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Comparison of standardized patients with high-fidelity simulators for managing stress and improving performance in clinical deterioration: A mixed methods study☆,☆☆

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SUMMARY

Background: The use of standardized patients in deteriorating patient simulations adds realism that can be valuable for preparing nurse trainees for stress and enhancing their performance during actual patient deterioration. Emotional engagement resulting from increased fidelity can provide additional stress for student nurses with limited exposure to real patients. To determine the presence of increased stress with the standardized patient modality, this study compared the use of standardized patients (SP) with the use of high-fidelity simulators (HFS) during deteriorating patient simulations. Performance in managing deteriorating patients was also compared. It also explored student nurses' insights on the use of standardized patients and patient simulators in deteriorating patient simulations as preparation for clinical placement.

Methods: Fifty-seven student nurses participated in a randomized controlled design study with pre- and post-tests to evaluate stress and performance in deteriorating patient simulations. Performance was assessed using the Rescuing A Patient in Deteriorating Situations (RAPIDS) rating tool. Stress was measured using salivary alpha-amylase levels. Fourteen participants who joined the randomized controlled component then participated in focus group discussions that elicited their insights on SP use in patient deterioration simulations.

Results: Analysis of covariance (ANCOVA) results showed no significant difference ($p = 0.744$) between the performance scores of the SP and HFS groups in managing deteriorating patients. Amylase levels were also not significantly different ($p = 0.317$) between the two groups. Stress in simulation, awareness of patient interactions, and realism were the main themes that resulted from the thematic analysis.

Conclusions: Performance and stress in deteriorating patient simulations with standardized patients did not vary from similar simulations using high-fidelity patient simulators. Data from focus group interviews, however, suggested that the use of standardized patients was perceived to be valuable in preparing students for actual patient deterioration management.

Introduction

The delivery of safe patient care is essential to achieve optimum outcomes, particularly in the management of high-acuity clinical events such as patient deterioration. It has been suggested that emotional state is as vital as intellect when it comes to decision-making (Appelbaum, 1998). Stress, which is closely tied to emotions (Lazarus, 1999), involves both emotional and physiological responses to a stressor. In the classical theory of stress by Lazarus and Folkman (1984), it is defined as “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being” (p. 19). Stress is viewed as a connection between an individual and his environment, and physiological responses between individuals vary depending on the differences in cognitive appraisals of stressful events. Whether stress enhances or impairs performance depends on how a stressful stimulus is appraised (Lazarus and Folkman, 1984). Appropriate levels of stress, therefore, may have some value when stressors are appraised as challenges rather than threats.

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Stress, resulting in anxiety, can affect health-care professionals' clinical performance either positively or negatively in highly stressful clinical environments (LeBlanc et al., 2012; Müller et al., 2009; Melincavage, 2011; Wetzel et al., 2006). A recent study by Macdougall et al. (2013) supports the view that stressful clinical events may not necessarily impair clinical performance. In this study, additional stress in simulations did not decrease students' clinical confidence or knowledge (Macdougall et al., 2013), suggesting a lack of negative effects on performance. This is in agreement with another study that found an enhancement of advanced cardiac life support skills after addition of emotional stressors during simulation (DeMaria et al., 2010). It is vital to note, however, that these results were derived from studies conducted in simulated environments. Findings, therefore, may not be similar when investigation occurs in real clinical settings. Conversely, high cortisol levels indicative of stress has also been shown to impair performance (Arora et al., 2010; Harvey et al., 2010; LeBlanc et al., 2012). These studies involved fast-paced high-acuity simulations that caused sudden stress. Thus, cortisol increase was a response to this acute stress. Amylase, however, reacts more rapidly to a psychological stressor compared to cortisol with no carry-over effect (Takai et al., 2004). As a result of the acute nature of simulations and of patient deterioration in clinical settings, salivary amylase may be a better measure of acute stress. It is known to increase rapidly after introducing stressful stimuli as compared to cortisol (Takai et al., 2004).

Nurses play a vital role in the recognition and management of patient deterioration. As such, stressful incidents may affect their clinical performance notably when there is negative appraisal. It is therefore essential to prepare student nurses to manage emotions and stress better during training (LeBlanc, 2009; Liaw et al., 2012). The emotional content of learning experiences can be addressed during simulation as this is a safe modality through which the emotional climate of a stressful clinical event can be replicated (Kneebone, 2005). In high-fidelity simulations, a real-world environment is created such that learners are fully immersed in simulation. To make these simulations interactive, high-fidelity simulators (HFS) and/or standardized patients (SPs) are utilized. Because of the resultant learner emotional engagement during high-fidelity simulation training, authentic emotional responses similar to those in the actual setting are expected (Flanagan, Nestel and Joseph, 2004). It is thus postulated that by creating a simulation experience that provides not only physical fidelity, but also psychological fidelity, learners can be trained to manage stress better, resulting from the perception that stress is a challenge rather than a threat. In this case, resources are viewed as outweighing the demands, and thus can lead to enhanced performance (Lazarus and Folkman, 1984; LeBlanc et al., 2012).

According to Becker et al. (2006), “standardized patients are individuals who have been carefully trained to present an illness or scenario in a standardized, unvarying manner” (p. 103). It is also postulated that the use of SPs will accentuate the reality of simulations and create an approximation of the psychological responses toward a high-acuity clinical event. Studies, however, have demonstrated that SP encounters can cause anxiety, a response associated with stress, in students (Becker et al., 2006; Robinson-Smith, Bradley and Meakim, 2009). A study by Luctkar-Flude, Wison-Keates and Laroque (2012) demonstrated that perceived realism was higher when SPs were used; however, communication with ‘real’ patients was more stressful and produced higher anxiety in students. It is hence expected that SPs will increase students' stress levels during deteriorating patient simulations. Standardized patients become added emotional stressors that enhance clinical performance. This premise is supported by a study by DeMaria et al. (2010), which found that addition of emotional stressors in simulation increased anxiety and was correlated with enhanced performance. This is because during emotional learning experiences, such as during stressful events, the amygdala strengthens the memory for similar experiences, which brings about conscious recall (Cahill et al., 1996). The ability to recall and apply these learning experiences translates to better performance scores (DeMaria et al., 2010).

The aim of this study is twofold: to compare the effects of using SPs with using HFS on student nurses' stress levels and performance in managing patients in a simulated environment, and to explore their perspectives on these learning tools in deteriorating patient simulations as preparation for clinical placement. It was postulated that the student nurses in the SP group will experience greater stress as a result of using ‘real’ patients (SPs), but will have better clinical performance as compared with those in the HFS group at post-test, as evidenced by salivary alpha-amylase levels and performance tool scores, respectively.

Methods

Study Design and Participants

A mixed methods which included a randomized controlled trial (RCT) with a pre- and post-test design and qualitative focus groups was conducted. The mixed methods design was deemed appropriate as the qualitative data complemented the quantitative findings (Johnson and Onwuegbuzie, 2004). The RCT enabled the researchers to determine which group had higher stress levels and higher performance scores using objective measures. The focus groups, meanwhile, provided more subjective data by exploring students' insights on the two modalities and their perceived effects on stress and performance.

Participants were recruited from a nursing department in a university in Singapore. Ethics approval was given by the university's institutional review board. All Year Three student nurses ($N = 81$) enrolled in the Clinical Decision-Making module and who had had no previous experience in managing deteriorating patients in clinical settings were invited to participate. Fifty-nine students volunteered and gave written consent to participate. Participants were assured that they can withdraw from the study at any time if they feel that there is potential harm to their well-being or if they are uncomfortable with continuing in their involvement. Using a computer-based random number generator, the participants were randomly assigned to either the SP group ($n = 30$) or to the HFS group ($n = 29$). Two students withdrew after the pre-test. Only 57 students completed the post-test, with 29 participants in the SP group and 28 participants in the HFS group. In the qualitative study, the 57 students who completed the post-test were invited to participate in focus group discussions after a nine-week clinical placement. Fourteen students agreed to participate. The study's flow diagram is presented in Fig. 1.

Simulation Program

The study was implemented as part of the simulation program of the Clinical Decision-Making module. All Year Three student nurses were required to participate in multiple deteriorating patient simulations. After a pre-test simulation on performance, the participants went through a simulation intervention program that used either SP (SP group) or the SimMan® 3G HFS (HFS group). All the participants went through three deteriorating patient simulations using either of these modalities. As the three scenarios ran concurrently for both groups, the order of the scenarios was randomized for the participants. All scenarios, including patient parameters and SP or SimMan® 3G responses/scripts used for the two groups were identical, so that the degree of stress was the same for both groups. The only variable that could possibly affect stress was the modality used: SP or HFS. A post-test on student performance was then conducted a week later for all the participants. The deteriorating patient scenarios used in the simulations are presented in Table 1.

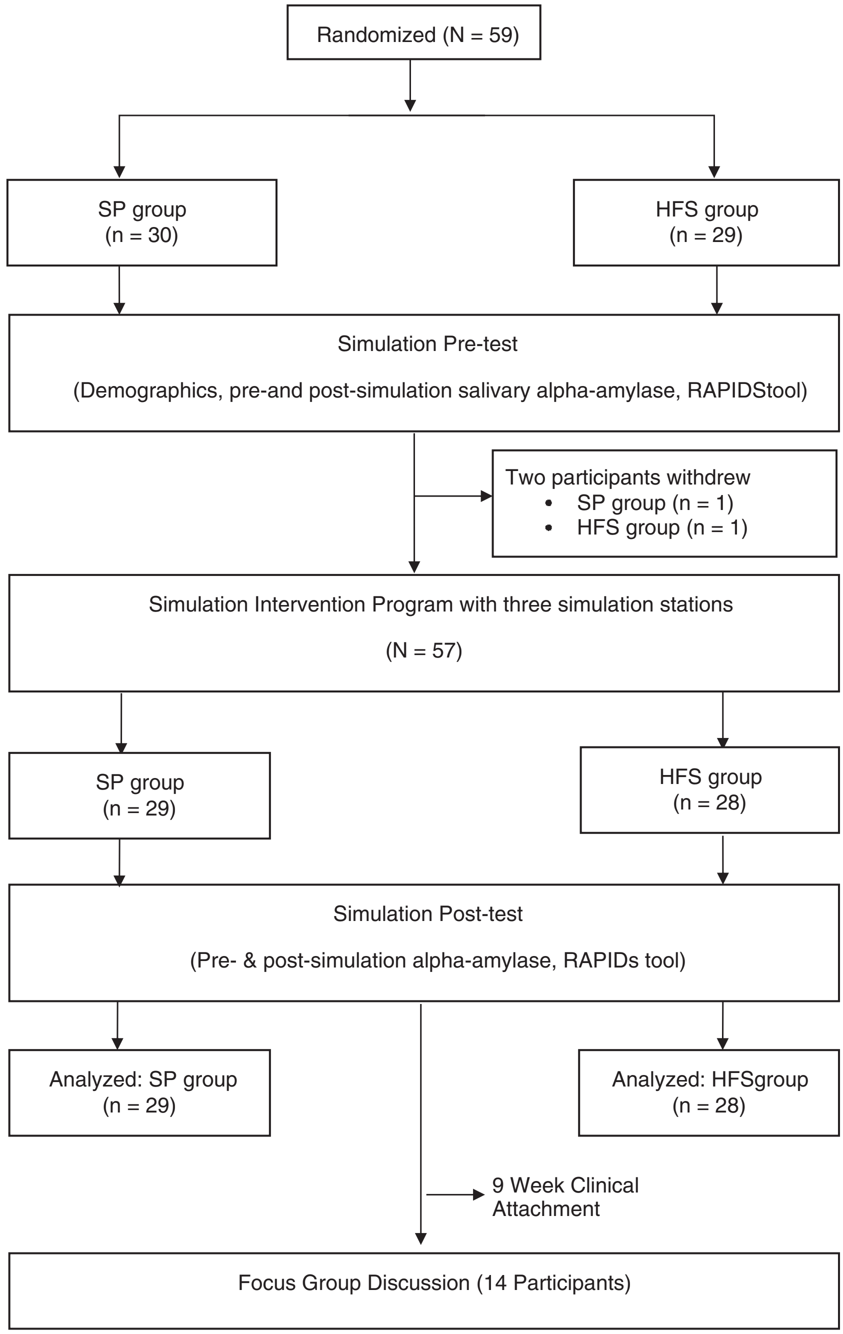

Fig. 1. Flow diagram of the study.

SP and HFS Preparation

For the pre- and post-test simulations, two different deteriorating patient simulation scenarios were used. These engaged four SPs, all Chinese females aged between 55 and 60 years old. The SPs were used for the pre- and post-tests to approximate actual interaction with real patients. To ensure reliability, the same SPs were used for the pre- and post-test scenarios. The intervention simulation program, on the other hand, involved six SPs. All of them were Chinese females, 50 to 60 years old. The SPs utilized in the study had been trained by an experienced SP educator for 2 h on portraying their roles. For standardization purposes, the SPs were given a script and trained in providing standard responses to students during the simulations. During the simulations, they were attached to monitors reflecting deteriorating patient parameters. To establish role accuracy, the SPs were required to go through their role-plays with simulation facilitators and scenario developers who had had extensive experience with deteriorating patient simulations.

The SimMan® 3G HFS was used in the intervention and was operated by fully trained simulation technologists and a faculty expert in simulation learning. HFS interaction with the student was established with the faculty voicing over standardized responses based on scripts identical to those provided to the SPs. Except for the use of either SP or HFS, the scenario, patient condition and parameters, the script and patient responses were identical for the SP and the HFS groups.

Table 1
Deteriorating patient case scenarios.

	Patient profile	Initial presenting problem	Co-morbid illnesses	Diagnosis
Pre-test	B.K. Lee, 59 year-old female	Moderately confused; high blood glucose	Hypertension, diabetes mellitus type 2, COPD	Post-surgery (IM nailing, tibia, left)
Intervention 1	R. Loh, 59 year-old female	Giddiness and feeling weak; low blood pressure	Hypertension, ischemic heart disease, pancreatic cancer	Post-Whipple's procedure
Intervention 2	M. Wong, 59 year-old female	Breathlessness; low SpO_2	Hypertension, COPD, diabetes mellitus type 2	Post-transient ischemic attack
Intervention 3	J. Lee, 59 year-old female	Chest pain; tachycardia	Hypertension, diabetes mellitus type 2	Post-surgery (IM nailing, tibia, left)
Post-Test	B.K. Lee, 59 year-old female	Drowsy, deteriorating level of consciousness; low blood pressure	Hypertension, diabetes mellitus type 2, COPD, ischemic heart disease	Total knee replacement, right

Legend: COPD — chronic obstructive pulmonary disease.
IM nailing — intramedullary nailing.

Outcome Measures

To assess the students' performance, the Rescuing A Patient In Deteriorating Situations (RAPIDS) rating tool was used in the pre- and post-tests. The RAPIDS is a 42-item tool with good construct validity ($t = 15.48$, $p < 0.0001$) and inter-rater reliability ($ICC = 0.99$) established in the local context (Liaw et al., 2011). It measures nurses' performance in assessing, managing and reporting of patients in deteriorating situations. Two assessors, both faculty members trained to use the RAPIDS tool, assessed the participants' performance during the pre- and post-tests. The participants wore gowns and masks to blind their identities from the assessors. The assessors were also blinded to group allocation. Each participant was instructed to manage a deteriorating patient in the pre- and the post-tests. The assessors evaluated the performance behind a one-way mirror.

In the course of the study, the participants were exposed to acute stress in simulations mimicking real patient deterioration. The acute nature of these events warranted the use of salivary alpha-amylase, a biomarker for sympathetic nervous system activity (Nater and Rohleder, 2009). Salivary amylase is also a better index of stress as it increases more rapidly than cortisol after presentation of psychological stressors (Takai et al., 2004). The participants' salivary alpha-amylase levels were measured before simulation, and after simulation at pre- and post-tests (Fig. 1).

As alpha-amylase can be affected by food and beverages such as coffee (Nater et al., 2007), the participants were instructed to avoid heavy meals and were allowed to drink only water before the simulation. The circadian pattern of alpha-amylase is a mirror-image of that of cortisol, having the lowest levels in the morning, and highest levels at night (Rai, Kaur and Foing, 2012); thus the pre-test and the post-test, although held on different days, were scheduled at the same time of the day.

Focus Group Discussions

Upon completion of the Clinical Decision-Making module, the students had clinical placement for nine weeks. After this period, they were invited to participate in focus group interviews. This aimed to elicit their insights on how the simulations (with/without SPs) helped them in actual clinical settings, particularly when they encountered patient deterioration. Two focus group sessions, each with participants from both groups ($SP = 6$, $HFS = 8$) and facilitated by a nursing faculty experienced in conducting focus groups and who was involved in the initial part of the study, were held. As the focus group discussions were conducted during a break period prior to graduation (after the students' clinical placement), most of the participants from the randomized controlled pre- and post-test component opted not to join due to scheduling issues. Each focus group session lasted around 60 min. During the sessions, the participants were asked to identify whether they were from the SP or the HFS group to enable the researchers to compare their perceptions. They were queried regarding their views on deteriorating patient simulations using SPs and HFS, their actual experiences with deteriorating patients during their clinical placement, and how the use of SPs or HFS facilitated their learning and preparation for clinical placement. The questions helped to determine if multiple deteriorating patient simulations using either modality had effects on their performance and stress perceptions. The participants were probed on these areas until they no longer had further insights to give. As non-verbal cues can be useful to complement participants' verbal responses, these cues were also documented in the field notes.

Data Analysis

Descriptive statistics was used to analyze the demographic characteristics of the participants. As two assessors were involved in the evaluation of the participants' performance using the RAPIDS tool, inter-rater reliability was tested using intraclass correlation coefficient. The final score for analysis was calculated based on the average scores given by the two assessors. Percentage change value was calculated for alpha-amylase levels as these were measured at two time points each during the pre- and post-tests: before and after the participants were engaged in the pre-test and post-test simulations. Analysis of covariance (ANCOVA) was used to evaluate the effect of the intervention on post-test performance scores and on post-test amylase levels using pre-test measures as covariates. Paired t-test was used to evaluate any change from pre-test to post-test performance scores and amylase levels for each group.

For the focus group discussions, four criteria were used to ensure rigor and trustworthiness: credibility, dependability, conformability, and transferability (Streubert Speziale and Carpenter, 2010). To maintain credibility, focus group discussions were audio-recorded so that the participants' responses were accurately captured. Member checking was done after each focus group by re-stating the participants' comments and questioning them for accuracy. The interview recordings were also listened to several times before transcribing them verbatim. The transcripts were then compared with the actual audio-recordings to establish accuracy. As dependability is linked to credibility, demonstration of credibility also establishes dependability (Streubert Speziale and Carpenter, 2010). Data was analyzed using thematic analysis, which involved the description and interpretation of qualitative data to find patterns of meaning and to make sense of the participants' experiences (Braun and Clarke, 2006). Two researchers familiarized themselves with and immersed themselves in the data. Transcripts were read and re-read. Words or phrases that were related to the research questions were highlighted by each researcher, after which, the two researchers met and discussed to establish conformability. Highlighted information with the same meaning was categorized together. Themes from the categories were developed by both researchers independently. A final consensus on the themes was reached after another discussion between the two researchers. As all participants were graduating student nurses preparing for actual clinical work, transferability was ensured.

Results

Participant Demographics

A total of 57 Year Three student nurses completed the study. The participants' ages ranged from 20 to 25 years, with a mean age of 21.74 (SD 1.078) years old. The majority of the participants were female (86%), Chinese (89.5%), and had junior college education (82.5%) prior to pursuing university education (Table 2).

Inter-rater Reliability of Assessors

The pre-test ICC of the total RAPIDS tool scores across the two assessors was 0.906 (95% CI, 0.840–0.944). The post-test performance evaluation ICC was 0.930 (95% CI, 0.882–0.959) across the two assessors, demonstrating good inter-rater reliability.

Simulation Performance

As presented in Table 3, the ANCOVA results showed no significant difference between the SP and the HFS groups in their post-test performance scores based on the RAPIDS tool ($F = 0.108$, $p = 0.744$). There was, however, a significant increase in post-test scores from baseline in both the SP ($t = -7.017$, $p < 0.001$) and HFS ($t = -4.647$, $p < 0.001$) groups.

Stress Levels Using Salivary Alpha-amylase

As salivary amylase was measured twice at pre-test (before and after simulation) and twice at post-test (before and after simulation), percentage change values from the pre- and the post-tests were analyzed. ANCOVA results indicated no significant difference between the SP and the HFS groups ($F = 1.021$, $p = 0.317$) as shown in Table 4. The pre-test percentage change value of the participants' salivary alpha-amylase was significantly reduced at post-test in the HFS group ($t = 2.252$, $p = 0.033$) from the pre-test value, indicating a more relaxed state at post-test. There was no significant decrease in the percentage change value of alpha-amylase in the SP group ($t = 0.366$, $p = 0.717$) from pre- to post-test, suggesting that the SP group's stress level did not change much.

Focus Group Discussions

Six students from the SP group and eight students from the HFS group participated in the discussions. Majority of the participants were female (93%), Chinese (86%) and with junior college education (93%).

Analysis of the transcripts resulted in the identification of three themes and two subthemes for each. The themes are: stress in simulation, awareness of patient interactions, and realism. Table 5 shows the themes and the subthemes with their descriptions and verbatim quotes from the participants.

Stress in the simulation, particularly as a result of adding SPs, was perceived by the participants as helpful in preparing them to manage stress and anxiety. They have also noted that the stressful patient deterioration scenarios prepared them emotionally and increased their confidence in knowing what to do when they encountered similar events in the clinical settings. The participants also noted the importance of verbal and non-verbal communication as well as of understanding patients through having awareness of patient interactions. Realism was also a theme that came about from the participants as they acknowledged the limitation of the SP and the patient simulator in terms of patient assessment. The SP, however, was noted to provide a more authentic experience of managing clinical deterioration.

Table 2
Demographic characteristics.

Demographic		Mean (SD)		Range
Age (years)		21.75 (1.078)		20–25
		Total N (%)	SP group N (%)	HFS group N (%)
Gender	Male	8 (14.0)	3 (10.3)	5 (17.9)
	Female	49 (86.0)	26 (89.7)	23 (82.1)
Ethnicity	Chinese	51 (89.5)	26 (89.7)	25 (89.3)
	Malay	4 (7.0)	2 (6.9)	2 (7.1)
	Indian	1 (1.8)	1 (3.4)	0 (0.0)
	Others	1 (1.8)	0 (0.0)	1 (3.6)
Education	Polytechnic diploma	10 (17.5)	6 (20.7)	4 (14.3)
	Junior college	47 (82.5)	23 (79.3)	24 (85.7)

Legend: SP — standardized patient.
HFS — high-fidelity simulator.

Discussion

This study compared the effects on performance and stress between a high psychological fidelity SP and a HFS. Our results demonstrated that there was no significant difference in performance between the SP and HFS groups. This contradicted the assumption that better stress management from an authentic learning environment will result in better post-test performance scores in the SP group. The participants of this study could be considered novice learners in managing patient deterioration as they had had no clinical experience prior to participation in this study. As such, simultaneously performing patient-relevant skills and interacting with 'real' patients (Luctkar-Flude et al., 2012) could have posed a challenge for them, especially without repeated practice that a longer intervention period would offer. The improvement in performance, however, of both groups when the pre-test and post-test were compared, provides evidence that multiple learning modalities through simulations provide participants with repeated exposure that prepares and aids performance (LeBlanc, 2009; Liaw et al., 2011).

In the present study, the level of amylase measured from the SP and the HFS produced comparable objective outcomes on the participants' level of stress levels. This was contrary to the expectation that the SP group would experience significant stress with the addition of SPs (DeMaria et al., 2010). However, in our focus group discussion, the perception that having SPs was more stressful was shared by both groups. An explanation for the differing results from the objective and subjective outcomes is the possibility of salivary amylase levels not being captured at their peak as some participants took a longer time to produce sufficient amounts of saliva for analysis. According to Takai et al (2004), salivary amylase rapidly increases and wanes after exposure to stress.

The perception that having SPs was more stressful was shared by both groups during the focus groups. All the participants had no exposure to SPs prior to the research—hence their perceived stress with the modality. The relationship between objective and subjective stress measures, and performance, however, needs to be further explored as current literature show that stress determined objectively and/or subjectively may enhance or impair performance (Harvey et al., 2010; LeBlanc et al., 2012; Macdougall et al., 2013).

The significant difference between pre- and post-test amylase values demonstrated that the HFS group's stress level decreased significantly through repetitive training (Müller et al., 2009) as compared with the SP group, which had SP as an added stressor (DeMaria et al., 2010; Luctkar-Flude et al., 2012).

The premise that similar learner emotional responses are elicited during emotionally engaging simulations, such as during stressful

Table 3
Comparison of performance by groups.

Outcome measure	Groups	N	Pre-test		Post-test		Difference		Within groups	Between groups
			M (SD)	95% CI	M (SD)	95% CI	M (SD)	95% CI	t values	F values
RAPIDS tool scores	SP	29	56.07 (11.56)	51.67–60.46	69.33 (7.97)	66.30–72.36	13.26 (10.18)	9.39–17.13	−7.017***	
	HFS	28	53.91 (14.08)	48.46–72.35	67.99 (11.23)	63.64–72.35	14.08 (16.03)	7.86–20.30	−4.647***	0.108

Legend: SP — standardized patient.
HFS — high-fidelity simulator.
*** p value significant at <0.001.

experiences (Flanagan et al., 2004), have been shown to be important in managing stress and anxiety, and in developing emotional preparedness. It was noted during the focus group interviews that the participants felt that the deteriorating patient simulations were stressful experiences. Those from the SP group perceived that their SP simulation experience trained them to be emotionally prepared for actual patient deterioration. The participants from the HFS group, on the other hand, noted their limited emotional preparedness for such events. The opportunity to experience emotions similar to those experienced in real-life clinical situations elicited actual stress in participants during simulations. It is thus argued that emotionally engaging simulations enable learners to cope better in real-life deteriorating patient situations by emotionally preparing them and enabling them to manage actual stress and anxiety involved in similar situations in future. DeMaria et al. (2010) noted that added stressors can enhance performance. Standardized patients were considered as added stressors by the participants of the SP group. Because of this, they felt that they were better prepared to perform similar tasks in real-life settings, as they had had a more stressful experience.

A second theme that arose from the focus group discussions was awareness of patient interactions. The participants noted that they were more aware of the nuances of patient interactions, which involved communication and understanding patients, and how these influenced patient management. Those from the SP group reported that SPs facilitated their acquisition of both verbal and non-verbal communication skills, thus enhancing their confidence and communication skills during clinical events, including patient deterioration (Marken et al., 2010). The participants of the HFS group likewise agreed that training with SPs would enable them to communicate better with real patients, particularly in stressful clinical events. All these corroborate with the assertion that SPs prepare students to interact with real deteriorating patients by giving authenticity to the experience and by promoting empathy development (Webster, 2014).

Lastly, the concept of realism in terms of patient assessment and the participants' simulation experience also emerged from the focus group data. Both the use of SPs and HFS has advantages and limitations. However, frequent practice in realistic environments, such as in simulations with SPs, not only engages participants emotionally, but also enables them to adequately appraise existing resources, hence preparing them for similar cases during their actual nursing practice (Liaw et al., 2011). These realistic and repetitive simulation experiences are crucial to patient management.

Limitations

This study has limitations that warrant attention. Firstly, the participants engaged in only three simulation stations during the intervention. This shortcoming was minimized by ensuring that each patient deterioration scenario was different so that students were exposed to a variety of cases. Secondly, the metrics used to measure performance and stress might not have captured the differences between the intervention and the control groups adequately. A self-report questionnaire, together with the RAPIDS tool and the salivary amylase measures, may be beneficial. The addition of focus group discussions, nevertheless, elicited information that provided a more holistic overview of performance and stress levels. Lastly, as only 25% of the number of participants from the initial part of the study joined the focus groups, the insights generated could have been limited. To address this issue, the researchers ensured that all the focus group sessions comprised participants from both the SP and HFS groups. The participants were encouraged to comment freely and the facilitator applied control during the focus group sessions only to keep the participants focused. Future research on the area, however, should further address these limitations.

Conclusions

In managing high-acuity clinical situations such as patient deterioration, nurses' performance can be affected by stress. It is important that simulation training be made as realistic as possible for the responses of student nurses to approximate those in actual clinical situations. The use of SPs was assumed to enhance the realism of simulations by providing psychological challenges similar to those from real-life clinical situations. It was anticipated that the student nurses would be able to practice their skills in simulation settings, and manifest stress comparable to that in real patient deterioration. In addition, with increased fidelity from the addition of SP, the students were expected to perceive stress as a challenge, and hence perform better in managing deteriorating patients.

The quantitative findings of this study demonstrated that performance and stress during management of deteriorating patients did not differ significantly with or without SPs. Based on the focus group data, however, both groups perceived that the use of SPs in simulation training had advantages over HFS as the former mimicked real-life interactions with deteriorating patients. The participants felt that the

Table 4
Comparison of stress by groups.

Outcome measures	Groups	N	Pre-test % change		Post-test % change		Difference		Within groups	Between groups
			M (SD)	95% CI	M (SD)	95% CI	M (SD)	95% CI	t values	F values
Salivary alpha-amylase levels (U/mL)	SP	29	86.66 (102.01)	47.86–125.46	75.64 (159.32)	15.04–136.24	−11.02 (162.20)	−72.72–50.68	0.366	
	HFS	28	88.34 (114.67)	43.87–132.80	43.49 (88.50)	9.17–77.81	−44.85 (105.36)	−85.70 to −3.99	2.252*	1.021

% change values were calculated based on the following formula: (pre-test 2nd amylase collection — pre-test baseline) / pre-test baseline; (post-test 2nd amylase collection — post-test baseline) / post-test baseline.
* p value significant at <0.05.

Table 5
Focus group themes and participants' comments.

Themes	Subthemes	Interpretation	Examples of significant statements
Stress in simulation	Managing stress and anxiety	Participants felt that the simulation experience was stressful, and SPs added more stress to already stressful scenarios. Interestingly, even participants form the non-SP group felt that having SPs would be more stressful. Overall, the exposure to SPs in deteriorating patient situations was perceived by all the participants to be helpful in preparing them to deal with the stress and anxiety associated with stressful clinical events.	• "SP gave us more stress, so in times of stress, we know what to do." • "I think the stress level in terms of clinical practice, doing with the SP would be a lot better, you would have that experience. Ok, my patient [SimMan], I don't know how it will react but if I go with SP, she reacted that way, so that maybe in the ward, the patient might react this way, so you can manage or handle anxiety level better compared to simulated ones."
	Emotional preparedness	The stressful deterioration simulation prepared participants emotionally, especially those from the SP group, for similar events in the clinical setting. Confidence in managing patient deterioration was also perceived by the participants to be enhanced as they felt they would know what to do when they encountered similar events in the real life.	• "So whatever you had that experience with the (standardized) patient, at that very moment you remember like emotions… it helped me to prepare myself for when I go to hospital …" • "I was in the SP group and then for the first few times when we practised, we always were very nervous, don't know what to do, don't know what to get. Because CDM [Clinical Decision--Making], we actually practised, a lot, a lot of times for deteriorating patients. So I kind of know what to do in the clinical setting." • "In the sense when SP comes in during school, it was a training opportunity with the SP. So I was able to face them with more confidence even though I was struggling inside."
Awareness of patient interactions	Verbal and non-verbal communication	The importance of effective patient communication during high-acuity clinical events was recognized by all the participants. It was noted that in terms of communication, the use of SPs resulted in enhancement of their communication skills, both verbal and non-verbal.	"The SP of course it helps more on communication part and anticipating what is unexpected." "… I think standardized patient will help us, prepare for our non-verbal skill. I think we usually forget about that." "I guess the advantage of a SimMan is a SimMan is merely an object … you don't feel embarrassed … when we have to talk to the SimMan, very vague response … I think the SP will be good because it allows spontaneous communication, very well reflect how we would actually respond in a real situation."
Awareness of patient interactions	Understanding patients	The interaction with SPs during patient deterioration simulations allowed participants from the SP group to understand where the patients were coming from and in the process, learn to be more sensitive and aware that they were managing a person, not just a disease or a condition.	"So I think SP really trained me sort of multi-task because you have to, not only to handle the condition in the simulation but also handle the person you are taking care of. Not only the condition but also the person's emotion …" "So when they [SPs] are in pain, they will act like a patient in pain, which can be very difficult at times to handle. So you will see (this) again in [transition-to-practice], but this time round it is real. So you will be more sensitive and you will be more aware where they are coming from." "Definitely SP because living humans will give you reactions you cannot anticipate, so you have to learn to manage not only the clinical part but also how you interact with the human being as opposed to just a mannequin."
Realism	Patient assessment	The participants reported that both the SP and the SimMan® 3G had limitations in terms of manifesting all the signs and symptoms of real patients. The clinical manifestations of the condition could not be assessed fully in either modality.	"Because for the SimMan, the lips go cyanotic … you don't know whether it's really cyanotic or blue… so something you tend to overlook … but when you have SPs you can see that they are flushed, you see that they are real." "That time when you are using the lung sound, you can't really change the SPs' condition. It will be useful on your SimMan …. When there's a heart defect, then you can hear a gushing sound, the heart, the blood." "I think both the SimMan and the standardized patient cannot really give you the actual representation of what a real patient would be like, but for SP, you can feel the softness of the body like the hand can do things, the physical extent as compared to SimMan."
Realism	Providing experience	Lack of clinical experience of the participants meant that they appreciated the use of simulations for managing deteriorating patients. Students from both the SP and HFS groups thought the use of the SPs, however, was more realistic, hence giving them an experience closest to reality.	"I think I can be a bit nervous to take care of (a) patient in a bad situation for the first time, but the simulations really helped as we went through so many times like patients deteriorating although [SPs] may not be real, but somehow you will be prepared to intervene if anything happens." "So, I feel that SP is better because it's more real. And the thing is that it better helps me apply into practice, when I'm in my clinical attachment." "SP is the closest you get to a real thing." "The SP of course helps more on [the] communication part and anticipating what is unexpected. I think for the SimMan, it helps us to practise more with our skills. Because we can do over and over again with the SimMan without having to take into account [that] the hand is already swollen or whatever…"

Legend: SP — standardized patient(s).
HFS — high-fidelity simulator.

use of SPs added more stress that prepared students emotionally to manage stress in similar real life clinical events. The use of SPs also heightened the students' awareness of patient interactions that facilitated communication with, and understanding of, real-life patients better. Lastly, the participants also felt that more realism was gained from using SPs rather than HFS. Overall findings of this study, however, suggest that there is a need to further explore the potential advantages of using SPs in deteriorating patient simulations in terms of performance and stress. The impact on actual clinical practice also needs to be investigated.

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