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**Publisher:** BioMed Central Ltd.

**DOI:** https://doi.org/10.1186/s41077-016-0010-5

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Please cite the published version
Title: Using video-reflexive ethnography and simulation-based education to explore patient management and error recognition by pre-registration physiotherapists.

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Abstract

Background

Upon graduation, physiotherapists are required to manage clinical caseloads involving deteriorating patients with complex conditions. In particular, emergency on-call physiotherapists are required to provide respiratory/cardiorespiratory/cardiothoracic physiotherapy, out of normal working hours, without senior physiotherapist support. To optimise patient safety, physiotherapists are required to function within complex clinical environments, drawing on their knowledge and skills (technical and non-technical) to maintain situational awareness to function efficiently whilst optimally managing the patient and filtering unwanted stimuli from the environment. Prior to this study, the extent to which final year physiotherapy students were able to manage a deteriorating patient and recognise errors in their own simulated practice was unknown.

Methods

A focused video-reflexive ethnography study was undertaken to explore behaviours, error recognition abilities and personal experiences of 21 final year (pre-registration) physiotherapy students from one Higher Education Institution. Social constructivism and complexity theoretical perspectives informed the methodological design of the study. Video and thematic analysis of 12 simulation scenarios and video reflexive interviews were undertaken.

Results

Participants worked within the expected professional standards of physiotherapy practice expected of entry-level physiotherapists. Students reflected appropriate responses to their own and others’ actions in the midst of uncertainly of the situation
and physiological disturbances that unfolded during the scenario. However, they
demonstrated a limited independent ability to recognise errors. Latent errors, active
failures, error producing factors and a series of effective defences to mitigate errors
were identified through video analysis. Perceived influential factors affecting student
performance within the scenario were attributed to aspects of academic and placement
learning and the completion of a voluntary acute illness management course. The
perceived value of the simulation scenario was enhanced by the opportunity to review
their own simulation video with realism afforded by the scenario design.

Conclusion

This study presents a unique insight into the experiences, skills attitudes, behaviours
and error recognition abilities of pre-registration physiotherapy students managing an
acutely deteriorating simulated patient. Findings of this research provide valuable
insights to inform future research regarding physiotherapy practice, integration of
educational methods to augment patient safety awareness and participant-led
innovations in safe healthcare practice.

Keywords
Error recognition, deterioration, physiotherapy, simulation-based education, video-
reflexive ethnography

Abstract Word count 344/350

Manuscript Word count 5183

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In 2009, The Chief Medical Officer’s report to the UK’s Department of Health [1] stated that simulation offers an important route to safer care for patients and needs to be more fully integrated into healthcare education. Over the last two decades, evidence has demonstrated the benefits of simulation-based education (SBE) in healthcare [2-6]. There is now strong evidence that SBE improves learning outcomes [7-8], clinical practice [9-11], improving confidence, competency and clinical decision-making [12]. The integration of SBE within training and education has been shown to be cost-effective and associated with significant health-related cost savings [13]. The drive to improve patient safety has drawn upon SBE to support the quality to organisational priorities and address healthcare system failures [14], reduce adverse events [15] and reduce in-hospital infection rates [16]. It is also recognised that optimal advantages of SBE are realised when the interventions are appropriately designed and evaluated [17-19]. Negative SBE learning experiences, may arise due to ill-designed scenarios [19], particularly when a learner is cognitively overloaded [20-22], inappropriate levels of fidelity and realism, inadequately trained simulation faculty, ineffective facilitation techniques, lack of or ineffective feedback [17, 19, 23-24]. The barriers to implementing SBE include: scheduling difficulties within curricula or training facilities, financial and time costs associated with the need for high staff to learner ratio, lack of available equipment to ensure equity of provision; lack of technical support and lack of funding for simulation resources [26-30].

SBE is not a new teaching modality within the physiotherapy profession. Clinical skill development (experienced during practice placements) on ‘real’ patients is deemed an essential component in the development of professional skills and has been used within
physiotherapy education since the inception of the profession in 1895 [26, 30-31]. SBE modalities reported in physiotherapy literature included role-plays involving simulated patients (peers, actors or volunteers trained to portray the role of a patient), paper vignettes, use of part-task trainers, haptic simulators, virtual reality simulators and computerised full body manikins [23, 25-39]. The extent to which simulation-based education (SBE) has been embedded within pre-registration physiotherapy curricula was outlined in a national survey in Australia [25]. A review of the UK provision and use of simulation was commissioned by the Department of Health in 2009. This review highlighted varied provision and use across the UK in medical, nursing and midwifery, allied health professional and clinical psychology education and training [23]. However, only one reference was made to the use of SBE within a single physiotherapy programme and no reported use within postgraduate physiotherapy training provided by National Health Service Trusts. Gough et al [30] reported that SBE was used to teach a wide variety of cardio-respiratory skills relevant to the acute respiratory and emergency on-call physiotherapy environments. National consistencies in adoption, availability, fidelity and accessibility have been similarly reported by both Australian and UK surveys [25, 30].

Jull et al [25] reported the use of problem-based learning or case-based learning approaches, (featuring lectures, tutorials, practical sessions, clinical education and simulation based learning experiences). However, the report lacked specific detail of the use and application of each simulation medium (mode of delivery). Three formal pedagogies that underpin Australian physiotherapy curricula include: a constructivist approach, computer-assisted learning approach and Blooms Taxonomy, have been reported by Jull et al [25]. The physiotherapy literature reports the use of facilitator-led
(instructional methods) within pre-registration and postgraduate physiotherapy education [25, 30]. No studies were identified that have involved student-led SBE in physiotherapy. SBE has been predominantly used in cardio-respiratory and musculoskeletal physiotherapy [32-36] and patient safety education [29]. Respiratory, musculoskeletal and neurological physiotherapy are an integral part of pre-registration physiotherapy education [37-38]. Physiotherapy programmes are required to demonstrate compliance with all nine of the Chartered Society of Physiotherapy’s (CSP) learning and development principles [39], to prepare learners to the continually changing healthcare environment. In addition, programmes are required to incorporate the CSP’s Physiotherapy framework: putting physiotherapy behaviours, values, knowledge and skills into practice [39]. Globally, physiotherapy students are required to complete 1,000 hours of placement-based education to prepare them for immediate clinical practice on graduation [25, 40].

The CSP recognised that newly qualified physiotherapists should be competent in respiratory care but will require further educational opportunities before becoming competent within the cardio-respiratory on-call context [40]. Concerns have been repeatedly raised regarding some physiotherapists’ abilities to deliver on-call respiratory physiotherapy in the UK, [40-43]. Additionally, the CSP published ‘Emergency Respiratory On-call Working: Guidance for Physiotherapists’ [40] in response to longstanding concerns regarding the delivery of physiotherapy care to patients who are at risk of deterioration (compromised respiratory function) outside of normal working hours (traditionally, 8.30am – 4.30pm). Discrepancies in training within respiratory physiotherapy services have been identified by numerous UK surveys pertaining to respiratory care and on-call physiotherapy [42, 44-45]. Roskell and Cross
[46] described the complex interactions a respiratory physiotherapist undertakes to function effectively within their clinical environment. The importance of the physiotherapist’s non-technical skills have been recognised including the need to maintain situational awareness to efficiently function whilst optimally managing the patient [46]. A recent study has highlighted that significant disparities in treatment outcomes have been reported when paediatric patients are treated by non-respiratory on-call physiotherapists compared to specialist respiratory physiotherapists [47].

This article will focus on the following research questions:

1) To what extent are final year pre-registration physiotherapy students able to independently manage an acutely deteriorating patient in a simulation context?

2) To what extent are final year physiotherapy students able to independently recognise errors within a simulation-based learning experience?

3) Which elements of prior learning do pre-registration physiotherapy students perceive may influence their performance within a simulation-based learning experience?

4) What value do pre-registration physiotherapy students attribute to the cardio-respiratory simulation-based learning experience?

This article builds on previous research by providing unique insights into the experiences, skills attitudes, behaviours and error recognition abilities of pre-registration physiotherapy students managing an acutely deteriorating patient in a simulation context. Prior to this study, pre-registration physiotherapy students’ acute illness management skills, error recognition abilities, concomitant influential factors
affecting performance within physiotherapy simulation scenarios and the perceived value of SBE in physiotherapy education had not been explored.

Methods

Prior to commencement of this study, university ethical approval was obtained (Reference number: 1102). This study follows an earlier study reporting a comprehensive examination of the use of SBE in cardio-respiratory physiotherapy education in the UK [30, 48]. Data was collected using survey methods. Findings from these surveys have been presented elsewhere [30, 48], and were used to develop the SBE resources presented in this paper. The current research study was informed by social constructivism [49-50] and socio-material (complexity) theoretical perspectives [51-53]. Video-reflexive ethnography (VRE) methodology [55-57] was used to explore performance, behaviours and personal experiences of final year (pre-registration) physiotherapy students from one UK, Higher Education Institution. Video-observation and focused, unedited video-reflexive interview methods were selected to capture multiple perspectives (approaches and understandings) and the complexity of managing an acutely deteriorating patient in a simulation context. A debrief was undertaken to resolve any erroneous events or discussions arising from the scenario or VRE interview. The debrief ensured that the participants were aware of any errors, or intervention that contravened professional practice and discussed how they could be mitigated in the future, if these were not already addressed in the VRE interview.

Participants:

Twenty-seven final year pre-registration physiotherapy students volunteered and consented to participate (34% of the maximum available sample size of 85). Random allocation of participants to dates was not undertaken. Accommodation of
participants’ preferred dates was undertaken to reduce the burden of participation and potentially the dropout rate. Despite allocating two students per simulation session according to participants’ preferences, three withdrew during the course of the study, three participated in the pilot and the remaining 21 completed the scenario and VRE interview reported in this article. Two doctoral students (from within the faculty) volunteered to undertake the role of the healthcare assistant in place of the withdrawn participants. The two volunteers both had prior experience of participating in SBE within the physiotherapy programme and were pre-briefed with the respective physiotherapy participants. In three scenarios, the pre-registration physiotherapy participant was allocated to the role of the physiotherapist and the doctoral healthcare student was assigned to the healthcare assistant role (Volunteer A and B). In the scenarios where a volunteer healthcare assistant (A or B) was involved, only the pre-registration physiotherapy students participated in the VRE interview. Thus in the remaining 9 scenarios, all participants were pre-registration physiotherapy students. All 21 pre-registration physiotherapy students participated in both the simulation scenarios and VRE interviews.

Data collection tools: The tools included video recording of the scenario and VRE interview. The VRE interview consisted of 21 specifically designed questions (available from the corresponding author), which aimed to promote self-reflection, whilst engaging in a critical discussion of themselves and their clinical practices [52]. The VRE interview schedule mapped directly to the research questions.

[Insert Box 1: Summary of the physiotherapy simulation scenario]
Data collection: Table 1 illustrates the seven key elements that underpinned the simulation design, development and analysis of the study. An authentic scenario (Box 1) was purposely designed to replicate the complexity of an emergency on-call physiotherapy situation involving an acutely deteriorating cardio-respiratory in-patient. The scenario was based on the findings from the national surveys undertaken in phase one [30, 48] and an anonymized patient case study. Participants were randomly assigned to either the role of the physiotherapist or healthcare assistant (HCA) in the scenario and orientated to the simulation environment and its equipment before receiving the pre-brief. Immediately following the scenario, a VRE interview was conducted, during which the participants reviewed their respective un-edited simulation videos. The VRE interview included a question that required the participants to review their respective video and provide a running commentary (thinking aloud) with respect to their assessment, physiotherapy intervention and clinical decision-making processes. The ‘Think Aloud’ method [58] was integrated within the VRE interview schedule to encourage participants to independently review the video and verbalise their clinical decisions and clinical reasoning. The VRE interview video was generated using the QuickTime software (http://www.apple.com/quicktime/download/) screen recording feature. This enabled the voice recording and simultaneous capture of the screen displaying the participants’ individual simulation experience. Data collection and storage was undertaken in line with the university ethical approval requirements.

Data analysis: Scenario and VRE interviews were transcribed verbatim (totaling 290 and 690 minutes respectively). Qualitative Thematic Analysis of 12 scenarios and VRE interviews were undertaken using video analysis software and a thematic framework approach [59]. A priori themes were integrated within the thematic video analysis from.
the acute illness management (AIM) rubric [60] Chartered Society of Physiotherapy framework [39], and non-technical skills for surgeon’s observational behaviour tool [61]. Quantitative descriptive statistics include the frequency and percentage of observed instances e.g. events, technical and non-technical skills, present in relation to the simulation scenario and interview analysis. Mean, standard deviation and range are also reported for assessment and management components of the scenario.

[Insert Table 1: The integration of seven key elements underpinning the simulation design, development and analysis of the study]

Results and discussion

Twenty-one students (5 male and 16 female) participated in both the scenario and VRE interviews. The mean (SD) scenario duration was 24-minutes (5) and VRE interviews 57-minutes (10) respectively.

1. *The extent to which final year physiotherapy students were able to independently manage an acutely deteriorating patient in a simulation context*

There are two focuses of analysis for research question one: video analysis of physiotherapy skills, knowledge and behaviours (Table 2), non-technical skills (Table 3) observed during the scenario and thematic analysis of interview data (Table 4).

Although all of the participants independently assessed the deteriorating simulated patient, their overall assessment was basic and in the majority of cases lacked structure. Despite some participants’ utilising the GMCCSI [57] acute illness management (ABCDE, airway, breathing, circulation, disability and exposure) approach to assess and manage the deteriorating simulated patient, this was not comprehensively
completed by any of the participants. A mean of 4.17 (SD 2.29, range 2-10) of the 19
assessment components and 4.67 of the 10 management (SD 1.07, range 3-7) were
completed. The scenario pre-brief information did not specify that a particular
approach to assessing the patient was required. This facilitated emergence, permitting
multiple and diverse ways of thinking and acting on information provided within the
scenario [69]. Within the VRE interview, participants also demonstrated attunement
when openly discussing their assessment strategies, mental models and
suggesting modifications to future practice (e.g. the adoption of a structured AIM
approach to facilitate effective assessment and timely intervention). Attunement,
emergence, disturbance and experimentation are some of the concepts within
complexity theory [53-54] that have not previously been explored within physiotherapy
SBE. During the scenario and VRE interview, participants’ demonstrated skills that
aligned with the professional standards of physiotherapy practice [39] expected of
entry-level physiotherapists (Table 2). Additionally, examples of how the participants
demonstrated achievement of these physiotherapy standards relating to knowledge,
skills, values and behaviours [39] within the VRE interview are also provided in Table 2.
In the majority of cases, the findings mapped directly to the entry-level descriptors.
There were some exceptions, where advanced graduate level reflective practice
descriptors [39] were evidently observed during the VRE interview. All participants
undertaking the role of the responding physiotherapist demonstrated a degree of
competency in managing a deteriorating patient, which was characterised by their
ability: to prioritise actions, demonstrate and understanding of abnormal clinical
findings and implement appropriate intervention [39, 68]. Participants demonstrated an
ability to reflect-in-action [insert Schon ref] during the scenario and later review their
own and others actions in the midst of uncertainty of the situation and physiological disturbances that unfolded during the scenario [53-54].

[Insert Table 2: Demonstration of physiotherapy knowledge, skills and behaviours]

Table 3 provides a summary of the participants’ non-technical skills, which mapped to the CSP behaviours, values, knowledge and skills framework [39] and non-technical skills for surgeons [61].

Participants demonstrated variable situational awareness skills (Table 3, Theme 1). All participants demonstrated an ability to gather appropriate information and demonstrating an immediate understanding of the situation (Table 3, Theme 1). To a lesser extent, participants were able to project or anticipate possible future changes in the patient’s condition. All participants verbalized their decisions, selected and communicated their options, implementing them appropriately and eleven reviewed their decisions (Table 3, Theme 2). In the majority of scenarios, participant demonstrated their ability to independently manage tasks, including planning and preparing the environment and equipment, demonstrating and awareness of standards, responding flexibly to changes in the patient’s verbalised needs or physiological parameters (Table 3, Theme 3). Leadership skills varied amongst participants, in particular relating to setting and maintaining standards for moving and handling and infection control (Table 3, Theme 4). Only two participants demonstrated a supportive attitude towards the healthcare assistant during the assessment or intervention (Table 3, Theme 4). Communication and teamwork skills (Table 3, Theme 5) also varied across the scenarios. An additional subtheme was identified relating to the teamwork and communication theme 5, which, referred to the use of a standardised communication
tool [70] when communicating with other members of the multi-disciplinary team (Table 3, Subtheme 5.5). During the scenario and VRE review, participants discussed their own level of expertise, requested help and delegated tasks appropriately. Overall, participants demonstrated attunement through their ability to listen to the patient and healthcare assistant (HCA) and patient, observing, touching and sensing the scenario that was unfolding [53-54]. This study has provided a unique exploration of physiotherapy non-technical skills demonstrated within a simulation scenario. Findings indicate that scenario and debriefing learning outcomes focusing on non-technical skills could be factored into the physiotherapy curriculum to enhance patient safety.

During the VRE interview, participants independently reviewed their unedited simulation video. As participants reviewed their respective video of their scenario, they reflexively discussed their behaviour. The thematic analysis is presented in Table 4, Theme 1: behaviour. Six themes were identified including: professionalism, situational awareness, communication, knowledge and skill deficit, clinical reasoning and error identification. Participants discussed their professional behaviour and future modifications (Subtheme 1). Fluctuations in the simulated patient’s physiological status and how this affected the situational awareness, clinical reasoning and choice of intervention was discussed (Subtheme 2). The impact of communication with each other and the patient was recognised by participants (Subtheme 3). Knowledge and skill deficits related to respiratory physiotherapy and oxygen therapy intervention (Subtheme 4). Participants reviewed their ability to clinically reason their actions (Subtheme 5) and identify errors during the scenario (Subtheme 6). The scenario was
designed to replicate the complex interactions a respiratory physiotherapist undertakes to function effectively within their clinical environment, including constant observation of the patient, and the noise and visual disturbances generated by monitors and equipment located within the visual field around the patient’s bed space and ward [46, 51, 53-54]. Participants discussed their interaction with the environment, artefacts embedded in the scenario and their resultant behaviours [53-54]. Despite being pre-registration physiotherapy students, the participants in this study demonstrated an ability to recognise the complexities and dynamics that unfolded within the simulated scenario, and to suggest alternative practices in future situations [55, 57].

2. The extent to which final year physiotherapy students were able to independently recognise errors within a simulation-based learning experience

There are two focuses of analysis for research question two. Table 5 presents the video analysis of the simulation scenarios, identifying error types and defences utilised by participants’ to mitigate errors. Additionally, thematic analysis of the participants’ ability to recognise errors is presented in Table 4, Theme 2. Video analysis identified one-hundred and seven errors during the scenario (Table 5).

Participants’ independently identified twenty-eight of the one-hundred these errors, two during the scenario and the remaining twenty-six during the unedited review of their scenario during the VRE interview. Thus, 79 errors (74%) were unrecognised by the participants either in-action (during the scenario) or on-action (when reviewing their video). The unrecognised errors related to key physiotherapy skills (poor auscultation skills, suction skills, failure to recognise abnormal, failure to seek/obtain the
prescription for the change in oxygen therapy prior to administration, errors in the delivery of physiotherapy intervention and a communication error). The participants’ limited ability to independently recognise errors encountered in their own simulated scenario was consistent with a previous study involving pre-registration nursing students [71]. Thematic analysis of the VRE interview identified six themes in relation to the participants’ ability to independently identify errors in their own scenario including: no errors, assessment, communication, infection control, moving and handling and intervention. No previous studies have explored pre-registration physiotherapy students’ ability to identify errors in their simulated practice using VRE. During the interview, the participants lacked insight into their own abilities regarding cardio-respiratory physiotherapy and AIM skills, moving and handling, and infection control procedures (Table 4, Theme 2). This is an important finding since a lack of insight into one’s own skills can have a fundamental impact on patient safety [72]. This study has identified that the use of VRE has the potential to facilitate the identification of participants who lack insight into their knowledge, skills and behaviours, and has the potential to play an important part in improving patient safety [55]. Ahmed et al. [75] proposed that reflection on personal performance and errors is critical in ensuring deep learning and positive behavioural change.

3. Perceived elements of prior learning that may influence performance within a simulation-based learning experience

Table 4, Theme 3 presents the thematic analysis of the VRE interview data relating to the influence of prior learning on performance within the simulated experience. Three
subthemes were identified: university units, placement and the AIM course [60]. During
the VRE interview, participants shared the impact of personal experiences, which they
perceived may have been central to their actions, clinical decisions, and physiotherapy
practice (Table 4, Theme 3). Whilst participants reported that the university units had
influenced their actions, clinical decisions, and intervention provided during the
scenario, they indicated that this was a unique, realistic experience that had not been
previously provided within cardio-respiratory skills sessions (Subtheme 1). Individual
placement experiences reportedly varied with some participants organising a
forthcoming respiratory-biased elective, as they had not yet been responsible for the
management of an acute or critical ill patient during placements (Subtheme 2). Whilst
the participants perceived the AIM course (Subtheme 3) provided the underpinning
knowledge and skills to enable them to grasp the key concepts of the scenario
(identification of the deteriorating patient, identification of abnormal clinical features
and initiate appropriate intervention), none of the participants fully completed an AIM
assessment (including airway, breathing, circulation, disability and exposure
components) during the scenario (research question 1).

4.  Perceived value attributed to the cardio-respiratory simulation-based learning
experience

Table 4, theme 4 presents the thematic analysis of the VRE interview data relating to the
perceived value attributed to the cardio-respiratory simulation-based learning
experience. Seven subthemes were identified: skills development, increased self-
awareness, placement preparation, added realism, patient safety, video review and
digital video disc. Participants felt that the experience provided an opportunity to
further develop their skills, putting theory into practice (Subtheme 1) and increasing
their self-awareness (Subtheme 2). The experience was deemed valuable for placement
preparation or as a refresher (Subtheme 3). In particular the participants’ valued the
realism afforded by the scenario (Subtheme 4) and the varied opportunities that SBE
provides in relation to positively impacting on patient safety (Subtheme 5). Value was
reportedly attributed to the scenario, as it provided an opportunity to practice and
utilise physiotherapy skills in a safe environment, learning from their own mistakes,
without risks to patients. Participants’ also valued the opportunity to review their
reflexively review their simulation video to influence future practice (Subtheme 6),
which afforded the ability to scrutinise their own and each other’s behaviour [55].
Additionally, they valued the opportunity to extrapolate their existing behaviours and
activities within the simulated scenario and project into the near future (elective
placement, EOC situations and post-graduation). The possibility to develop action plans
and use the digital simulation resources (generated from the scenario and reflexive
review) to evidence their personal development, within their electronic portfolio [74, 76]
was positively reported. Value was also attributed to the opportunity to repeatedly
reflect on their experience using the digital resources provided in preparation of future
learning activities in their forthcoming placement (Subtheme 7), which concurs with the
literature [74, 76]. The scenario and VRE interview permitted experimentation of
knowledge, skills, clinical reasoning and decision making within a situation that was
deemed by participants to be a realistic representation of acute respiratory
physiotherapy practice and valuable for pre-registration physiotherapy students prior
to placements [53-54]. Participants’ valued the opportunity to influence future practice,
during the video-reflexive review of their scenario, which afforded the ability to
scrutinise their own and each other’s behaviour [55, 57]. These are essential skills
required for autonomous practice as a physiotherapist [37-39].
Summary of the research findings

Participants independently assessed the patient within a simulation context, but their overall assessment was basic and in the majority of cases lacked structure and depth.

During the scenario, participants worked within the expected professional standards of physiotherapy practice expected of entry-level physiotherapists [39]. Participants demonstrated an ability to reflect-in-action (during the scenario) in the midst of uncertainty of the situation and physiological disturbances that unfolded during the scenario and later reviewed their own and others actions during the VRE interview [69].

However, they demonstrated a limited ability to independently recognise errors in their own simulated practice. Latent errors, active failures (communication verification, monitoring and intervention), error producing factors and a series of effective defences to mitigate errors were identified through video analysis. Perceived influential factors affecting performance within the simulation scenario related to learning attributed to the physiotherapy academic and placement components and participation in an additional, voluntary AIM course. The perceived value of the simulation scenario was enhanced by the opportunity to reflexively review their own simulation video and the realism afforded by the scenario design.

One additional product of this study was the development of an ‘integrated simulation and technology enhanced learning’ (ISTEL) framework. The ISTEL framework integrates the theoretical and educational practices that underpinned the simulation design, development and analysis of the study, implementation and evaluation of STEL interventions (appendix 1). In this instance, STEL is defined as the inclusion of simulation, simulated patients, and other ‘innovative educational technologies, such as
e-learning, smart phones, which provide unprecedented opportunities for health and social care students, trainees and staff to acquire, develop and maintain the essential knowledge, skill, values and behaviours needed for safe and effective patient care’[18:6]. It incorporates technology to enhance learning such as video-recording equipment to support the use of video debriefing, video-reflexivity and generation of podcasts of simulation scenarios. Further details of the development of the ISTEM framework and how it can be used to support the design, development, implementation and evaluation/research of STEL will be presented elsewhere.

Methodological strengths and limitations

This study highlighted the power of video-reflexivity to explore and uncover the multiple and complex realities of managing a deteriorating simulated patient, that are constructed via social, verbal and non-verbal interactions with the patient, others and the environment [51-52, 53-54, 56]. This study demonstrated that the VRE was successfully employed to facilitate error recognition and patient safety awareness. It allowed the participants to question their own knowledge, skills and behaviours in a manner that impacts on themselves and how they relate to patients in a simulated learning environment [57]. The visualization and narratives provided by the participants during the VRE interview offered the ability to understand the complexity of learning within the simulated learning environment. Findings of this research provide valuable insights to inform future VRE research regarding physiotherapy practice, integration of educational methods to augment patient safety awareness and participant-led innovations in safe healthcare practice. Carefully designed and executed STEL experiences, coupled with video-reflexive methods can offer a safe learning environment to allow learners to explore routine, evolving and complex clinical
situations whilst allowing them to learn to be become comfortable with making and exploring errors (mistakes/violations).

Reassuringly, findings have indicated the participants worked within the expected professional standards of physiotherapy practice [39]. The use of VRE allowed participants to openly reflect on their knowledge, skills attitudes and behaviours as well as identify errors and develop appropriate remedial action. This study demonstrated that VRE methods were successfully employed to explore the management of a deteriorating patient, facilitate error recognition and patient safety awareness, which may be equally beneficial to exploring medicine, nursing and allied health professions education and practice. It allowed the participants to question their own knowledge, skills and behaviours in a manner that impacts on themselves and how they relate to patients in a simulated learning environment [57].

This study highlights that learning is highly complex, requires context and continually evolves through social interaction [53-54], which may be extrapolated to medicine, nursing and allied health professions involved in managing deteriorating patients. One strength of this study is gained through the pragmatic approach, which drew on both qualitative and quantitative approaches, to explore learning and practice within the simulated environment and to establish the extent to which transformations in learning and/or patient care are realized, or not, by the learner [77]. By employing and triangulating qualitative and quantitative approaches to explore multiple levels of impact, the complexities of learning can be explored identifying areas of best practice and helping to remedy any deficits, to enhance the transformation between theory and practice [77].
The authors acknowledge the potential influences an insider-researcher perspective may have on this study. Whilst, insider-researchers have the potential to facilitate a greater understanding of the participants’ (physiotherapy) practices and social interaction, we also acknowledge the potential effect of acquiescence, owing to the principal investigator’s role as an academic on the physiotherapy programme [56, 78]. Additionally, the authors acknowledge that being an insider-researcher also brings various disadvantages, including the potential loss of objectivity due to relative familiarity of physiotherapy practice and introduction of bias through incorrect assumptions based on the researchers’ prior knowledge [78].

We acknowledge that the findings of this study are drawn from a BSc (Hons) physiotherapy programme, from one HEI in the UK. The participants were also only exposed to one deteriorating simulated, adult patient scenario. An adult scenario was selected as pre-registration students have limited exposure to paediatric patients. Participants were not followed up after their elective or graduation was undertaken at the time. It is acknowledged that such follow-up may have provided a valuable opportunity to explore the transfer of skills to their elective and employment beyond graduation.

Recommendations for education and research

Findings from this study have influenced on-going simulation scenario design within the physiotherapy curricula in relation to further embracing complexity of learning within simulation-based learning activities. Whilst the scenario embraced the complexity of emergency on-call situations, the findings have indicated that it is important to
recognise the knowledge and skills (technical and non-technical) limitations of pre-
registration physiotherapists. In this instance, the scenario was designed to replicate an
on-call situation that the participants may encounter within the forthcoming months, as
a qualified physiotherapist. The combination of SBE and VRE can provide supportive
learning opportunities that enable learners to move from their current level of
knowledge and understanding, into what is referred to by Vygotsky as the ‘zone of
proximal development’[62].

In this study, participation in the SBE scenario and VRE promoted the use of problem-
solving skills, as participants drew on their current and pre-existing knowledge gained
from the academic and placement experiences, to select appropriate information,
construct hypotheses and make appropriate clinical decisions. However, the findings
indicated that repetitive practical reinforcement of essential physiotherapy clinical skills
(e.g. auscultation, positioning, moving and handling and infection control procedures)
non-technical skills would be of benefit to pre-registration physiotherapy students
participating in simulation-based scenarios. Additionally, overt scaffolding of non-
technical skills (e.g. situational awareness, decision-making, task management,
communication and teamwork and leadership) may help to improve patient safety
within scenarios and facilitate translation through to practice. The provision of
additional ‘flipped classroom’[64] resources (educational videos and podcasts) have
been introduced to support repetitive practice of essential technical and non-technical
skills required to manage cardio-respiratory and acutely deteriorating patients.

Conclusion
In summary, this study has presented a unique insight into the experiences, skills, attitudes, behaviours and error recognition abilities of pre-registration physiotherapy students managing an acutely deteriorating simulated patient. This study has demonstrated that the combination of SBE and video-reflexive methods has the potential to facilitate the identification of participants who lack insight into their knowledge, skills and behaviours, and has the potential to play an important part in improving patient safety. SBE and VRE could be employed to explore the complexities of healthcare professional learning and practice beyond cardio-respiratory; in particular to highlight key gaps in the curricula, as well as the existence/deficits in learner knowledge, skills and behaviours. Findings of this research provide valuable insights to inform physiotherapy practice, integration of educational methods to augment patient safety awareness and participant-led innovations in safe healthcare practice.

References


795 List of abbreviations

796 HCA Healthcare assistant
797 ISTEI Integrated simulation and technology enhanced learning
798 SBE Simulation-based education
799 STEL Simulation and technology enhanced learning
800 VRE Video-reflexive ethnography

801 Author contributions

802 This article is a component of the doctoral thesis by Suzanne Gough entitled: The use of simulation-based education in cardio-respiratory physiotherapy in the United Kingdom.
803 SG conceived and designed the study, collected and analysed the data and developed the ISTEI framework in partial fulfilment of her doctoral studies. SG constructed the
article. AMY and JM were doctoral supervisors and have critically reviewed and approved the final manuscript.

Authors’ Information

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Acknowledgements

The authors would like to acknowledge Dr Pennie Roberts (Retired Head of Physiotherapy Department, Manchester Metropolitan University) for providing doctoral supervision. The authors thank Mrs Leah Greene (Manchester Metropolitan University) and the anonymous reviewers for their critical review of this article.

Competing interests

SG received funding for her PhD course fees from the Faculty of Health, Psychology and Social Care, Manchester Metropolitan University. JM and AY have no competing interests.