, attitudes and practice. The video vignettes contain minimal depictions of technical or procedural skills, or clinical interventions. The VPs present multiple professional perspectives, highlighting that patient safety is everyone's business. Further, the VPs present common, everyday patient care situations within acute and primary care contexts, rather than focusing on primary responses in emergency care situations. Finally, the ‘play your own adventure game’ approach enables learners to experience evolving consequences of ineffective NTS in practice. Table 1 reports the details of the simulation-based intervention. The table provides information on the key elements of the simulation and identifies the simulation exposures and how the simulation was used in the research.

### 2.2. Design

This paper reports on one aspect of a larger exploratory research project, which employed case study methodology. A case study is defined as “an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit” (Merriam, 1998). Case studies are best to describe, explore and understand phenomenon in its real-life context (Anthony and Jack, 2009). The clear and bounded case in this research is the VP from the VSPR. The exploratory case study was intrinsic in nature as the aim was to understand this particular case, the VPs in VSPR (Stake, 1995). The theoretical framework surrounding this exploratory case study was informed by the themes identified in Peddle et al. (2016) and the NTS categories developed by Flin et al. (2013), situation awareness, decision-making, communication, teamwork, leadership, coping with fatigue and managing stress. The unit of analysis in the exploratory case study was the year level of the undergraduate nursing students.

### 2.3. Population and Sampling

In Australia, a Registered Nurse requires an undergraduate degree level education. Two university nursing schools in Victoria, Australia, with active Bachelor of Nursing programs were using VSPR and both were proactive in the integration of simulation into curricula. Purposive convenience sampling was used to select participants to explore our study aims. First- and third-year students who had interacted with VPs were invited to participate. Students were recruited via invitations disseminated online through subject forums and verbal invitations at each site post-simulation activities. Recruitment occurred from March to April 2017 and was completed by the primary author (MP). Forty-five first-year and 31 third-year students consented to participate. Human Research Ethics approval was obtained for the study and guidelines adhered to throughout the study.

**Table 1**  
Key elements of the VSPR simulation (Adapted from Cheng et al. (2016)).

<b>Intervention</b>		
<b>Elements</b>	<b>Sub-elements</b>	<b>Descriptor</b>
<b>Simulation type</b>	Simulation approach	Web-based choose your own adventure game composed of video vignettes interspersed with a series of choices, each branching into different possibilities.
	Simulation functionality	Every choice made by the participants in the simulation impacts on future options available.
<b>Participant orientation</b>	Orientation to the simulation environment	As self-directed activity, the introduction to the simulation is text based. As group based activity, the introduction to the simulation activity and environment is given by facilitators using written information.
<b>Simulation environment</b>	Location	Self-directed activities completed in locations convenient to the learner. Group activities completed in allocated classrooms on campus.
	Equipment	Technologically compatible device with stable internet connectivity with additional audio-visual display equipment in group based activities.
	External stimuli	Stimuli in video vignettes is representative of realistic clinical situations including machinery alarms, telephone calls, visitors and significant others and overhead paging and announcements.
<b>Simulation event scenario</b>	Event description	The activity was governed by written instructions as guidelines for facilitators to support consistency of participant experience.
	Learning objectives	Learning objectives for the activity include: Apply knowledge and skills of non-technical skills to realistic clinical situations. Explore potential consequences of failures in non-technical skills in clinical practice.
	Group vs. individual practice	Activities were conducted in groups and as self-directed learning activities.
	Use of adjuncts	Moulage was utilised in preparing actors for patient roles including for example traumatic injury, bleeding wounds and suture lines.
	Facilitator/operator characteristics	All facilitators were experienced clinicians and/or educators and were required to attend orientation to the subject and facilitating the simulation.
	Pilot testing	Pilot testing of all simulations was completed during development and construction of the Virtual Simulated Patient Resource.
	Actors	All persons but two involved in the scenarios were professional actors. All scenes were scripted.
<b>Instructional design or exposure</b>	Duration	Scenarios completed as self-directed activities had no time limitations. Virtual Patient Simulations were allocated one hour during class based activity.

(continued on next page)

Table 1 (continued)

<b>participant groups</b>	Timing	Data collection occurred immediately after completion of the Virtual Patient Simulation as a group based activity.							
	Frequency/repetitions	Student can access the resource at any time with unlimited repetitions.							
	Clinical variation	Multiple different patient scenarios including multi-professional acute care, primary health care and obstetric specific. Year one students completed the Falls scenario. Year three students completed either the Falls, Aggressive Patient, Administering Blood Products (self-directed) Teamwork (self-directed) and Post-operative simulation or the Falls and Teamwork simulations.							
	Adaptability of intervention	Each simulation was consistent with predictable progression based on branching algorithms across all participant groups.							
	Range of difficulty	Simulations in the VSPR cater for varying levels of learning needs across the learning continuum. For nursing programs							
		<table border="1"> <thead> <tr> <th>LEVEL</th> <th>SCENARIO</th> </tr> </thead> <tbody> <tr> <td><b>YEAR ONE</b></td> <td>Falls and Aggressive patient scenarios.</td> </tr> <tr> <td><b>YEAR TWO</b></td> <td>Administering blood products and Teamwork scenarios.</td> </tr> <tr> <td><b>YEAR THREE</b></td> <td>Obstetric, Post-operative patient and Warfarin in the community scenarios.</td> </tr> </tbody> </table>	LEVEL	SCENARIO	<b>YEAR ONE</b>	Falls and Aggressive patient scenarios.	<b>YEAR TWO</b>	Administering blood products and Teamwork scenarios.	<b>YEAR THREE</b>
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Nonsimulation interventions and adjuncts	<p>Prior to participating in the simulations students had completed:</p> <p>Year one students - an introduction to non-technical and communication skill online module and one 1-hour recorded lecture.</p> <p>Year three students - introduction to non-technical skills, communication, teamwork, situations awareness, and decision making online modules with three 1-hour recorded lectures.</p>								
<b>Feedback and/or debriefing</b>	Integration	Simulations were integrated into purpose designed points of current curriculum where contexts of care, clinical topics, complexity of scenario and learning outcomes aligned with simulations.							
	Source	Feedback mechanisms include visualisation of the consequences of choices made and the patient outcome, along with peer and facilitator discussion when completed as group activities.							
	Duration	The simulation activity including debriefing was to be completed in one hour.							
	Facilitator presence	One facilitator was present for classroom based activities.							
	Facilitator characteristics	Facilitators were Registered Nurses and female. All facilitators were orientated to the simulation and provided a facilitator guide. All debriefing was student centred.							
	Content	Non-technical skills.							
	Structure/method	<p>Phases of debriefing included:</p> <ul style="list-style-type: none"> <li>• A reactions phase,</li> <li>• Discussion of the clinical considerations of the situation,</li> <li>• Discussion of nontechnical skills demonstrated, missing and/or ineffective in the simulation,</li> <li>• Identification of areas for improvement and what to do differently next time.</li> <li>• Summary of participant learning</li> </ul> <p>Note: Phase 2 and 3 can be completed in any order. Questioning techniques utilised Advocacy Inquiry approaches.</p>							
	Timing	Discussion of events depicted in the scenarios occurred sequentially though the simulation after each video vignette. The simulation was summarised with a concluding debrief.							
	Scripting	A written guide to support facilitation and debriefing of the activity was disseminated to all facilitators.							

### 3. Methods

#### 3.1. Data Collection

As part of the case study design, data collection focused on qualitative data collected from focus groups and interviews. A semi-structured topic guide was developed to explore students' perceptions and experiences of interacting with the VPs. The topics and techniques were piloted, with revisions made to ensure relevant data was obtained. Box 1 identifies focus group topics (available online).

Ten focus groups and one individual interview were conducted with first-year students and 6 focus groups, including two regional, and one individual interview, with third-year students. Focus groups with first-year students and the interview ranged from 14 to 37 min duration and with third-year students from 20 to 53 min duration. Focus group numbers ranged from two to nine students. All focus groups and interviews were facilitated by the first author (MP) except one, which due to timing conflicts was facilitated by local faculty on site using the same topic guide. Focus groups were conducted face-to-face, in a private room at a time convenient to the participants, except one that was facilitated via video-conferencing to a regional area. Contextual notes were made along with reflections post-sessions. Audio-recordings were professionally transcribed. Other demographic data such as year level, prior experience in healthcare and VPs completed was also collected. Written consent was obtained prior to participating.

#### 3.2. Data Analysis

Framework analysis was used to analyse data supporting consolidation, reduction and interpretation of data as per case study methods (Yazan, 2015). Framework analysis can be “adapted for use with deductive, inductive, or combined types of qualitative analysis” (Gale et al., 2013, p. 119) and provides a useful tool to organise text assisting in interpretation (Fereday and Muir-Cochrane, 2006). The aim of the coding process was to classify all data so it could be systematically compared (Gale et al., 2013).

The aspect of the case study reported here focussed on exploring what nursing students learnt about particular NTS. The conceptual organisation of the case study used the NTS categories developed by Flin et al. (2013) as theory-driven a priori codes guiding deductive analysis. One author (MP) coded all transcripts (n = 18) in NVivo. Inductive data analysis enabled recognition of data-driven codes that were discussed and added on consensus. Data coded was examined by MP and LM for coherence, consistency and fit. An extended summary of each code was developed with illustrative quotes selected from different units of analysis to identify similarities or differences amongst the level of leaners and their experiences with the VPs and perceptions of NTS. Revision of the extended analysis by MP and LM prompted codes to be reorganized and renamed upon consensus with identification of final categories and subcategories.

#### 3.3. Findings

Overall, students from both years and universities reported that interactions with VPs developed knowledge and skills of all categories of NTS to varying degrees. Third-year students suggested that interactions with VPs enabled development of knowledge and skills, as well as practise of NTS in the clinical setting.

Seven NTS categories were recognised, with 27 sub-categories identified in the data. In reporting findings, Y1-FG1 to Y1-FG10 and Y1-Int refer to focus groups and individual interview with first-year students, whilst Y3-FG1 to Y3-FG6 and Yr3-Int refer to focus groups and individual interview with third-year students.

#### 3.4. Communication

Communication was the most referenced NTS category developed across both year levels. Sub-categories included: *importance of communication, communication strategies in practice, taking communication skills for granted* and *communication with the patient* (Table 2). Students specified interactions with VPs highlighted how important communication skills are for safe patient outcomes with descriptions of poor communication skills and associated outcomes. Students acknowledged they often took communication skills for granted as they perceived communication as a ‘simple’ skill already mastered. However, interactions with the VPs ‘opened their eyes’ to the role of effective communication in healthcare. Students identified specific strategies for implementation in practice with third-year students describing specific communication strategies implemented in practice. First-year students highlighted the VPs made them aware of the importance of effective communication with patients, however third year students did not highlight this.

#### 3.5. Situation Awareness

Most students reported that their level of situation awareness increased following interactions with VPs. Sub-categories included: *increased level of awareness, gathering data, managing distractors and the deteriorating patient* (Table 2). Most students reported that they had more clarity about what they were looking for in practice and greater awareness of what was going on around and with their patients, including the impact of distractions in the clinical setting. Students identified the importance of gathering all relevant data to generate a complete picture. Third-year students specifically identified interactions with VPs developed abilities to recognise patient deterioration by identifying trends.

#### 3.6. Teamwork

Interactions with VPs developed students' understandings of effective teamwork. Sub-categories included: *working as a team, teamwork skills, patient as a member of the team and teamwork in action* (Table 2). Interactions with VPs facilitated students' appreciation that patient care requires all health professionals to work together to maximise patient outcomes. Students recognised the importance of interacting and connecting with others, role clarity, seeking support from others and mutual respect as important in effective teams. Students described barriers to teamwork and impacts on patient outcomes. However, only third-year students highlighted the importance of the patient being included as a member of the team and reported that they had recognised teamwork in the clinical setting.

#### 3.7. Decision-making

Focus groups identified interactions with VPs facilitated understanding of decision-making. Sub-categories included: *stop and think, the decision-making process, consequences of decisions, decisions from the driver's seat and making decision points more grey* (Table 2). Some students reported interactions with VPs made them actually stop and think about decisions and the potential consequences, rather than just act. Students reported interactions with VPs highlighted the decision-making process with students enjoying making decisions from the ‘driver's seat’ and feeling in control of the situation. However, some third-year students felt the options presented to advance the simulation were limited while others indicated the options were too ‘black and white’.

#### 3.8. Leadership

Learning related to leadership from interacting with the VPs was reported less with sub-categories identified including: *guidelines and protocols, accountability and situational leadership* (Table 2). Both year

**Table 2**  
Categories and sub-categories of the NTS reported by students in the VPs.

Communication	Importance of communication	"I don't think anybody realises how important communication is when you're working in such a big organisation, such as a hospital. ...you just always think about skilled, you know, you just always think about your clinical, your procedural; but you don't really think in detail about communication and how vital it is in a workplace" (Y1-FG3).
	Communication strategies in practice	"How important to listen. ... To listen to the patient. To listen to your colleagues" (Y1-FG5). "And they made me think right for this [ISBAR] I need to reflect and back and I need to include that, that and that" (Y3-FG1).
	Taking communication skills for granted	"...you know we talk about communication all the time and how we all know how to communicate (sarcastic)! But then when you do watch it, it's like ah ... you kinda pick up little things" (Y3-FG1)
Situation awareness	Communication with the patient	"Communication. Definitely, communicating, not only with other staff members but with the patient" (Y1-FG11).
	Increased level of awareness	"...it would develop more awareness wouldn't it. Sort of what to look out for when you are doing your work." (Y3-FG3).
	Gathering data	"... it is important to go back and do all of that stuff and get the bigger picture" (Y1-FG6).
	Managing distractors	"She had to pick up a [phone] call so ... you say – 'What should I do?' Should I pick up phone call because its work and they are waiting for an answer, or should I do my job slowly and then I will [answer] the phone" (Y1-FG1).
	The deteriorating patient	"And just like identifying trends and potential outcomes ... you did notice trends aww like it's only a little bit worse but it's obvious that its declining" (Y3-FG3).
	Teamwork	"... everyone needs to work together. It's not individual; we all need to work together; that's what I saw" (Y1-FG3).
Teamwork	Working as a team	"It really breaks down between all the staff like doctors and nurses and the patient too" (Y3-FG5)
	Teamwork skills	"... but you have to work with other members of the team, to get the whole picture, including the patient. That's important, yeah" (Y3-FG4).
	Patient as a member of the team	"...on one of my placements there was a MET call. You could see ... the team work" (Y3-FG2).
Decision-making	Teamwork in action	"It makes you think a lot about each decision you make along the pathway" (Y3-FG1).
	Stop and think	"Making sure that you have all the information before you go off 'half cocked' and make calls by yourself" (Y1-FG6). "You have to consider all the options ... It sort of gets you thinking about every sort of outcome" (Y3-FG2).
	The decision-making process	"...it felt like you were in control of choosing what happened. If you picked the wrong things, the patient's outcome would be affected, either positively or negatively" (Y3-FG5).
	Consequences of decisions	"We were the ones making the decisions ... it was almost like we were in the room and we were the ones making the call" (Y1-FG6).
	Decisions from the driver's seat	"Make it more grey, just a couple of more options of things we could do" (Y3-FG5).
	Make decision points more grey	"If there's no communication and there's no proper guidelines and protocols followed" (Y3-FG6).
Leadership	Guidelines and protocols	"You felt like you were in charge of it and if you did something wrong you were liable for it" (Y1-FG8).
	Accountability	"But to see like all the different roles ... What you should be doing ... delegation and that stuff" (Y3-FG3)
	Situational leadership	"It makes you wonder about the practicalities in the workplace, like it takes that much time to do one simple little task. You can see how people are going to be rushing. When you've got to attend to so many people, you know, he's scrambling all the time to attend to everyone. I don't know how they get through it all" (Y1-FG7).
Stress and fatigue	Competing demands	"I just suppose it comes to things like how long was his shift, if it was late at night, if his shift was already over and he'd worked ... We all know if we've worked long shifts the last thing you want to do is stay back" (Y1-FG8).
	Experiencing fatigue	"I work in pharmacy so I sort of get you can get really busy at times and forget to give people the right information. ... So, you need to make sure that everything you do, no matter how busy you are or how under the pump, your patient is the number one so you have to make sure that you ask all the questions, no matter what it is" (Y1-FG8).
	Stress in practice	"I feel like they do live up to that standard of being professional in the environments; especially towards their patients and to colleagues as well" (Y1-FG3).
Professional practice	Performing to a standard	"You can't have bias and you need to be empathetic and have those characteristics and really be professional and stuff like that" (Y1-FG8)
	Recognising empathy	"were taught to advocate on behalf of ourselves, our colleagues and the patient and I think it's a fantastic incentive" (Y3-III).
	Advocacy for patients and colleagues	"They have a very major role because if you don't have those skills then you can't apply your technical skills 100%. ... Because if you can't communicate, if you can't convey the message, okay, I want to do this dressing this way and why, there is no point of having a technical skill - you can be a best person to heal the wound but if you can't communicate or convey that ..." (Y1-FG10).
	Complement technical skills	

levels identified risk to patient outcomes from poor leadership demonstrated by not following guidelines or protocols. First-year students described how interacting with the VPs raised their awareness of open disclosure and being accountable for decisions. However, third-year students appreciated the depiction of situational leadership and delegation skills.

### 3.9. Stress and Fatigue

Reference to categories of stress and fatigue was significantly less compared with other categories. Sub-categories identified included: *competing demands* and *experiencing fatigue* and *stress in practice* (Table 2). Interactions with VPs enabled some students to realise how competing professional demands and high patient care loads create stressful environments in hospitals. First-year students identified that interacting with the VPs portrayed the role fatigue plays in performance.

### 3.10. Professional Practice

Some students identified that interactions with VPs highlighted

professional practice, with sub-categories including: *performing to a standard*, *recognising importance of empathy*, *advocacy for patients and colleagues* and *the complementary role of NTS with technical skills* (Table 2). Students described a sense of duty to the patient and the importance of empathy and advocacy for patients, with third-year student identifying advocacy for colleagues. Some students identified how technical and NTS complement each other and the important role each plays in professional practice and safe patient care.

## 4. Discussion

Within this case study, the exploration of how VPs influenced NTS, students identified that interaction with VPs developed their knowledge and skills of communication, situation awareness, teamwork and decision-making skills. To a lesser extent, students reported developing awareness of leadership skills, while managing stress and coping with fatigue were only minimally described. Students also reported developing professional skills including humanistic attributes of duty, advocacy and empathy. However, variance in the complexity of NTS learning across the year levels was noted. First-year students described fundamental development of NTS knowledge and skill, with limited

depth in understanding across all categories. Whereas, third-year students revealed greater sophistication to learning, describing nuances across NTS categories and associated implementation of knowledge, skills and attitudes related to communication, situation awareness and teamwork skills in practice.

The findings of this case study, exploring how VPs influenced NTS, suggests undergraduate nursing students perceive interactions with VPs can develop practise of NTS in categories including communication, teamwork, decision-making, situation awareness, leadership and professional practice. The findings present significant opportunities for nursing education, as VP approaches can be distributed across large, diverse student populations, are more flexible, consistent and can be repeated at times convenient to the learner. Further, application of VPs may reduce costs and enable engagement of larger student cohorts than traditional simulation approaches.

Students from both year levels identified particular communication strategies, such as speaking up and active listening, that were important in professional practice. Additionally, third-year students identified specific communication strategies such as Introduction, Situation, Background, Assessment and Recommendations (ISBAR) and situation awareness skills to identify deteriorating patients, they applied in practice. While there is substantive literature regarding simulation and learning outcomes, there is limited evidence regarding transfer of learning to the workplace (Boet et al., 2014). The findings of this case study, exploring how VPs influenced NTS, suggest learning developed via interactions with VPs is integrated into the practice of students and implemented in the clinical setting.

Students expressed taking communication skills in practice for granted. Communication skills were perceived as second nature and 'already mastered', requiring little further development and refinement. Taking communication skills for granted is a reported phenomenon in healthcare professionals (Daff, 2012; Tremayne, 2017) which can generate competency and skill deterioration over time (Haq et al., 2004; Saperstein et al., 2017). However, in this the case study, exploring how VPs influenced NTS, students described how interactions with VPs emphasised effective communication requires practise to ensure adequate, appropriate and accurate information is exchanged at the correct time. VPs may present an effective resource for maintaining focus on effective communication skills in undergraduate nursing students to support patient safety.

Some students stated they were conscious of being more aware in practice and had more clarity about what to look for following interactions with VPs. Situation awareness in nursing students is crucial, however it is an underdeveloped concept in undergraduate nursing curricula with low levels of situation awareness reported in final year nursing students (McKenna et al., 2014). Third-year students highlighted interactions with VPs improved their ability to identify patient deterioration via recognition of changes, trends and patterns. Resources, such as VPs, with capacity to improve students' abilities to identify deteriorating patients, would be a valuable addition to undergraduate nursing education.

Third-year students described effective teams in action in the clinical setting and were particularly conscious of inclusion of the patient as a member of the team following interactions with VPs. This facet of teamwork is minimally reported in nursing literature. Arguably, the patient has the most important role in the healthcare team (Frosch, 2015). Educational resources such as VPs, that facilitate health professionals to empower patients in teams, are fundamental to ensuring patients having active participation in their care (van Dongen et al., 2017).

Decision-making is fundamental to nursing practice and is often undertaken in time pressured, uncertain situations (Johansen and O'Brien, 2016). However, undergraduate nursing students rarely experience the obligation and liability of making decisions on their own in practice (Kumaran and Carney, 2014). This case study, exploring how VPs influenced NTS, suggests interactions with VPs enables students to

make independent decisions and experience consequences of decisions made. However, third-year students identified the decision options presented in the VPs as limiting and too black and white. Additional experience seems to develop awareness in students of alternate solutions and pathways. Hence, it is possible the VP decision pathways may not suit more experienced learners.

A lack of experience in accountability and responsibility has been identified as a significant stressor for new nursing graduates (Kumaran and Carney, 2014). The opportunity to experience accountability and responsibility may assist transition to graduate practice. In this case study, exploring how VPs influenced NTS, students expressed experiencing being accountable for patient outcomes, with first-year students particularly interested in repercussions following an adverse event. However, third-year students who only had a few months until graduation and independent practice, were more interested in situational leadership skills, including delegation and role clarity.

The NTS of managing stress and coping with fatigue were not well identified by students in this case study exploring how VPs influenced NTS. Limited students identified sources of stress in practice and potential impact of fatigue on practice. However, signs and symptoms of stress and fatigue, and coping strategies were absent from focus groups and interviews. These outcomes may be because the VP scenarios did not emphasise the topics of fatigue and stress, or that VPs may be less suitable to develop these NTS in undergraduate nursing students.

Humanistic traits such as empathy and advocacy are noted to be an important requirement for patients (Richardson et al., 2015), essential for establishing rapport, enhancing patient satisfaction with links to positive clinical outcomes (Williams et al., 2014). Findings from this case study exploring how VPs influenced NTS, identified that VPs can elicit emotional and empathic responses from undergraduate nursing students. These findings are supported by the findings of a systematic review reported by Bearman et al. (2015) that suggest simulation, including VPs, may be useful in developing empathic behaviours in undergraduate students. These findings also align with those reported in the review by Peddle et al. (2016) suggesting that VPs may have the ability to develop students' empathic skills.

#### 4.1. Strengths and Limitations

The strengths of the research relate to adherence to case study methodology and data collection across two sites and two year levels, with analytical suppositions to guide data analysis that are accepted in clinical practice. Categories and sub-categories were constructed by MP and LM with conflicts resolved through discussion and consensus from all authors. The naturalistic setting of the study, along with data sources across two-year levels, units of analysis, at two sites, supports transferring findings to other student cohorts. While this paper report reports one aspect of larger case study, it provides insight into students' perceptions and practice of NTS after engaging with the VPs, caution must be exercised as focus group composition may not be representative of the wider population and there is risk that data arises from dominant participants. It is also important to note that the lead author contributed to the design and development of the VSPR.

This research focused on undergraduate nursing students. Further research is required to investigate the perceptions and experiences of students from other professions following interactions with VPs. The relationship between quantity of clinical experience and decision-making process warrants investigation to enable insight into the decision-making nuances of more experienced students to ensure learning resources offer suitable complexity to optimise learning. Finally, to confirm the suggested benefits in teaching and learning afforded by interactions with VPs to develop NTS knowledge, skills and practice are likely, a comparison between outcomes of face to face simulation experiences and VPs may be warranted.

## 5. Conclusion

The findings of this aspect of the case study which explores how VPs influenced NTS, suggests integrating interactions with VPs across a curriculum assisted students in developing knowledge, skill, attitudes and practice of NTS categories including communication, situation awareness, teamwork, decision-making skills and humanistic attributes of duty, advocacy and empathy. Students perceive that leadership skills are developed to a lesser extent, with minimal learning related to managing stress and coping with fatigue. These findings point to the value of VPs in developing safe and competent practice and, ultimately, enhancing patient safety.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.nedt.2018.11.008>.

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