Management of the deteriorating adult patient: does simulation-based education improve patient safety?

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Abstract

Failure to recognise the deteriorating patient can cause severe harm and is related to preventable death. Human factors are often identified as contributing factors. Simulation-based education is used to develop clinicians' human factors skills. This article discusses the evidence concerning the efficacy of simulation-based education for improving the recognition and management of the acutely deteriorating adult patient, and the limitations of simulation-based education. Findings demonstrated simulation-based education was the most effective educational method identified for training staff in recognising unwell patients. The evidence demonstrating the impact of simulation-based education on patient outcomes was equivocal. The quality of the evidence was low grade regarding the efficacy of simulation-based education on human factors. Further research is required to confirm the efficacy of simulation-based education for human factors and patient outcomes.

Key words: Education; Healthcare; Preventable incidents; Simulation-based education; Simulation

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Introduction and background

The World Health Organization (2019) defined patient safety as the prevention of errors and adverse effects to patients. The Healthcare Safety Investigative Branch (2019) reported that failure to recognise the acutely deteriorating patient can cause severe harm and at times preventable death. The increased complexity of care and patient populations presenting with multiple morbidities, as well as the associated economic burden on healthcare systems, have resulted in encumbered health environments. Consequently, healthcare professionals are required to make increasingly complex decisions (World Health Organization, 2019). The National Institute for Health and Care Excellence (2007) developed guidelines to address concerns relating to the acutely deteriorating patient. Furthermore, preventable deaths have been widely investigated and this has been suggested as a measure of rating hospital performance in the UK (Panagioti et al, 2017; Manaseki-Holland et al, 2019).

Between January and March 2020 there were 566 647 patient-related incidents reported in the NHS in England (NHS England and NHS Improvement, 2020). The four main categories highlighted were implementation of care or monitoring (19.2%), patient accident (12.9%), admission, transfer or discharge (11.8%) and medication (9.9%). The majority of incidents occurred in the acute or general hospital setting (72.5%). A systematic review and meta-analysis reported that almost one in 20 patients experienced preventable harm (Panagioti et al, 2017), although the quality of the evidence was low to moderate. Furthermore, the incidencts of preventable deaths have been broadly reported as a result of inconsistencies of definitions, a lack of reporting and a diversity of measures for patient safety (Hogan et al, 2013, 2014; Healthcare Safety Investigative Branch, 2019). In 2005 investigations were carried out over 1 year to identify potential causes and contributing factors of preventable deaths (National Patient Safety Agency, 2007). Findings suggested ineffective non-technical skills (currently termed human factors) such as teamwork, leadership and poor communication, as well as a lack of training and implementation of protocols, were contributing and causal factors (National Patient Safety Agency, 2007).

Since then, multiple partnerships between the Royal College of Physicians, Health Education England, and NHS England and NHS Improvement have prioritised the

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improvement of interprofessional recognition and management of the acutely deteriorating patient. The partnerships have advocated the interprofessional and systemic incorporation of the National Early Warning Score monitoring tool and the situation background assessment and recommendations communication tool (NHS England, 2016; Royal College of Physicians, 2017a).

Simulation-based education is a training modality used to develop clinicians' human factors skills to improve the quality and safety of patient care (Association of Simulated Practice in Healthcare, 2016; Uramatsu et al, 2017). Furthermore, it provides a safe learning environment for participants to explore complex situations and promote healthy reflective practice regarding the making and exploring of errors (Gough et al, 2013). Perceived cost, inconsistencies of outcome measures used, diversity of uni-professional and interprofessional approaches and the quality of evidence may limit the implementation of simulation-based education in training programmes.

Educational strategies such as simulation-based education have been on the healthcare agenda internationally for many years. Early accounts of simulation-based education date back to the 1800s in midwifery education in France and in the 1900s in cardiopulmonary resuscitation training in Norway (Alinier and Platt, 2014). The Association of Simulated Practice in Healthcare (2016) defines simulation-based education as an activity involving any or a combination of role play, full body manikins, task trainers or simulated patients to replicate a specific complex environment. Simulation-based education has been delivered in preregistration training and post-registration training within universities and healthcare trusts. Simulation-based education has also been termed high, moderate or low fidelity simulation throughout the literature. The term fidelity refers to the different dimensions of simulation described such as physical, conceptual, psychological and emotional (Gu et al, 2017). The Association of Simulated Practice in Healthcare (2016) developed the National Standards Framework and Guidance for Simulation-Based Education in Healthcare across the UK. Although these guidelines have been developed to inform quality assurance processes of simulation-based education, they are not obligatory but currently function as a tool to facilitate innovation as highlighted within the framework.

A mixed-methods systematic review analysed the evidence of educational effectiveness in recognition and management of the deteriorating patient as well as the outcome measures used. The results demonstrated simulation-based education was the most effective educational method compared to interactive focus groups, tutorials, lectures, grand rounds, e-learning, seminars, slide presentations, theoretical training days and a 1-hour interactive situation background assessment and recommendations and Modified Early Warning Score training (Connell et al, 2016).

Simulation-based education and human factors training

Teamwork and leadership

There is an association between interprofessional teamwork and quality of patient care (Motola et al, 2013). The Royal College of Physicians (2017b) highlighted that the increasing complexity of healthcare potentially limits effective communication. Following a report on team communication they recommended an interprofessional approach to healthcare and education to maximise resources, performance, job satisfaction and coordination of care. A multiprofessional academic project comprising 95 healthcare students explored whether interprofessional simulation training using scenarios improved healthcare students' knowledge of other healthcare disciplinary roles and skills using simulation-based education (Alinier et al, 2008). Self-reported questionnaires were completed pre-simulation-based education by the control group (45) and post-simulation-based education by the experimental group (50). Findings suggested students' knowledge of the multi-professional roles improved and they were better prepared to enter the healthcare workforce.

Briggs et al (2015) investigated the human factors of 20 interprofessional trauma teams using a crisis resource management model of simulation-based education within a retrospective cohort design study. Performance was measured using the surgeons' framework for non-technical skills and the modified non-technical skills scale. Findings showed a statistically significant correlation between the team leaders' decision making and critical task (insertion of an endotracheal tube and chest tube placement) completion (r=0.351, *P*=0.039) as well as the team leaders' situational awareness and critical task completion (r=0.412, *P*=0.014). Team performance demonstrated similar findings. Decision making of the team and critical task completion were correlated (r=0.478, *P*=0.004) and a correlation between situational awareness and team performance was identified (r=0.438, *P*=0.008). However, there were no statistically significant relationships between communication, teamwork and leaderships skills and the team leader's completion of critical tasks. Results were similar for these skills and the team's completion of critical tasks. An interesting finding was the statistically significant correlations identified between the team leader and team's situational awareness (r=0.775, *P*=0.001), decision making (r=0.785, *P*=0.001), communication and teamwork (r=0.602, *P*=0.001) and leadership skills (r=0.657, *P*=0.001). However, the interpretation of these findings may be limited by the small sample size in the study. Furthermore, neither of these studies controlled for variables allowing for risk of bias and confounding factors. Nevertheless, these findings do support recommendations for an interprofessional rather than uniprofessional approach. They also provide insight into the potential relationships between the team leader and the team to work together during high stress environments.

Communication and confidence

The Healthcare Safety Investigation Branch (2019) produced an independent report about recognising and responding to critically unwell patients. The report discussed the findings of 31 investigations, 65% of which reported failure to escalate the deteriorating patient. This included failure to initiate appropriate treatment and poor communication. A prospective cohort study compared performance pre vs post-simulation-based education training (Steinemann et al, 2011). This involved groups of interprofessional trauma emergency teams. There was a significant (76%) increase of near-perfect task completion and resuscitation time decreased by 16%. Moreover, results demonstrated a subsequent change in clinical practice, 6 months following training.

A survey study exploring the clinical application of teamwork skills in interprofessional trauma simulation-based education, identified communication and decision making were barriers to teamwork skills (Murphy et al, 2019). Communicating task completion to the team lead was inconsistent and team members often escalated issues to members of the team they knew instead of the appropriate member role. This may be partly explained by the 51.2% of participants who did not feel confident to escalate issues during resuscitation. Although these findings may highlight human factors to include in training programmes, the response rate (37%) was low which may limit the generalisability of results. The Association of Simulated Practice in Healthcare (2016) standards framework and guidance for simulation-based education requires training to result in a significant increase in participants' confidence. However, pre- vs post-simulation-based education clinical application of communication skills and confidence were not measured.

A mixed-methods cohort study investigated the impact of simulation-based education on confidence and human factors of non-respiratory physiotherapists within a local on-call respiratory physiotherapy service (Mansell et al, 2019). Self-reported confidence levels pre- and post-simulation-based education demonstrated a statistically significant difference (*P*=0.034) and large effect size (r=0.57). Although the study was carried out uniprofessionally, thematic analysis demonstrated simulation-based education provided coping strategies for emergency on-call scenarios using cognitive tools such as the situation background assessment and recommendations tool which is used across medical and nursing professions. The interpretation of the quantitative findings is limited to descriptive analysis without a conclusive cause and effect. However, the mixed-methods design incorporating focus groups, provided further meaning to the data collected using thematic analysis. This demonstrated that simulation-based education may support the dissemination of communication tools and protocols into clinical practice to improve the recognition and management of the deteriorating patient.

The evidence suggests there is the potential for simulation-based education to support clinicians to deliver best practice in difficult environments as well as aid the transfer of knowledge into daily clinical practice. However, generalisability of the evidence is limited because of the variety of approaches, methodologies and diversity of outcome measures used. Nonetheless, these findings provide an awareness of the potential impact of communication skills and confidence upon clinicians' performance in delivering best practice in unpredictable and high stress environments.

Efficacy of simulation-based education and patient outcomes

Gjeraa et al (2014) carried out a systematic review investigating the efficacy of simulation-based education on interprofessional human factors for reaction, learning, behaviour and patient outcomes in trauma team training. They identified that simulation-based education significantly increased team performance but did not improve patient outcomes. The patient outcomes identified included the time taken from arrival in the emergency department to time of assessment, duration of time spent in the emergency department, complication and mortality rates and duration of stay in the intensive care unit and/or in hospital. However, only two out of the 13 included studies measured patient outcomes. All 13 studies were observational design studies. These included two retrospective studies and 11 prospective studies demonstrating a moderate to high risk of bias and none included randomisation. Therefore, the authors suggested the efficacy for simulation-based education improving patient outcomes remains unknown.

Cook et al (2011) completed a systematic review with meta-analysis to summarise the outcomes of simulation-based education for health professionals' education compared with no intervention. Pooled effect sizes demonstrated large effect sizes for knowledge (1.20, 95% confidence interval 1.03–1.16), time skills (1.14, 95% confidence interval 1.03–1.25) and other behaviours (0.81, 95% confidence interval 0.66–0.96). Moderate effect sizes were demonstrated for patient-related outcomes (0.50, 95% confidence interval 0.34–0.66). However, the heterogeneity of the research measured was large (>50%). This may be a result of the diversity of study designs, lack of randomisation and outcome measures.

Connell et al (2016) found the main patient-focused outcome measures used to evaluate the effectiveness of education in recognising and managing the deteriorating patient were patient mortality, intensive care unit admission rates and hospital length of stay. The authors speculated that the effectiveness of these outcome measures specifically related to education were difficult to measure because of the extent of uncontrolled variables. The authors recommended the use of quality patient assessment and documentation as patient outcome measures. Further research is needed to explore the validity of patient-focused outcome measures concerning the effectiveness of simulation-based education.

Limitations of simulation-based education

Faculty and quality of simulation-based education

A multicentre cross-sectional survey explored the implementation of simulation-based education in emergency medicine (Takahashi et al, 2019). Results showed a significant association between the number of faculty members and the quality of implementation for simulation-based education following adjustment of confounding factors (odds ratio 1.33, 95% confidence interval 1.10–1.60). Lack of faculty time (85%), payment (35%) and shortage of faculty members (29%) were identified as perceived barriers for the incorporation of simulation-based education. The authors suggested that a faculty programme was important to ensure the quality of simulation-based education. These findings are in agreement with reflections of faculty members delivering interprofessional simulation-based education for healthcare providers (Watts et al, 2020). The authors suggested that faculty development, an overall needs assessment, curriculum integration, logistical plans, a structured pre-brief and debrief plan and a process evaluation were vital factors for effective implementation of interprofessional simulation-based education. However, the cost to support protected time of faculty members with the relevant expertise is the largest contributed cost of implementing simulation-based education (Watts et al, 2020).

Costs

Reporting of costs has been inconsistent throughout the evidence. A systematic review found that only 6.1% of 967 studies reported any costs concerning simulation-based education (Zendejas et al, 2013). The majority (71%) of studies only reported costs of the mannequin itself. Ten potential cost components such as staff training and facility costs were not reported by the included studies.

A randomised controlled trial compared high and low fidelity simulation and the effect on human factors teaching for medical doctors. Results suggested there were no significant differences between the types of simulator and the outcomes on human factors (Gu et al, 2017). Therefore, this study suggests educators may consider lower cost methods for delivering simulation-based education. However, the study was not double-blinded so observer bias may have occurred. Furthermore, many of the participants had previously completed simulation-based education before the trial which may have influenced outcomes.

The Association of Simulated Practice in Healthcare (2016) emphasised that support for funding by both academic and health organisations is important to ensure the quality of simulation-based education delivery and therefore clinical education. Moreover, the guidance highlights the significance of programme planning to ensure efficient use of resources such as time (Association of Simulated Practice in Healthcare, 2016). However, the guidance does not provide parameters of time for implementation of simulation-based education in clinical training.

Time

Connell et al (2016) completed a systematic review evaluating the effectiveness of a variety of education methods in recognising the deteriorating patient. More than 87% of education methods used simulation-based education. The duration of simulation-based education sessions varied from 44 hours to 40 minutes with a mean of 8 hours. The most effective simulation-based education identified lasted 40 minutes. The 40-minute simulation-based education session was investigated in a UK comparative randomised prospective interventional study (Crofts et al, 2007). Randomisation reduced the risk of bias and the observational design limits inferring causal findings. Therefore, understanding the effectiveness of the 40-minute programme for services to implement simulation-based education in clinical training is unclear. However, controlling for the diverse variables within simulation-based education training challenges the methodological design of this area for research. Moreover, the identified discrepancies for the duration of simulation-based education training sessions may limit service implementation and prioritisation by clinicians who are regularly short of time. Further evidence is required to understand the optimal time commitment for clinicians and educators to improve the implementation of simulation-based education.

Discussion

Appropriate use of human factors such as leadership, teamwork and communication is challenging. This may be a result of the growing demands placed-upon the current health system and increasingly complex decision making required of health professionals. However, continuous professional development of human factors should be a priority, because evidence suggests poor human factors are causal and contributing factors to preventable incidents and deaths concerning the recognition and management of the deteriorating adult hospitalised patient. Evidence has shown simulation-based education is the most effective educational training tool for improving human factors as well as confidence, task performance, adherence to protocols and appropriate team referrals. Furthermore, the most effective simulation-based education demonstrated the shortest implementation time (40 minutes). Simulation-based education provides a safe environment for health professionals to make mistakes at no risk to the patient. Therefore, simulation-based education may contribute to supporting and developing clinicians' human factors for complex decision making in emergency environments. Subsequently, simulation-based education may ensure safer quality care for patients in difficult circumstances. However, the evidence demonstrating the effectiveness of simulation-based education for developing human factors is low grade and

Key points

- Failure to recognise the acutely deteriorating patient can cause severe harm and at times preventable death.
- The highest percentage of reported patient incidents in the NHS occur during implementation of care and monitoring patients in acute general hospitals.
- Human factors are contributory and causal factors for patient-related incidents concerning the recognition and management of the acutely deteriorating patient.
- The evidence suggests there is an association between simulation-based education and the improvement of clinicians' human factors as well as confidence and performance.
- However, the quality of studies identifying the efficacy of simulation-based education and human factors is limited.
- Evidence establishing the effectiveness of simulation-based education and patient outcomes is unclear.
- Future research comprising of generalisable methodologies and validated outcome measures is required to provide conclusive findings of the efficacy of simulation-based education for human factors and patient-focused outcomes.

the impact on patient outcomes and service costs is currently unknown. Varied reporting of time taken for implementation as well as discrepancies between quality assurance standards could explain the inconsistent implementation of simulation-based education across the NHS. Currently there is no conclusive standardisation of simulation-based education. This may be because of the diversity of research methodologies and complexity of knowledge translation into practice.

Conclusions

Further research comprising of robust methodologies is needed to confirm the efficacy of simulation-based education on human factors and patient outcomes. A mixed-methods approach may facilitate an efficient implementation strategy of simulation-based education and determine its value in the training of services and clinicians.

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