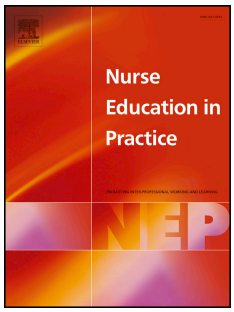
Accepted Manuscript



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PII: S1471-5953(17)30815-6

DOI: https://doi.org/10.1016/j.nepr.2019.02.011

Reference: YNEPR 2526

To appear in: *Nurse Education in Practice*

Received Date: 16 November 2017

Revised Date: 24 May 2018

Accepted Date: 16 February 2019

Please cite this article as: Gluyas, H., Stomski, N., Andrus, P., Walters, J., Morrison, P., Williams, A., Hopkins, M., Sandy, M., Performance based situation awareness observations in a simulated clinical scenario pre and post an educational intervention, *Nurse Education in Practice* (2019), doi: https://doi.org/10.1016/j.nepr.2019.02.011.

Performance based situation awareness observations in a simulated clinical scenario pre and post an educational intervention

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There are no acknowledgements associated with this work.
There was no financial support was received by a third party for this study.

ABSTRACT

This study compared final year nursing students' error rate and use of strategies to maintain SA when undertaking specific nursing care in a simulated clinical environment pre and 10 weeks post a planned SA education intervention.

Students were observed using a Performance Based Situation Awareness Observation Schedule (PBSAOS) undertaking two tasks in a simulated clinical environment pre and post the SA education.

For task 1, post educational intervention, there was no significant increase in the error rate for any performance measures, and there were significant decreases in the error rates for three performance measures. For task 2, post educational intervention, there was a significant decrease in the error rate for two measures and a significant increase in the error rates for seven performance measures.

In considering the overall group error rate when excluding uncompleted tasks, there was a significant (x =.0001) decrease in the error rate for task 1 post educational intervention (41.4% compared to 26.6%), and significant (x =.01) increase in the error for task 2 post educational intervention (39.6% compared to 47.3%).

The findings of this study demonstrate that the implementation of an intervention designed to increase SA actually appear to have resulted in hyper-vigilance and subsequent non-completion of required tasks.

Keywords

Situation awareness; Nursing; Education; Error; Simulation

Introduction

The education of health professionals, including nurses, has for many years focused on the teaching of the technical psychomotor skills and the evidence-based knowledge that underpins the understanding and application of the technical skills in clinical practice (Mansour, 2013). In nursing, these technical skills would include physiological observations, physical assessment, medication administration, and wound management. However, it has become increasingly evident in recent years that even with a highly educated and technically competent health professional workforce, there remains the problem that one in ten patients will suffer and adverse event, one in five of those will be serious, and one in three of those will die (IOM, 2000; Wilson et al., 1995; Wilson and Van der Weyden, 2005). Efforts to improve the safety of healthcare have focused on identification and improvement of error provoking systems and organisational factors, as well as increasing the proficiency of health practitioner technical skills and knowledge.

While improvement in system and organisation factors and, know-how and technical skills are vitally important in the preparation of competent and safe health professionals, it is recognised that non-technical skills also play an integral part in mitigating the likelihood of errors that results in a patient experiencing adverse events (Brady and Goldenhar, 2014; Gillespie et al., 2013; Stubbings et al., 2012). Such non-technical skills include situation awareness (SA), which relates to how we handle and process information about what is going on around us; teamwork; communication; and, managing authority gradients. These skills are important in preventing errors and accidents.

The importance of SA and other non-technical skills in mitigating errors and adverse events has been recognised by safety critical industries such as aviation, oil and gas, defence and nuclear for several decades (Carayon, 2012; Endsley, 2012; Flin et al., 2008). As the understanding of the role that non-technical skills play in minimising errors increases, it is apparent that there is a need to teach health practitioners these skills rather than assume that they will be developed through clinical experience (Flin et al., 2008; Milligan, 2007).

There is limited literature focused on SA in nurses' planning and decision-making when delivering nursing care (Stubbings et al., 2012). However, several studies have identified that there is very little explicit inclusion of patient safety education including non–technical skills within nursing undergraduate curricula (Attree et al., 2008; Mansour et al., 2015; Tella et al., 2014; Tregunno et al., 2014). In the main, nurses have more patient contact compared to other health professionals and are well placed to notice and mitigate potential errors at the sharp end of healthcare (Chenot and Daniel, 2010). Thus, there is a compelling argument to increase the focus on educating nurses about non-technical skills including SA (Flin et al., 2008).

Situation Awareness

Situation awareness represents an individual's perception, comprehension, and subsequent projection of what is going on in the environment around them (Endsley, 1995). It involves three levels of cognitive performance:

> Level 1- perceptions of elements in the environment
>
> Level 2-comprehension of the current situation
>
> Level 3- projection of future status (Endsley and Jones, 2012: pg14)

There are many factors that can have a negative influence on successful SA. These factors can be related to the context of the situation, individual factors, and particular cognitive processing factors that lead to poor SA (Gluyas and Morrison, 2013).

Environmental factors that impact include workload, noisy environments, poor teamwork, and poorly designed work places and equipment (Endsley, 2012). These can increase stress on the working memory capacity and result in poor scanning of the environment. Also, distractions and interruptions are context factors that notably impair maintenance of SA (Thomas et al., 2015). Individuals rely heavily on working memory to process information to maintain SA. Unfortunately, the working memory has very limited capacity for storage and is limited in ability to hold onto information (Baddeley, 2010; Eriksson et al., 2015). Thus interruptions and distractions lead to rapid decay of the information that is in the working memory as it is replaced with the sensory information that has captured attention from the distraction or interruption (Flin et al., 2008).

Individual factors such as anxiety, illness, fatigue and negative life events may also affect working memory capacity(Endsley, 2012). As well, the experience and skill within the context in which the individual is working impacts directly on the mental models available in the long term memory for perception (what cues should be noticed), comprehension stage (pattern matching to understand what is happening) and the projection stage (predicting what might happen) (Endsley, 2012).

From a cognitive perspective, accurate SA relies on the individual being able to cognitively process many different pieces of information at the same time. Issues with cognitive processing can arise which include attentional tunnelling, limitations of capacity, information overload, and sensitivity to certain types of noise, light, and colour(Endsley, 2012). As well, the capability humans have to undertake familiar tasks automatically with little cognitive attention can result in poor SA, as changes in the situation are not noticed. (Endsley, 2012; Flin et al., 2008; Gluyas and Harris, 2016)

Situation Awareness Education

The basic principles that underpin SA and strategies to improve SA can be taught to individuals (Endsley, 2015). This encourages individuals to improve skills in this area and to recognise conditions that may impinge on accurate SA. Many of the organisational and systems factors that weaken SA such as workload, inadequate or poorly designed equipment and poor working conditions may be beyond individual's sphere of influence to change. However, understanding the negative affect of organisational, system, and

individual factors on the development and maintenance of SA can assist the individual to improve SA (Brady et al., 2013; Gartenberg et al., 2014; Salas et al., 2008; Stubbings et al., 2012).

This paper reports the results of a study exploring undergraduate final year nursing students' error rate and use of strategies to maintain SA when undertaking specific nursing care in a simulated clinical environment pre and post a planned intervention SA education program.

Methods

This study used a single-group, two-time point repeated measures design. Observations were undertaken before a planned SA educational intervention and 10 weeks after. In the intervening 10 weeks students undertook a six-week clinical practicum (Figure 1). During the clinical practicum students were sent emails reminding them of the SA strategies that had been discussed during the education program (Figure 2). The University's Human and Research Ethics Committee approved the study 2016/009.

Setting/ Participants

The pre and post intervention SA observations for this study took place in in the clinical simulation suite at a West Australian university. The simulation suite replicates a seven-bed ward, where nursing students can plan and provide the care for allocated patients. There is

a one-way observation window in the control room overlooking the ward, which gives general visibility of the student workspaces

The sample was a convenience sample with participants recruited from the cohort of final year nursing students enrolled in nursing clinical practice units. These units involve a series of workshops in the simulation suite, which occur regularly over the final two semesters of study for the nursing students. All students were offered the opportunity to take part in the study. Participation was voluntary and students were advised they could withdraw at any stage with no adverse consequences to their enrolment or marks. Of those who consented (n=96) only the students in each workshop who were working in the bed spaces closest to the observation window were observed to ensure uninterrupted vision of their activities. In total, 25 students were observed pre and post SA training intervention.

For the pre-intervention observations, the students were allocated to each bed space by the supervisor by allocating every fifth student who entered the room to the bed space closest to the viewing window. The same students were allocated to the bed space closest to the viewing window to be observed post intervention. There was no interaction between the students and the observers (who were behind one-way mirrors). Moreover, because students were not told in which workshops out of the 17 workshops over the two semesters observations would occur, or that only students closest to the one-way mirror would be observed, students were not aware that they were being observed (Figure 3).

Instruments

A structured performance based situation awareness observation schedule (PBSAOS) was developed using performance based SA measurement based on the work of Pritchett and Hansman (2000) and adapted to the clinical context.

Pritchard and Hansman (2000) describe three different types of performance based SA measures:

- Imbedded task measures-procedural steps that demonstrate unambiguous expected or required actions for the task
- Global measure – measures of final performance outcome
- External task measures- expected reactions to external impacts on task completion such as interruptions, distractions or changed information

These descriptors guided a detailed task analysis undertaken by the research team to identify unambiguous proceduralised performance-based actions and outcomes as an indication of a person's SA in the clinical scenario (Endsley, 1995; Pritchett and Hansman, 2000; Wright et al., 2004a). In this observed clinical scenario, the absence of task actions and outcomes (imbedded and global measures) indicated an error. For task 1, there were 20 possible errors comprising 19 imbedded and 1 global performance based measures (Figure 4). For task 2, there were 26 possible errors comprising 21 imbedded and 5 global measures (Figure 5). The presence of actions, observed within the section focused on performance based external measures, indicated the student was using strategies to maintain or increase SA. There were 4 performance external measures for both task 1 and 2. (Figure 4 & 5)

The schedule provided fields for the observers to tick if the identified, imbedded global or external task measures for each task was observed during the simulation scenario. As well, observers were able to write comments about what they were observing.

The PBSAOS was developed by expert nursing clinicians and evaluated to ensure clarity, consistency and content validity by a panel of nursing clinical supervisors. The development and validation process for the PBSAOS tool is reported in more detail elsewhere.

The observers undertook a specialised training program to ensure accuracy and consistency. This program included theoretical and practical training before the implementation of the educational intervention and attendance at a refresher and practical skills training session before the post-intervention observations. The consistency and accuracy of the recorded observations was examined through an additional observer replaying video-recordings of the workshops and checking observations for each task. The Kappa coefficient was calculated to establish the inter-observer reliability. The results demonstrated that the Kappa coefficient ranged from 0.4 to 0.6 for five sets of observations, indicating good agreement, whereas for the remaining 22 sets of observations the Kappa coefficient exceeded 0.6, indicating substantial agreement.

Simulated Clinical Scenario

Students were given a clinical scenario that directed them to complete certain clinical tasks and assessments of the simulated patient. Students were required to complete two tasks within the simulated clinical scenario of caring for a patient post surgery. Task 1 involved pain assessment and analgesic administration, and task 2 involved assessment and management of the patient's changed clinical status after analgesic administration. A supervisor was always present in these workshops to answer questions and give directions if required.

The clinical scenario also included interruptions and distractions that realistically reflected a busy ward environment. The interruptions comprised a patient care attendant offering the patient refreshments and asking students if the patient was allowed fluids; a staff member asking if the students had the schedule 8 medication keys, and on another occasion asking the students if they knew where a particular doctor was. These interruptions occurred during medication administration for both task 1 and 2, and also during the handover communication with the doctor. Also, a bedside alarm rang every 3-5 minutes, which the students had been asked to reset each time it went off. Other distractions were present but not planned as part of the study, including other students engaging the observed students in conversation, visitors to the simulation suite walking through the clinical setting, and other staff walking into the suit looking for equipment or other staff members. These events are typical of any busy surgical unit

Situation Awareness Training Intervention

The SA training comprised a two- hour interactive tutorial at the beginning of the second semester. Students were introduced to basic principles that underpin accurate SA, organisational and situation factors that erode SA and promote errors, and strategies that maintain SA. Also, videos and interactive scenario problem solving were utilised to provide opportunities for students to apply SA strategies to potentially error provoking situations.

Data Analysis

All quantitative data were analysed in SPSS v.22. For each of the simulation scenario performance measures, a value of 1 was assigned if the performance measure was completed correctly, and a value of 0 was assigned if the performance measure was completed incorrectly or if the task was not completed within the required time frame. McNemar's test was used to examine differences in the error rate before and after the delivery of educational intervention for each of the simulation scenario performance measures. In addition, a chi-square test was used to examine differences in the overall group error rate for task 1 and task 2 pre and post administration of the educational intervention. Finally, qualitative data derived from the observers' free text comments were thematically analysed.

Results

Demographics

In total, 25 students completed the simulation scenario both before and after the delivery of the SA educational intervention. The mean age of the students was 30.5 (SD= 8.0) years, and 81.0% were female.

Student Error rate and use of SA Strategies in Simulation Scenario

Tables 1 and 2 (Appendix 1) display the full results for the completion of each of the performance measures in task 1 and task 2 of the simulation scenario before and after the delivery of the SA educational intervention.

For task 1, subsequent to the administration of the educational intervention, there was no significant increase in the error rate for any performance measures, but there were significant decreases in the error rates for the following performance measure: “checks right time”, “IMI analgesic in correct anatomical location”, and “provides call bell” (Table 3).

For task 2, subsequent to the administration of the educational intervention, there was a significant decrease in the error rate for the “performs pre hand hygiene” and “checks dose” performance measures (Table 4). As well, there were significant increases in the error rates for the following performance measures: “lowers patient to check hypertension”; “increases

IVT"; "checks allergies"; "draws back"; "disposes of sharp"; "documents oxygen therapy on observation chart"; and "documents antiemetic" (Table 5).

In considering the overall group error rate when excluding uncompleted tasks, there was a significant (x =.0001) decrease in the error rate for task 1 post educational intervention (41.4% compared to 26.6%), and significant (x =.01) increase in the error for task 2 post educational intervention (39.6% compared to 47.3%).

Finally, the use of SA strategies (the external measures of the PBSAOS) showed no significance increase from pre to post education intervention.

Observer free text comments

Two main content areas emerged that captured SA strategies: reaction to distraction/ interruptions and length of discussions. In both pre and post educational intervention observations, it was noted that distractions or interruptions were often associated with an error in automatic tasks such as the "six-right" checking for medication or performing hand hygiene at the appropriate time. In terms of the theme discussion time, observers noted that after the education intervention students spent more time discussing the safety risks and possibilities of error for different performance measures.

Discussion

Errors Task 1

Task 1 involved pain assessment and analgesic administration. The results of the post education intervention showed a significant decrease in error rates in several areas for task 1 , and a significant decrease in overall error rate for task 1. The performance measures that demonstrated significant reductions in error rates were all imbedded task actions involving automatic procedural steps. Previous research has reported that automatic procedural steps are particularly sensitive to error provoking situations such as distractions and interruptions (Gartenberg et al., 2014; Prakash et al., 2014). SA strategies mitigate the impact of distractions and interruptions, and as such should reduce errors associated with automatic procedural steps (Goldenhar et al., 2013). Our findings did not identify significant increases in the use of SA strategies, despite the significant reduction in errors rates for automatic procedural steps. This is likely related to the measures used in the PBSAOS, which are behaviour and outcome based, and do not directly measure the three levels of cognitive processing (perception, comprehension and projection) involved in maintenance of SA. Instead, assessing the accuracy of cognitive aspects of SA must be inferred from the results of the observations (Bell and Lyon, 2000; Wright et al., 2004b). While this could be perceived as a disadvantage, other methods of measuring SA using knowledge based or verbalisation measures, also have limitations in that they do not necessarily predict final performance of the individual and can in themselves be distracting to the individual's performance (Pritchett and Hansman, 2000).

Errors Task 2

Task 2 involved assessment and management of the patient's changed clinical status after analgesic administration. Task 2 showed a significant increase in the error rate of seven performance-based measures, and an overall increase in the error rate for task 2. Much of the increase in error rate for task 2 owed to the non-completion of performance based measures, which were coded as errors for the purpose of analysis. In the simulated clinical situation, the focus was on reducing errors while completing tasks, and time was a secondary consideration. However, in the genuine clinical situation non-completion of tasks elements would be deemed errors of omission and can result in adverse events for patients (Gluyas and Morrison, 2013).

The observers' open-ended responses indicated the students' discussions in the clinical scenario post-educational intervention were longer and more detailed, suggesting that the students drew on the provided course material in seeking to comprehend the situation and plan actions. The students pre-intervention tended to focus only on the technical aspects of the particular task, whereas post-intervention students deliberated at length about medication dosage, possible side effects, and antiemetic interactions. Hence, the education intervention appears to have led to an increased level of vigilance, perhaps out of a concern about making errors, which slowed their responsiveness within the parameters of the study. It would be expected the changes in discussions would be reflected by an increase in the use of SA discussion strategies, but no such increase was observed. This in part owed to the

fact that our measure captured data on the frequency of events, but did not assess time intervals over which each event occurred.

There is another possible explanation that might help to understand the unexpected increase in errors for task 2 after the implementation of the educational intervention. In comparison to experienced practitioners, nursing students have not had the clinical experience to build up a store of mental models that enable them to maintain SA while working through clinical problems. (Endsley, 2000; Gluyas and Harris, 2016; Gluyas and Morrison, 2013). While SA discussion strategies were encouraged as part of the education intervention to recognise and then minimise risk, the lack of clinical experience means that the students do not have a store of mental models to draw on and help them problem solve the issues they were discussing in a time efficient manner (Cooper et al., 2010). Hence, this shortage of experience lead to lengthy discussions and delays in waiting for the supervisor to help interpret the perceived risks, which then increased cognitive pressure, and subsequently errors, as students realised that time was running out to complete the second task. This was reflected by the observers' open-ended comments, in which it was noted that the students were particularly prone to making errors when time pressure to complete the task increased.

Limitations

The sample size for this study was limited and drawn from only one nursing degree program. Hence, our findings should be interpreted cautiously in considering the

implications for other nursing educational programs. As well, this was the first time that the PBSAOS had been used in a nursing educational context. While our results demonstrated that the PBSAOS was a reliable instrument, further studies are warranted to consolidate its psychometric properties.

Conclusion

Overall, the findings of this study demonstrate that the implementation of an intervention designed to increase SA and thereby reduce error rates actually appear to have resulted in hyper-vigilance and subsequent non-completion of required tasks. This study was conducted using a cohort of final year nursing students without previous exposure to SA training. It may be the case that if SA was introduced at an earlier stage of nursing training and constantly incorporated throughout the curriculum, students may eventually learn to maintain SA while completing tasks in a timely manner with an attendant reduction in errors. Further studies are warranted to establish if the inclusion of SA training at the commencement of nursing education leads to enhanced SA and more proficient, safer clinical skills upon graduation.

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Figure Legend

Figure 1	Timeline of Study Procedures
Figure 2	Example of SA strategies used in the reminder sent to students while on clinical practicum
Figure 3	Clinical simulation suite viewed from behind the one-way mirror in the control room
Figure 4	Performance Measures for Task 1
Figure 5	Performance Measures for Task 2
Table 3	Task 1 McNemars test results for measures showing significant decrease in error rate post SA Education
Table 4	Task 2 McNemars test results for measures showing significant decrease in error rate post SA Education
Table 5	Task 1 McNemars test results for measures showing significant increase in error rate post SA Education
Appendix 1: Table 1 & 2	Full results for the completion of each of the performance measures in task 1 and task 2 of the simulation scenario before and after the delivery of the SA educational intervention

Appendix 1: Full results for the completion of each of the performance measures in task 1 and task 2 of the simulation scenario before and after the delivery of the SA educational intervention.

Table 1: Results of McNemars Test for Task 1

		Incorrect Post Intervention	Correct Post Intervention	McNemar's p Value
Uses PQRST	Incorrect Pre Intervention	9	6	.75
	Correct Pre Intervention	4	6	
Notes Pain Score	Incorrect Pre Intervention	0	4	.38
	Correct Pre Intervention	1	20	
Reviews Med Chart	Incorrect Pre Intervention	0	4	.25
	Correct Pre Intervention	1	20	
Notes & Discusses Antiemetic	Incorrect Pre Intervention	10	9	.15
	Correct Pre Intervention	3	3	
6 Rights Patient	Incorrect Pre Intervention	0	1	1.0
	Correct Pre Intervention	0	24	
Route	Incorrect Pre Intervention	0	1	.63
	Correct Pre Intervention	3	21	
Drug	Incorrect Pre Intervention	1	8	.39
	Correct Pre Intervention	4	12	
Dose	Incorrect Pre Intervention	7	8	.23
	Correct Pre Intervention	3	7	
Time	**Incorrect Pre Intervention**	**3**	**13**	**.002**
	Correct Pre Intervention	**1**	**8**	
Confirms 2nd Checker	Incorrect Pre Intervention	0	6	.13
	Correct Pre Intervention	1	18	
Checks Allergies	Incorrect Pre Intervention	3	8	.23
	Correct Pre Intervention	3	11	
Performs Pre HH	Incorrect Pre Intervention	11	6	.51
	Correct Pre Intervention	3	5	

IM Correct Location	**Incorrect Pre Intervention**	**0**	**7**	**.016**
	Correct Pre Intervention	**0**	**18**	
Alco Wipe	Incorrect Pre Intervention	0	7	.34
	Correct Pre Intervention	3	22	
Draws Back	Incorrect Pre Intervention	0	1	1.0
	Correct Pre Intervention	2	22	
Informs Side Effects	Incorrect Pre Intervention	12	4	.55
	Correct Pre Intervention	7	2	
Provides Call Bell	**Incorrect Pre Intervention**	**13**	**12**	**.0001**
	Correct Pre Intervention	**0**	**0**	
Disposes of Sharp	Incorrect Pre Intervention	2	11	.21
	Correct Pre Intervention	5	7	
Performs Post HH	Incorrect Pre Intervention	16	6	.29
	Correct Pre Intervention	2	1	
Global Measure Verbalises Warning No Interruption	Incorrect Pre Intervention	12	1	.07
	Correct Pre Intervention	7	5	
Global Measure Checks with Other Team Members	Incorrect Pre Intervention	0	4	.69
	Correct Pre Intervention	2	19	
Global Measure Discusses Plans	Incorrect Pre Intervention	0	6	1.0
	Correct Pre Intervention	5	14	
Global Measure Verbalises Self-Checking	Incorrect Pre Intervention	16	7	.07
	Correct Pre Intervention	1	1	
Documents Pain Relief on Chart	Incorrect Pre Intervention	0	0	1.0
	Correct Pre Intervention	1	24	

Table 2: Results of McNemars Test for Task 2

		Incorrect Post Intervention	Correct Post Intervention	McNemar's p Value
Assesses Patient Condition Post IMI Pain	Incorrect Pre Intervention	2	1	.07
	Correct Pre Intervention	7	15	
Performs Pre HH	**Incorrect Pre Intervention**	**19**	**6**	**.03**
	Correct Pre Intervention	0	0	
ABC Notes Observations	Incorrect Pre Intervention	0	6	.75
	Correct Pre Intervention	4	15	
Commences O2	Incorrect Pre Intervention	2	1	.38
	Correct Pre Intervention	4	18	
Lowers Patient for Hypertension	**Incorrect Pre Intervention**	**3**	**1**	**.02**
	Correct Pre Intervention	**9**	**12**	
Discusses with Mo Using Isobar	Incorrect Pre Intervention	3	8	.11
	Correct Pre Intervention	2	12	
Increases IVT	**Incorrect Pre Intervention**	**2**	**2**	**.02**
	Correct Pre Intervention	**11**	**10**	
Review Antiemetic Order	Incorrect Pre Intervention	0	3	.51
	Correct Pre Intervention	6	16	
6 Rights Patient	Incorrect Pre Intervention	4	2	.29
	Correct Pre Intervention	6	13	
Route	Incorrect Pre Intervention	9	3	.14
	Correct Pre Intervention	9	4	
Drug	Incorrect Pre Intervention	9	5	.42

	Correct Pre Intervention	9	2	
Dose	**Incorrect Pre Intervention**	**19**	**6**	**.03**
	Correct Pre Intervention	**0**	**0**	
Time	Incorrect Pre Intervention	10	3	.22
	Correct Pre Intervention	8	4	
Confirms 2nd Checker	Incorrect Pre Intervention	7	2	.18
	Correct Pre Intervention	7	9	
Checks Allergies	**Incorrect Pre Intervention**	**13**	**0**	**.002**
	Correct Pre Intervention	**10**	**2**	
Performs Pre HH	Incorrect Pre Intervention	20	3	1.0
	Correct Pre Intervention	2	0	
IM Correct Location	Incorrect Pre Intervention	5	3	.23
	Correct Pre Intervention	8	9	
Alco Wipe	Incorrect Pre Intervention	6	9	.80
	Correct Pre Intervention	7	3	
Draws Back	**Incorrect Pre Intervention**	**4**	**4**	**.03**
	Correct Pre Intervention	**14**	**3**	
Disposes of Sharp	**Incorrect Pre Intervention**	**4**	**1**	**.003**
	Correct Pre Intervention	**12**	**8**	
Performs Post HH	Incorrect Pre Intervention	19	0	.06
	Correct Pre Intervention	5	1	
Global Measure Verbalises Warning No Interruption	Incorrect Pre Intervention	13	2	.06
	Correct Pre Intervention	9	1	
Global Measure Checks with Other Team Members	Incorrect Pre Intervention	0	3	1.0

	Correct Pre Intervention	4	18	
Discusses Plans	Incorrect Pre Intervention	0	5	.73
	Correct Pre Intervention	3	17	
Global Measure Verbalises Self Checking	Incorrect Pre Intervention	14	6	.29
	Correct Pre Intervention	2	3	
Documents ADD Score	Incorrect Pre Intervention	7	4	.27
	Correct Pre Intervention	9	5	
Documents O2 on Obs Chart	**Incorrect Pre Intervention**	**9**	**1**	**.003**
	Correct Pre Intervention	**12**	**3**	
Documents IVT Intervention on Obs Chart	Incorrect Pre Intervention	20	1	.38
	Correct Pre Intervention	4	0	
Documents IVT on FBC	Incorrect Pre Intervention	10	4	.18
	Correct Pre Intervention	10	1	
Documents anti-emetic	**Incorrect Pre Intervention**	**3**	**1**	**.001**
	Correct Pre Intervention	**15**	**6**	

Table 3: Task 1 McNemars test results for measures showing significant decrease in error rate post SA Education

Task		Incorrect Post Observation	Correct Post Observation	
Time	**Incorrect Pre Intervention**	**3**	**13**	**.002**
	Correct Pre Intervention	**1**	**8**	
IM Correct Location	**Incorrect Pre Intervention**	**0**	**7**	**.016**
	Correct Pre Intervention	**0**	**18**	
Provides Call Bell	**Incorrect Pre Intervention**	**13**	**12**	**.0001**
	Correct Pre Intervention	**0**	**0**	

Table 4: Task 2 McNemars test results for measures showing significant decrease in error rate post SA Education

		Incorrect Post Intervention	**Correct Post Intervention**	
Performs Pre HH	**Incorrect Pre Intervention**	**19**	**6**	**.03**
	Correct Pre Intervention	0	0	
Dose	**Incorrect Pre Intervention**	**19**	**6**	**.03**
	Correct Pre Intervention	**0**	**0**	

Table 5: Task 1 McNemars test results for measures showing significant increase in error rate post SA Education

		Incorrect Post Intervention	Correct Post Observation	
Lowers Patient for Hypertension	**Incorrect Pre Intervention**	**3**	**1**	**.02**
	Correct Pre Intervention	**9**	**12**	
Increases IVT	**Incorrect Pre Intervention**	**2**	**2**	**.02**
	Correct Pre Intervention	**11**	**10**	
Checks Allergies	**Incorrect Pre Intervention**	**13**	**0**	**.002**
		Incorrect Post Intervention	**Correct Post Observation**	
	Correct Pre Intervention	**10**	**2**	
Draws Back	**Incorrect Pre Intervention**	**4**	**4**	**.03**
	Correct Pre Intervention	**14**	**3**	
Disposes of Sharp	**Incorrect Pre Intervention**	**4**	**1**	**.003**
	Correct Pre Intervention	**12**	**8**	
Documents O2 on Obs Chart	**Incorrect Pre Intervention**	**9**	**1**	**.003**
	Correct Pre Intervention	**12**	**3**	
Documents anti-emetic	**Incorrect Pre Intervention**	**3**	**1**	**.001**
	Correct Pre Intervention	**15**	**6**	

Situation Awareness Strategies

Think Safety:

- Assess how stressful in terms of self, context and task the situation

Safety Actions:

- Mindful Self-check task sequence
- Mindful check with others re task sequence
- Mindful check of Checklists or Procedures

Safety Communication:

- Tell others – "Don't interrupt!"
- Regroup with team "Huddles"
- Objective communication: ISOBAR
- Communicate risks using Concern, Uncomfortable, Safety (CUS) risk escalation tool

Figure 2: Example of SA strategies used in the reminder sent to students while on clinical practicum

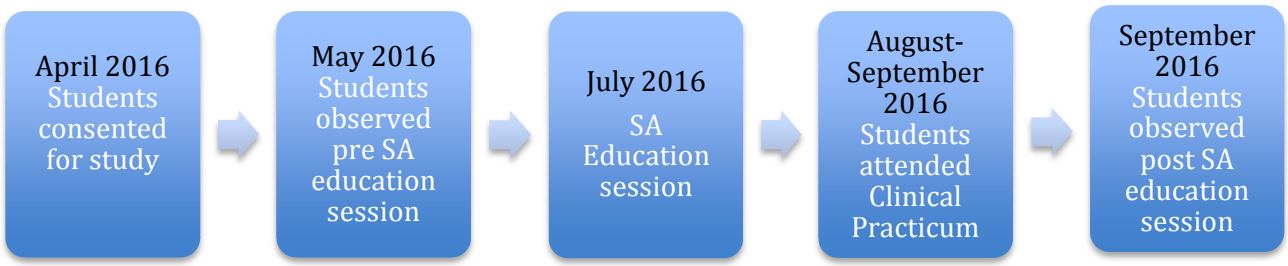

Figure 1: Timeline of Study Procedures

Figure 3: Clinical simulation suite viewed from behind the one-way mirror in the control room

Pain Assessment & Administration of pain relief (Imbedded)*
Uses PQRST to assess need for pain relief
Notes observation of pain score
Reviews medication chart for pain relief medication orders
Notes & discusses charted anti–emetic order
• Checks right Patient
• Checks right Route
• Checks right Drug
• Checks right Dose
• Checks right Time
Confirms medication checks with second checker
Checks for allergies
Performs hand hygiene pre procedure
Administers IMI analgesic in correct anatomical location
• Alco wipe
• Draws back
Informs patient side effects
Provides call bell
Disposes of sharp properly
Performs hand hygiene post procedure
Outcome measures (Global)**
Documents pain relief administration on medication chart
Strategies to improve/ maintain SA (External)***
Verbalises to others warning to not interrupt task procedures
Checks with others team members / or supervisor if unsure of next actions
Team discusses current situation and/ or plans action/s
Verbalises self-checking
**** Imbedded Measures are procedural steps that demonstrate unambiguous expected or required actions for the task*** ***** Global Measures are expected outcomes for task*** ****** External Measures are actions that will demonstrate use of strategies to recover SA following interruptions, distraction or changed conditions***

Figure 4: Performance Measures for Task 1

Assessment & Management of patient changed clinical status (Imbedded Measures)*
Performs hand hygiene pre procedure
Assesses Pt. condition when alerted to problems post IMI pain relief
ABC - notes observations
Commences either Hudson mask @ 6 litres per minute or nasal prongs @ 3 litres per minute O2 therapy
Lowers Pt head for hypotension recovery
Discusses with MO using ISOBAR communication
Increases IVT rate as per orders
Reviews antiemetic order in medication chart
• Checks right Patient
• Checks right Route
• Checks right Drug
• Checks right Dose
• Checks right Time
Confirms medication checks with second checker
Checks for allergies
Performs HH pre procedure
Administers IMI anti-emetic in correct anatomical position
Alco wipe
Draws back
Disposes of sharp appropriately
Performs hand hygiene post procedure
Outcome measures (Global Measures)**
Documents ADD score on observation chart
Documents O2 therapy intervention on observation chart
Documents IVT intervention on observation chart
Documents IVT intervention on Fluid Balance
Documents anti-emetic administration on medication chart
Strategies to improve/ maintain SA (External Measures)***
Verbalises to others warning to not interrupt task procedures
Checks with others team members / or supervisor if unsure of next actions
Team discusses current situation and/ or plans action/s
Verbalises self-checking
**** Imbedded Measures are procedural steps that demonstrate unambiguous expected or required actions for the task***   ***** Global Measures are expected outcomes for task***   ****** External Measures are actions that will demonstrate use of strategies to recover SA following interruptions, distraction or changed conditions***

Figure 5: Performance Measures for Task 2