Exploring the relationship between stress and performance in a simulated workplace environment with final year medical students

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Abstract

Background
There is widespread consensus in the literature that stress induces both physiological and psychological changes. Perfectionism and self-criticism are common amongst all students but it is more explicit amongst medical students.

Aim
This small scale exploratory research study builds upon previous work by observing stress reactions in final year medical students whilst undertaking a multi-faceted assessment within a simulated clinical environment.

Method
A mixed methods research approach was used to evidence the relationship between stress and performance during the Final Year Ward Simulation Exercise. The Final Year Ward Simulation Exercise is ideal for exploring students' stress reactions in the clinical workplace as it simulates a busy ward environment.

Results
This research study shows that the Final Year Ward Simulation Exercise has a significant effect on the physiological parameters of students undertaking this performance assessment. The physiological effect of undertaking this exercise is more pronounced in candidates who failed this assessment but is not exclusive to this group.
Introduction

Hobfoll (1998) defines stress as ‘the state in which individuals judge their response capabilities as unable to meet the threat to the loss of desirable experiential states—states that are dictated by their values and expectations’. There is widespread consensus in the literature that stress induces both physiological and psychological changes that can threaten the health of an individual or have an adverse effect on the functioning of the body (Balodis et al. 2010; Rourke et al. 2010; Amr et al. 2008).

Reactions to stress are not determined by geographical location, sex or ethnicity (Dimitriev et al. 2008; Elzubeir et al, 2010; Khaliq et al, 2010; Shaikh et al. 2004; Ziv et al. 2008). Published research documenting stress reactions during simulation activities have observed a stress reaction in candidates undertaking a singular task including pelvic examination (Wanggren et al. 2005), laparoscopy (Andreatta et al. 2010), trauma resuscitation (Leblanc, 2009) and consultation skills (Rieber et al. 2009). Methods of identifying a stress reaction include electrocardiogram analysis (Rieber et al. 2009), adrenal gland function (Brown et al. 2009), heart rate variability (Dimitriev et al. 2008) testing of cortisol levels (Leblanc, 2009) and blood pressure monitoring (Andreatta et al. 2010). Perfectionism and self-criticism are common amongst all students but it is more explicit amongst medical students because they are high achievers (Firth-Cozens, 2001). This research study builds upon previous work by observing stress reactions in
final year medical students whilst undertaking a multi-faceted assessment within a simulated clinical environment.

It is challenging to standardise assessments within clinical settings due to the varying levels of experience and availability of assessors, the opportunistic nature of workplace assessments and the limitations of the assessment tools to provide reliable and objective assessments (Aaron, 2009; General Medical Council 2010; Miller & Archer, 2010). Simulation can allow the measurement of a student’s preparedness for clinical practice to be made by observing their performance within realistic simulated clinical environments without distressing patients or compromising patient safety (Ziv et al. 2005; Bradley, 2006; Ker & Bradley, 2007).

This research study examined what effect stress had on the performance capacity of final year medical students within a simulated ward environment had. This study identified the effect that practicing within this contextually authentic environment had on the physiological parameters of the individual, their ability to deal within competing demands and subsequently their capacity to deliver effective patient care. The individual’s perception of stress during this assessment was established to implement modifications and strategies to mitigate undesirable stress reactions.
Background

The University of Dundee undergraduate medical curriculum is a five year outcome based spiral curriculum where students revisit core learning throughout their time of study. Simulation and clinical skills teaching is currently integrated into years 1-3 of the undergraduate curriculum and in years 4-5 students spend the majority of their time on clinical attachments and have limited access to simulation activities. Leblanc’s (2009) comprehensive review of the effects of acute stress reactions identifies that this process of revisiting skills or ‘overlearning’ has its advantages but:

   to be an effective method of preparing trainees for performance under acutely stressful conditions, its application can have significant drawbacks if it is not carefully designed and executed. One of the more important drawbacks is that overlearning can limit the individual’s ability to demonstrate flexibility in his or her response and to adapt to changing conditions. (S30)

Final year medical students are required to submit a portfolio of evidence that describes how they have progressed to achieve the Curriculum Outcomes. In 2009, the Final Year Ward Simulation Exercise (FYWSE) was introduced as part of a student’s portfolio of evidence as an attempt to objectively assess a medical student’s readiness for clinical practice (Mcllwaine et al. 2007 & Garry & Stirling, 2012). The FYWSE assesses a
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students’ ability to prioritise competing demands including scripted timed interruptions, make safe decisions and manage the care of three patients. To increase authenticity three volunteer simulated patients are trained for each exercise, instead of using manikins such as SimMan, to play either a new admission, a patient with a communication issue or an acutely unwell patient.

three standardised scenarios have been developed that replicate instances from a student’s actual clinical practice (Table 1). Students perform as a final year student who is undertaking a shadowing attachment for their role as a newly qualified doctor as this is congruent with their level of practice within the clinical domain (Dornan et al. 2007). The FYWSE replicates instances from a student’s actual clinical practice during their undergraduate training. The FYWSE is one of the final assessments a student will undertake prior to graduation and is the only observed assessment of performance that a student will undertake as an individual within a simulated environment. As such, the FYWSE is an important contribution to the evidence that determines a students’ readiness for clinical practice.

since the introduction of the FYWSE, 30% of each subsequent cohort has failed to meet the required standard on their first attempt and have had to undertake a second FYWSE. Data gathered from student evaluations of the FYWSE have identified that students categorise their experiences of undertaking this assessment as feeling
“terrified, scared, anxious and unprepared” (Figure 1). These responses correlate with previous studies that have found that a student’s perceptions of a simulation activity and their subsequent preparedness to engage with the activity in the simulated environment can elicit a stress reaction (LeBlanc, 2009; Dieckmann et al. 2007). Leblanc (2009) states that there are three phases to a stress reaction: ‘alarm’ where a stressor is identified and the body mounts an alarm response; ‘resistance’ as the body attempts to adapt and cope with the stressor; and ‘exhaustion’ when resources are eventually depleted in the face of sustained stress and the body is unable to maintain normal function.

The University of Dundee is the only University in the United Kingdom that uses a FYWSE to assess a students’ preparedness for clinical practice and the evidence base for the FYWSE is therefore limited. Data analysis relating to the reliability and validity of the FYWSE is currently being published. An adapted model of the ward simulation exercise is used at postgraduate level to assess the competencies of trainees who have been identified with performance issues within their clinical practices. The processes are very similar to the FYWSE and have been shown to have good reliability (Cronbach’a = 0.817) (Stirling et al. 2012).

This research study examined the effect that participating in the FYWSE had on individual performance using a mixed methods approach. A student’s stress reaction
Exploring the relationship between stress and performance in a simulated workplace environment with final year medical students within a busy simulated clinical workplace was observed and measured to understand what effect this process had on their ability to manage patient care effectively, prioritise competing demands and make safe decisions. The study attempted to answer the following questions:

1. Are there physiological changes taking place in medical students who undertake the FYWSE?
2. Are there significant differences in physiological changes between medical students who pass and fail the FYWSE?
3. What are final year medical students’ perceptions of their performance whilst undertaking the FYWSE?

Method

Participants

The invitation to participate in this research study was given to all 133 final year medical students. A convenience sample of 19 students, who were undertaking their FYWSE over a defined six week period, were recruited during the FYWSE orientation lecture. Students were informed that this study would have no bearing on their final portfolio of evidence and that they were free to leave the study at any time without prejudice.
The Ward Simulation Exercise

The FYWSE took 90 minutes for each student to complete:

1. Student received a pre-simulation briefing (15 minutes)
2. Student completed the FYWSE (30 minutes)
3. Student watched a video of their FYWSE conducting a self-assessment (30 minutes).
4. Student received individual feedback on their performance (15 minutes).

Protocol Design

A mixed methods research approach using physiological measurements and a free text questionnaire was devised to evidence the relationship between stress and performance in the FYWSE. This approach allowed a critical analysis of the FYWSE to be made and allowed the unpicking of how students’ interpreted this reality and the effect this had on their subsequent ability to perform.

Quantitative data collection of a medical student’s blood pressure, pulse, respiration rate, oxygen saturation level and temperature, by conducting manual recordings was
selected for this research study as it has been shown to be minimally disruptive to the simulation activity and the assessment process (Andreatta et al. 2010). Although this method of data collection is not the most robust measurement available when compared to ECG analysis, it was deemed the most appropriate for this research study as it allowed students to perform as they would normally within the simulated environment. It was considered that the use of ECG electrodes could potentially disadvantage students who participated in this study as they would be exposed to an additional stressor during the FYWSE which could potentially impact on their performance (LeBlanc, 2009; Shah et al. 2010). Testing of cortisol levels was not feasible when this research study was conducted due to the required laboratory work and the controlled conditions that samples required to be stored in immediately after collection.

Physiological recordings were taken at the following intervals with the student seated:

1. At the time of recruitment providing a base line measurement (Baseline).
2. Prior to undertaking the FYWSE (Pre-FYWSE).
3. Immediately after undertaking the FYWSE (Post-FYWSE).

Qualitative data were collected via a questionnaire to establish:

1. How did you feel prior to undertaking the FYWSE?
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2. When did you feel most stressed during the FYWSE?

3. How do you feel now that you have completed the FYWSE?

Questions were designed to be logical and quick to answer, attributes which were necessitous so as not to compromise the scheduling and assessment processes of the FYWSE. All data were entered onto a data collection form created for this research study (Figure 2). Data were collected at the following intervals:

1. Prior to undertaking the FYWSE students completed question 1 and their pre-FYWSE vital sign measurements were taken.
2. Within two minutes of the FYWSE concluding vital signs measurements were repeated.
3. Prior to conducting their self-assessment students completed question 2.
4. After conducting their self-assessment students completed question 3.

All physiological data was collected by the lead author. Students were allowed to answer the questionnaire alone to avoid undue influence from other participants.
Ethical Approval

Ethical approval (UREC 10081) for this research study was granted from the University of Dundee’s Research and Ethics Committee. A participant information sheet was given to all students’ detailing how data would be collected, stored and analysed. Confidentiality was ensured by allocating a numerical identifier to each student. Students were informed of the time commitment involved in this study and that the results would be used to inform curriculum development.

Procedures

Randomisation

Participants were randomly allocated a date and time to attend for assessment. Participants were then randomly allocated to undertake one of the three standardised FYWSE scenarios (Table 2).

Data collection

Data were collected in the Clinical Skills Centre, Ninewells Hospital, Dundee except for the initial physiological baseline data which were collected in an adjoining lecture.
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theatre following the orientation lecture. All pre and post FYWSE data was collected within two minutes of the assessment commencing and concluding and were conducted out with the simulated environment.

Quantitative Data Analysis

Each student’s physiological data (vital sign scores) were entered into an Excel spreadsheet and all analyses were carried out with the IBM SPSS statistical package. The physiological data were also entered onto the Standardised Early Warning System (SEWS) scoring chart. SEWS is used in Scotland to calculate a score for all physiological measurements which highlights any parameters that are not within normal acceptable ranges (Paterson et al. 2006).

Mean and Standard Deviations for all vital sign scores of the 19 students who participated in the study were calculated at Baseline, Pre-FYWSE, and Post-FYWSE. The data were then further analysed using paired-samples t-tests to compare the actual Baseline, Pre-FYWSE, and Post FYWSE vital sign values of each student who participated in the study.

The students’ results was then split into those who passed the FYWSE and those who failed and independent-samples t-test analyses conducted to investigate possible
differences between the actual physiological values of the two groups at Baseline, Pre-FYWSE and Post-FYWSE.

With small samples sizes it becomes difficult to show that both samples meet the assumption of normality and therefore we repeated these analyses with Mann-Whitney U tests.

**Qualitative Data Analysis**

Open text responses were fully transcribed and were categorised against each question. A process of Qualitative description (Sandelowski, 2000 & Neergaard, 2009) was used to describe the experiences of the individual and their perception of stress during the FYWSE.

**Results**

Of the 19 students recruited to this research study 11 were female (58%) and 8 were male (42%). Ages ranged from 22 - 30 years. 5 students (26.3%) in the research group failed the FYWSE on their first attempt and 3 of those who failed the FYWSE were male (60%). The total failure rate for this cohort was 28.6% which was comparable with the rest of the year and representative of previous cohorts.
Quantitative Results

A comparison of the mean and standard deviation values of the vital signs for all 19 students who participated in the study (Table 3) indicated that physiological changes had taken place during the FYWSE. Paired t-test analyses to compare the actual vital sign scores of each student identified significant differences between values before, after, and during the FYWSE, particularly so between the Baseline and Post-FYWSE values where only the SpO₂% changes were not significant (Table 4).

In this study 6 x 3 = 21 paired t-test analyses were conducted and so a Bonferroni-adjusted (Bland & Altman, 1995) significance level of 0.002 was calculated to account for the increased possibility of a Type 1 error. After applying the Bonferroni correction to the p-values shown in Table 2, it can be seen that differences in respiration rate, temperature, and SEWS scores between Baseline and Post-FYWSE, as well as between Baseline and Pre-FYWSE for Temperature and SEWS scores, remained statistically significant.

The results of the participants was then split into those who passed the FYWSE (n = 14) and those who failed (n=5) to investigate possible differences in the measured physiological changes of these two groups. Figures 3 to 6 show comparisons of vital
sign changes from Baseline to Pre-FYWSE and then to Post-FYWSE for those participants who passed the assessment and those who failed. Independent-samples t-test analyses were then conducted to investigate possible differences between the actual physiological values for the group who passed the FYWSE and those who did not at Baseline, Pre-FYWSE and Post-FYWSE. The results of these analyses showed significant differences ($\alpha = 0.05$) between the two groups for diastolic blood pressure at Baseline ($p = 0.015$) and Post-FYWSE ($p = 0.006$) levels, for pulse rate at post-FYWSE ($p = 0.018$) level, and for respiration rate at Pre-FYWSE ($p = 0.010$) level.

Because of the small sample sizes, the above analyses were repeated using the Mann-Whitney U test. The results of these analyses supported the Independent-samples t-test results by indicating significant differences ($\alpha = 0.05$) between the group who passed and the group who failed for diastolic blood pressure both at Baseline ($p = 0.044$) and Post-FYWSE ($p = 0.014$) levels, for pulse rate at post-FYWSE ($p = 0.044$) level, and for respiration rate at Pre-FYWSE ($p = .026$) level.

**Qualitative Responses**

All student responses to the questionnaire were collected prior to the student receiving their individual feedback where they learnt if they had passed or failed the FYWSE. Students responses were categorised into a pass or fail group dependant on the
outcome of the assessment process. Students’ responses are grouped according to the questions.

**Question 1: How did you feel prior to undertaking the FYWSE?**

A mix of positive and negative emotions was noted in both groups prior to undertaking the FYWSE. The following responses were documented after the pre-simulation briefing and demonstrate the different perceptions of those who passed and failed the FYWSE. Although both groups are exhibiting stress responses there is a noted underlying confidence in personal capabilities in the student who failed the FYWSE which is not present in those who passed.

**Passed**

*I feel nervous, not that I do not feel prepared, but because I am not sure how I will react to a stressful ward environment. I am concerned that I may not be able to stay calm when I need to think clearly - I am looking forward to the ward sim [FYWSE] though because it will provide me with feedback & if I do fail I will have the opportunity to improve. Prior to foundation year [junior doctor rotation]. **Candidate 11***
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Nervous more than I have been for other assessments. Because I want to perform well at this. Because I should perform well at this. **Candidate 1**

Failed

Calmer than other ward sim [FYWSE] candidates I have met today. But still feeling under a little pressure. **Candidate 5**

Well prepared. Not anxious due to the feeling of I do not know what to do but moderately anxious in the sense of I hope I have a good day. I am most concerned about the 20 minute window of opportunity to show my ability. If I would rank last years final exams as 10/10 for sheer petrification I would rate how I feel now as 5/10. In the background I have a sense of this being my last true exam to show my skills (thus far exempt from OSCE) So I really want to make it count. Finally a number of my peers have already done this task and I feel slight competitive pressure to perform well. So far this year I have done 3 ward-based blocks learning the role of the FY1 [junior doctor] – this feels like enough to know what is expected. **Candidate 17**
Question 2: When did you feel most stressed during the FYWSE?

These statements were documented immediately following the FYWSE. All students identified feeling more stressed as the FYWSE progressed and the timed interruptions increased. The prioritisation of multiple demands appears to have tested both groups. All students identified feeling more stressed when dealing with the acutely unwell patient who deteriorates during the FYWSE. The medical student is asked to review this patient and is then expected to work collaboratively and systematically with the nurse to treat this patient whilst prioritising other competing demands. Those who passed the FYWSE are still attempting to prioritise their workload whilst those who failed are less successful in this action.

Passed

I was very aware of the time limitation throughout. I feel I rushed history taking (clerking). I was most stressed when dealing with the hypoglycaemic exercise. I should have called for senior help at this point when the patient was unresponsive. I was uncertain about prescribing the insulin fluids. Candidate 18
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When the nurse said the patient was now having chest pain radiating down left arm. As I realised I had a list of things (getting longer) that I had to do. When I had no idea what dose of morphine to give. **Candidate 10**

**Failed**

*Either: when I was deciding if I should stay with the 1st patient or review 2nd or when trying to figuring out what fluid to give. Candidate 13*

*Felt most stressed at when receiving phone call from GP as wanted to concentrate on acute management of patient, and make sure got through ABCDE. Candidate 15*

**Question 3: How do you feel now that you have completed the FYWSE?**

These statements were documented following the student conducting their self-assessment. Those who passed the FYWSE are critical of their ability to apply prior learning during the FYWSE and the impact this has on patient care. There is a noted reliance on past successes in the responses of those who failed the FYWSE. Those who passed the FYWSE appear to have engaged with the process of becoming critically reflective whilst conducting their self-assessment. Those who failed the
FYWSE continue to exhibit a lack of insight into their performance and have a greater degree of confidence in their abilities.

**Passed**

*I feel disappointment in my management of the critically ill patient. She required IV access and I should have done this earlier. But it has been an experience and I will work on my abilities to multi task and deal with interruptions.* **Candidate 11**

*I am relieved that the process is over however I am really disappointed in myself with my performance. I allowed my nerves to take over common sense and feel I did not act as I would have on a normal day to day basis on a clinical block.* **Candidate 7**

**Failed**

*Good to have practice, will feel more confident and calmer if I have to do it again. Would be interesting to see [my physiological] observations if I have to do it again.*

**Candidate 15**

*Relief – Felt I gave it a good shot as yet unaware of pass/fail, however if feel I performed at about 70% of my potential. Do not think anything seriously dangerous*
resulted from my actions. I would recommend it as an examination tool – but perhaps with two exposures on a “mock” prior to the real thing. Candidate 17

Discussion

Undertaking any assessment, especially one that is physically and mentally demanding, would be expected to induce a stress reaction in students (Hunziker et al. 2011) and this research study has shown that the FYWSE has a definite effect on the physiological parameters of students undertaking this performance assessment. The physiological effect of undertaking the FYWSE is more pronounced in relation to diastolic blood pressure, pulse rate and respiration rate in those who failed the FYWSE.

The United States Department of Health and Human Services (2004) has developed a comprehensive process for classifying blood pressure in adults over 18 years of age (Table 5). Applying the blood pressure classifications against both populations identified that those students who passed the FYWSE stayed in the pre-hypertensive state throughout the exercise whilst those who failed the FYWSE moved from being pre-hypertensive in their baseline recordings to stage 1 hypertension prior to the FYWSE and Stage 2 hypertension post FYWSE.
Those students who failed the FYWSE exhibited significant changes in their physiological status but showed less insight into the effect that this stress response had on their performance capacity.

It could be argued that students who failed the FYWSE progressed through the three phases of a stress reaction (alarm, resistance and exhaustion) as described previously by Leblanc (2009). Students who passed the FYWSE seemed to have a greater ability to adapt and cope with the stressors thus avoiding the exhaustion phase. In the instance of this study scenario 2 proved to be the most challenging exercise. Examining the written responses of those who failed this scenario would suggest that this group of students passed through the three phases of a stress reaction and became unable to prioritise competing demands and to confidently implement management plans. When answering question 3 the responses of this group of students were very introspective and focused upon themself. Those who passed this scenario were able to prioritise effectively during the FYWSE but were more critical of their performance thereafter. These students documented far more negative emotions in relation to their performance than those who failed this scenario. When answering question 3 the responses of this group of students focussed on the impact of their actions on the patients and the care that they had received.
Assessments have been identified as a key stressor in undergraduate medical education (Shaikh et al. 2004; Dimitriev et al. 2008). The open text responses demonstrated the role conflict that students experienced during the FYWSE. The internal conflict between the desires to perform well versus the confidence in one’s abilities is an emergent theme. The FYWSE challenged students’ perceived self-efficacy and in some instances there was a disparity between students’ perceived and actual abilities. This displacement prompted a re-evaluation of self in response to the FYWSE. A core determinant of this process is the student’s ability to reflect, calibrate, filter and assimilate dynamic interrelationships in a meaningful and productive manner (Bodner, 1986; Sargeant et al. 2010).

Although the ability to engage with the simulated environment and camera awareness might compromise or sanitise a students’ performance and subsequent learning (Dieckmann et al. 2007 & Lee, 2000), recording students’ performance enables self-review and more specific feedback of performance to be discussed. This study has shown correlation with the work of Harvey et al. (2010) in that there may be fortitude in identifying which students are more likely to have elevated stress responses during simulation activities so that institutions can target stress management training and support to those who most need it.
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Woolliscroft et al. (1993) identified that how an individual perceives themself is multi-dimensional and based on their actual performance, their potential performance and future aspirations. Over time this perception becomes resistant to change. Simulation is ideally placed to inform and ground these phases of self-conceptualisation. Kruger & Dunning (1999) identified that students in the top percentile of their cohort succumbed to a false consensus where they decreased their self-assessment scores to be more in relation to their peers. The reverse was shown in those in the lower percentile who lacked insight into their suboptimal performance and rated themselves higher. Therefore, highly reflective and introspective students will embrace negative self-concepts regarding their practice whilst those with low reflective abilities will endorse a more favourable evaluation of their abilities (Hixon & Swann, 1993). Understanding how a student rates their confidence and capabilities in relation to their practice would give a better understanding of how stress impacts on an individual’s performance capacity; is a stress response triggered by a disparity between perceived and actual performance or is it solely a reaction to environmental stressors.

Highly elevated stress levels can interfere with students’ ability to self-monitor and regulate performance. Training students to self-monitor in the moment could allow the development of frameworks that allow students to identify when they are exceeding their performance capacity and implement appropriate coping strategies.
Limitations

A limitation of this study is the small sample size and the fact that only five students in this group of 19 failed the FYWSE on their first attempt. The performance of the convenience sample was representative of the overall population and has demonstrated a meaningful interaction between stress and performance expressly in those students who failed this assessment. This study has shown correlations with the recent work by Pottier et al. (2013) in that both studies created realistic simulated clinical environment to allow researchers to identify the factors that illicit a stress response and then observe the effect that this response has on a student’s clinical and diagnostic reasoning. This study could be viewed as a pilot for a larger research study where the number of participants will be increased and more sensitive stress measurement tools will be used (such as analysis of cortisol levels and ECG recordings). This larger piece of work will allow the interpretation of the results to be more meaningful, defensible and generalisable.

Conclusion

This study has highlighted the relationship between stress and performance and the effect that this relationship can have on a student’s performance capacity during a complex simulation activity. The FYWSE is a multifaceted and sophisticated tool that
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allows the observation of how a medical student copes with competing demands and whilst managing a realistic clinical environment. This study has evidenced the relationship between stress and performance during the FYWSE. This relationship has been shown to be able to discriminate candidates, based on an individual student’s performance, to the extent that a rudimentary pass / fail judgement can be made by assessors.

The relationship between stress and performance in itself is not a new revelation but this study has shown that simulation has the potential to facilitate an exploration of the relationship between a student’s perceived levels of stress and their actual levels of stress. Identifying what factors cause a disparity between these measures could be used as a predictor of those at risk of developing sub-optimal performance and allow the instigation of appropriate measures to mitigate this effect. In the context of this study it is necessary to ensure that the FYWSE is a robust and reliable method for assessing final year medical students and that interventions are implemented that provides students with better stress management skills.
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students’ skills and feelings. Medical Teacher. 27(2): 130-135.


Illustrations and Tables

Figure 1: Students’ statements regarding how they felt prior to undertaking the FYWSE.

![Pie chart showing student feelings before FYWSE]
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Figure 2: FYWSE Student data collection form.

Is there variance between a final year medical students’ perception of stress and their recorded physiological data? How does this correlate with their performance during the Final Year Ward Simulation Exercise?

You are being asked to take part in a research study in which the investigator will try and determine what effect perceived and actual levels of stress have on your performance during the Final Year Ward Simulation Exercise.

This shall be achieved by recruiting final year medical students who are required to undertake the Final Year Ward Simulation Exercise as part of their final portfolio of evidence.

I will document your vital signs recordings at the following intervals:

- At the time of recruitment to give a base line measurement.
- I will ask you to record your vital sign recordings during a clinical shift when you feel particularly stressed.
- Prior to undertaking the Final Year Ward Simulation Exercise?
- Immediately after undertaking the Final Year Ward Simulation Exercise.

I will also ask you to complete a short questionnaire which will let me understand better the effect that the Final Year Ward Simulation Exercise has had on you personally.

1. How do you feel prior to undertaking the Final Year Ward Simulation Exercise?

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<th>Name</th>
<th>Age</th>
<th>Sex</th>
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<th>Pulse</th>
<th>Resp</th>
<th>Temp</th>
<th>Spo2%</th>
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2. When did you feel most stressed during the Final Year Ward Simulation Exercise?

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<th>After FYWSE</th>
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<th>Pulse</th>
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3. How do you feel now that you have completed the Final Year Ward Simulation Exercise?

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Figure 3. Comparison of changes in systolic blood pressure rates for the 14 participants who passed the FYWSE and the 5 participants who failed.
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**Figure 4.** Comparison of changes in diastolic blood pressure rates for the 14 participants who passed the FYWSE and the 5 participants who failed.
Figure 5. Comparison of changes in average pulse rates for the 14 participants who passed the FYWSE and the 5 participants who failed.
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Figure 6. Comparison of changes in average respiration rates for the 14 participants who passed the FYWSE and the 5 participants who failed.
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Table 1: Description of the three standardised scenarios

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<th>Scenario</th>
<th>Patient Category</th>
<th>Patients main problem</th>
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<tr>
<td>1</td>
<td>New Admission</td>
<td>Chest infection</td>
</tr>
<tr>
<td></td>
<td>Communication Issue</td>
<td>Operation cancelled</td>
</tr>
<tr>
<td></td>
<td>Acutely Unwell Patient</td>
<td>Hypoglycaemia</td>
</tr>
<tr>
<td>2</td>
<td>New Admission</td>
<td>Haemoptysis</td>
</tr>
<tr>
<td></td>
<td>Communication Issue</td>
<td>Death certificate required for family</td>
</tr>
<tr>
<td></td>
<td>Acutely Unwell Patient</td>
<td>Gastrointestinal bleed</td>
</tr>
<tr>
<td>3</td>
<td>New Admission</td>
<td>Patient suffering from delirium</td>
</tr>
<tr>
<td></td>
<td>Communication Issue</td>
<td>Patient with possible metastatic cancer</td>
</tr>
<tr>
<td></td>
<td>Acutely Unwell Patient</td>
<td>Myocardial Infarction</td>
</tr>
</tbody>
</table>
Table 2: Scenario allocation, student sex and outcome from FYWSE assessment

<table>
<thead>
<tr>
<th>Candidate number</th>
<th>Sex</th>
<th>Scenario</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>1</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>2</td>
<td>Pass</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>2</td>
<td>Fail</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>3</td>
<td>Pass</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>2</td>
<td>Fail</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>1</td>
<td>Pass</td>
</tr>
<tr>
<td>7</td>
<td>Female</td>
<td>1</td>
<td>Pass</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>3</td>
<td>Pass</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>1</td>
<td>Pass</td>
</tr>
<tr>
<td>10</td>
<td>Female</td>
<td>3</td>
<td>Pass</td>
</tr>
<tr>
<td>11</td>
<td>Male</td>
<td>3</td>
<td>Pass</td>
</tr>
<tr>
<td>12</td>
<td>Female</td>
<td>2</td>
<td>Pass</td>
</tr>
<tr>
<td>13</td>
<td>Female</td>
<td>2</td>
<td>Fail</td>
</tr>
<tr>
<td>14</td>
<td>Male</td>
<td>3</td>
<td>Pass</td>
</tr>
<tr>
<td>15</td>
<td>Male</td>
<td>3</td>
<td>Fail</td>
</tr>
<tr>
<td>16</td>
<td>Female</td>
<td>3</td>
<td>Pass</td>
</tr>
<tr>
<td>17</td>
<td>Male</td>
<td>1</td>
<td>Fail</td>
</tr>
<tr>
<td>18</td>
<td>Female</td>
<td>1</td>
<td>Pass</td>
</tr>
<tr>
<td>19</td>
<td>Male</td>
<td>3</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Table 3: Means and standard deviations of vital sign values at Baseline, Pre-FYWSE, and Post-FYWSE, for all 19 participants in the study.

<table>
<thead>
<tr>
<th>Vital Sign</th>
<th>Baseline</th>
<th>Pre-FYWSE</th>
<th>Post-FYWSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure – Systolic</td>
<td>131.3 (13.5)</td>
<td>137.5 (16.7)</td>
<td>144.8 (14.7)</td>
</tr>
<tr>
<td>Blood Pressure – Diastolic</td>
<td>83.2 (8.0)</td>
<td>85.8 (12.5)</td>
<td>92.8 (12.5)</td>
</tr>
<tr>
<td>Pulse</td>
<td>80.2 (14.1)</td>
<td>91.5 (16.2)</td>
<td>95.2 (17.8)</td>
</tr>
<tr>
<td>Respiration Rate</td>
<td>20.4 (3.4)</td>
<td>23.0 (3.2)</td>
<td>25.0 (2.7)</td>
</tr>
<tr>
<td>Temperature</td>
<td>37.0 (0.4)</td>
<td>36.4 (0.5)</td>
<td>36.5 (0.4)</td>
</tr>
<tr>
<td>SpO₂%</td>
<td>97.7 (1.3)</td>
<td>97.9 (1.0)</td>
<td>98.1 (0.9)</td>
</tr>
<tr>
<td>SEWS Score</td>
<td>0.5 (0.5)</td>
<td>1.2 (0.6)</td>
<td>1.3 (0.6)</td>
</tr>
</tbody>
</table>

Note: Standard deviations presented in parentheses
Table 4: Paired t-test results comparing Baseline and Pre-FYWSE, Pre-FYWSE and Post-FYWSE, as well as Baseline and Post-FYWSE vital sign values for all 19 participants in the study.

<table>
<thead>
<tr>
<th>Vital Sign</th>
<th>Baseline/ Pre-FYWSE</th>
<th>Pre-FYWSE/ Post FYWSE</th>
<th>Baseline/ Post-FYWSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure – Systolic</td>
<td>-2.38*</td>
<td>-2.30*</td>
<td>-4.0**</td>
</tr>
<tr>
<td>Blood Pressure – Diastolic</td>
<td>-1.0</td>
<td>-3.4**</td>
<td>-4.05**</td>
</tr>
<tr>
<td>Pulse</td>
<td>-3.43**</td>
<td>-1.44</td>
<td>-3.84**</td>
</tr>
<tr>
<td>Respiration Rate</td>
<td>-2.19*</td>
<td>-2.02</td>
<td>-4.58***</td>
</tr>
<tr>
<td>Temperature</td>
<td>7.31***</td>
<td>-0.59</td>
<td>9.71***</td>
</tr>
<tr>
<td>SpO₂%</td>
<td>-0.71</td>
<td>-0.44</td>
<td>-1.29</td>
</tr>
<tr>
<td>SEWS Score</td>
<td>-4.44***</td>
<td>-0.90</td>
<td>-5.33***</td>
</tr>
</tbody>
</table>

Note. * = p ≤ 0.05, ** = p ≤ 0.005, *** p ≤ 0.001, df = 18.
Table 5: The United States Department of Health and Human Services classification of blood pressure in adults (>18yrs).

<table>
<thead>
<tr>
<th>Blood Pressure Classification</th>
<th>Systolic Blood Pressure (mmHg)</th>
<th>Diastolic Blood Pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;120</td>
<td>And &lt;80</td>
</tr>
<tr>
<td>Pre Hypertension</td>
<td>120-139</td>
<td>Or 80-89</td>
</tr>
<tr>
<td>Stage 1 Hypertension</td>
<td>140-159</td>
<td>Or 90-99</td>
</tr>
<tr>
<td>Stage 2 Hypertension</td>
<td>≥160</td>
<td>Or ≥100</td>
</tr>
</tbody>
</table>