Integrating awareness of the role of human factors in medical errors into a curriculum for foundation doctors: learning from clinical incidents

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Abstract

Problem

A considerable number of hospital inpatients will experience harm as a result of clinical error. Whilst there is a comprehensive investigation and reporting process when errors do occur, we are not maximising the opportunities to learn from these and reduce the risk of patients coming to harm in future.

Intervention

To address this, a course was designed and implemented to deliver human factors training using a combination of simulation methods to all foundation doctors across a large region of the UK. This was done following a review of significant untoward incidents occurring in a 12 month period at a large teaching hospital trust. The human factors contribution to the incidents was examined and the course content designed around this.

Context

This course has been delivered to all Foundation Year One (postgraduate year one) doctors across the East Yorkshire region in the United Kingdom for two consecutive years.

Outcome

Pre- and post-course confidence was recorded and the cognitive performance of trainees analysed at two time points. Attendance at the course resulted in a significant increase in confidence levels, and a significant degradation in cognitive performance between two time points was demonstrated.

Lessons learned

It is feasible and acceptable to teach human factors to a large number of foundation trainees using this format, utilising the lessons learnt from real clinical incident reports. This results in an increase in confidence when recognising the role that human factors play in medical practice.

Introduction

A substantial number of patients admitted to hospital will suffer harm as a result of healthcare error[1–3]. Many of these adverse incidents will be reported and investigated, but can we be more proactive in the information we gain from the investigation of errors in training clinicians?

The investigation of significant untoward incidents (SUIs) is a complex process, supported by recommendations from national bodies[4]. When SUIs associated with errors in practice occur, lessons can be learned to reduce the risk of such events happening in the future. This is contingent on the dissemination of reports and learning points from the investigation, made available to healthcare staff in a format which they can apply to their daily practice[5]. Unfortunately, whilst reports may be available, it is uncommon that these are taken forward by educators and embedded into curricular learning[6,7].

Human factors is the cognitive interface between human operators and healthcare systems. It has been shown that human factors often play a significant role in the sequence of events leading to an error.[8] In many cases, there is no deficiency in technical skill or knowledge and yet inappropriate decisions, poor awareness of situation and breakdowns in communication or teamwork lead to patients coming to harm[2,9–11]. This often occurs as a result of multiple errors or system deficiencies, each of which could have prevented the harm occurring

if they had not happened, giving rise to the 'Swiss Cheese' model proposed by Reason[12].

There is no agreed standard for human factors training, these transferable skills are not taught in a uniform fashion. There is also no formal teaching within the curriculum which describes how medical error is investigated and reported. It was felt that this is an area which was lacking from the Foundation Programme training scheme in Yorkshire and the Humber. We therefore set out to design and deliver a training programme for foundation doctors (postgraduate years one and two) with the specific learning outcomes to raise awareness of the role that human factors play in healthcare and adverse events, based on actual incidents which had occurred locally. We are not aware of any similar human factors courses based on learning from clinical incidents running in the UK.

Methods

Course design

A review of the database of significant untoward incidents and critical events occurring in a 12 month period at a Hull and East Yorkshire Hospitals NHS trust was conducted. A thematic review of 65 reports was conducted to identify the human factors component to the events that had occurred. From this, the themes themselves were matched with recognised human factors concepts and the content of the course was based on this.[13] Sessions were matched to a clinical incident which was presented with identifiable details of locations, staff and patients removed.

This course was designed from the outset to be deliverable across a variety of facilities, including those with limited access to high fidelity simulation equipment. In particular, the 'Investigation of Error' session was designed as a novel method of allowing participants to simulate a root cause analysis of a critical incident. This was achieved through a re-enactment of a critical incident, which participants were then asked to analyse and perform a root cause analysis on. A DVD and comprehensive course manual was prepared. All faculty themselves underwent human factors training, and attended a 'train the trainers in simulation' event. The opportunity for co-facilitation was offered to inexperienced faculty to allow them to deliver courses alongside more experienced faculty.

Full scale clinical simulation was used for stress and distraction, loading participants with multiple tasks and distractions throughout. The

Table 1: Session Content

Session	Nature of incident	Human Factors
Introduction to human factors *Includes a showing of the video "Just a Routine Operation"* [20]		
The patient experience Recorded Interview with a patient who suffered a surgical error	Failure to recognise complication	Communication, situational awareness
Stress and distraction (immersive simulation)		Stress and distraction, authority gradient, leadership, teamwork, decision making
Investigation of error	Diagnostic error (missed diagnosis)	Communication, leadership, teamwork, decision making
Authority gradients	Diagnostic error (missed diagnosis)	Authority gradient, teamwork, leadership
Situational awareness	Therapeutic error (inappropriate prescription leading to harm)	Situational awareness, decision making
Mental agility		Stress, distraction and fatigue

effect of fatigue and stress was demonstrated through a mental agility challenge both at the start and end of the day under time pressure. A video was recorded of a patient who had experienced harm as a result of error, and wished to use his experience as a result of a medical error to offer perspective.

Data collection and analysis

Pre- and post-course confidence questionnaires were designed using a 5 point Likert-type scale to establish confidence in the domains of human factors, understanding of the process of error investigation, and also acceptability and perceived utility of the course in the context of Foundation training. Non-parametric analysis of this data was conducted using Wilcoxon Signed Rank analysis. Descriptive analysis was used to describe the perceived utility of the course, and thematic analysis of the free text comments performed. The scores from mental agility tests were collected from participants compared using t-tests to establish whether there was a significant difference in cognitive performance between the two time points.

Results

For the first year of this course, feedback responses were collected for 138 attendees from 9 courses (15.3 +/- 2.5 per course). In the second year, there were 135 attendees to 7 courses (19.3+/- 3.9). All were at Foundation Year 1 (FY1) level.

Table 2: Pre and post course confidence questionnaires (1= not confident, 5 = very confident)

	Pre Course (mean, standard deviation)	Post Course (mean, standard deviation)	Change	P
How confident do you feel in delegating tasks appropriately in an emergency?	2.90(0.865)	3.47(0.698)	+0.57	<0.001
How confident do you feel in developing a problem list and action plan to prioritise tasks in an acute emergency?	3.01(0.827)	3.61(0.682)	+0.6	<0.001
How confident do you feel in identifying performance reduction when tired or fatigued?	3.31(0.919)	3.91(0.687)	+0.6	<0.001
How confident do you feel in managing performance reduction when tired or fatigued?	2.85(0.887)	3.71(0.745)	+0.86	<0.001
How confident do you feel about your ability to manage distraction?	3.05(0.847)	3.68(0.688)	+0.63	<0.001
How confident do you feel leading in acute medical emergencies?	2.45(0.880)	3.21(0.733)	+0.76	<0.001
How confident do you feel recognizing that senior input is required?	3.94(0.761)	4.19(0.687)	+0.25	<0.001
How confident do you feel in communicating with patients when errors have occurred?	3.22(0.868)	3.71(0.766)	+0.49	<0.001
Do you understand the process of investigating a serious untoward incident?	2.78(0.898)	4.10(0.702)	+1.32	<0.001

38 respondents (14%) reported having had previous formal training in human factors. This was consistent across both years. Results from the questionnaire are demonstrated in Table 2.

Participants were asked to provide a score from 1 to 5 for their overall impression of each scenario and its contribution to the day, to grade the scenarios for realism and difficulty, and whether feedback from facilitators was useful, shown in Table 3.

Table 3: Individual session scores (1=poor, 5 = excellent)

Session	Mean Score	Standard Deviation
Introduction to Human Factors	4.20	0.72
Patient Experience	4.29	0.64
Stress and Distraction	4.32	0.68
Authority Gradients	4.24	0.76
Investigation of Error	4.37	0.67
Communication and Situational Awareness	4.28	0.73

Table 4: Overall comments post course

	Agree (n)	Disagree (n)	No response (n)
The scenarios felt realistic	144	0	129
The difficulty level of the scenarios was realistic	195	3	78
Feedback from facilitators was useful	246	2	27
This day is a useful addition to the foundation programme	245	3	28

Qualitative analysis

A broad brush word frequency query was run on all free text comments received (n=184). The top six words are displayed in Table 5, and graphically in Figure 1.

Figure 1: Word Frequencies

Table 5: Word frequencies in feedback

Word	Frequency (%)
Useful	4.26
Good	3.83
Individuals	3.49
Communication	2.54
Skills	2.17
Opportunities	2.04

Thematic analysis of the comments was then conducted on the comments. The majority of comments were positive in tone (285 comments), and within this, 98 comments were made that the learning from the course would be useful or relevant to clinical practice. 68 comments identified the methods of facilitation as a positive attribute, and 47 identified the scenarios used as realistic to clinical practice. Four comments referenced an increased awareness of human factors issues following the course, and three comments felt that this would positively affect patient safety.

47 comments were recorded as negative in tone. The issues raised included aspects which were felt to be missing (23 comments) – primarily guidance on managing fatigue, authority gradients and stress and distraction in addition to awareness. Poor timing of the course delivery (2 comments, more suitable at undergraduate level or at induction), topic already covered (2 comments) and misjudgement of the level that the course was delivered at (8 comments). 8 comments referenced a wish for more simulation practice within the day and four found the facilitation to be poor.

Table 6: Themes in feedback

Theme	No. of comments
Useful or relevant to clinical practice	98
Good facilitation	68
Realistic scenarios	47
Increased awareness of human factors	4
Potential to improve patient safety	3
Subjects not included	23
Delivered too late	2
Repetition	2
Delivered at wrong level	8
Not enough simulation	8
Poor facilitation	4

Discussion

Specific training in human factors recognition and management amongst junior doctors in the UK is uncommon. Coupled with this, the lessons we can learn from untoward incidents in healthcare are underutilised. The review of adverse events occurring which was conducted in the preparation of this course revealed that human factors had a role to play in almost all of the incidents examined, often in conjunction with technical errors or system deficiencies. There is growing evidence that in an age of increasing technical complexity of healthcare and systems, human factors play a key role in the safety and quality of the care we deliver to our patients[14,15].

Finding faculty to deliver this course was at times challenging, all the faculty used had specific training in human factors and debriefing simulation scenarios with a human factors emphasis. The pool from which to draw this faculty was small, and encouraging new faculty to take the time to train and deliver this was difficult. Reasons cited for this were time constraints. This is somewhat surprising; those approached were often senior clinicians with extensive clinical responsibility and the authors consider this to be a reflection of the low awareness and prioritisation that human factors training in healthcare currently occupies, and the intense pressure clinicians are under, itself a contributory factor to error.

Baseline questionnaires revealed that a minority of participants had had human factors training prior to attendance at this course (14%), and assessment of confidence scores demonstrated low levels of confidence in certain areas relevant to the day-to-day practice of medicine such as leadership in medical emergencies, delegating and prioritising, and managing fatigue and distraction. Attendance at this one day course targeted specifically at these human factors appeared to significantly increase confidence levels, and it is hoped that this translates into more confident and assertive doctors in clinical practice. The biggest gains in confidence were seen in candidates' understanding of the process of investigating a serious untoward incident, an area which was poorly understood prior to this course. It is anticipated that the lessons learned from dissecting these specific incidents will be directly applicable to the practice of the doctors.

This course has demonstrated the feasibility and acceptability of delivering human factors training to a large number of trainees. The use of real-life clinical incidents adds familiarity and relevance when discussing abstract concepts in cognitive psychology. Analysis of the participants' comments shows that a large number consider the content to be relevant to clinical practice and that the scenarios used are realistic. Some referenced the increased awareness of human factors issues arising from the course and potential for patient safety improvements as a result. We did not ask participants specifically about this, and therefore others may not have considered this whilst making their response.

One commonly occurring theme from analysis of the free text comments was that the clinical simulation exercises were well received and that participants would welcome more of this. Simulation is commonly used in high risk industry as a vehicle for the delivery of human factors training[16–18]. Studies of simulation so far have failed to demonstrate an explicit link between delivery of the training and improved patient outcomes, primarily due to difficulty in designing such studies however it is widely accepted and increasing in scope and usage.

A variety of approaches to human factors simulation training have been described, most commonly focussing on team drills in emergency

clinical scenarios. Whilst direct comparison with our approach is not possible, we consider this approach to be a reasonable and pragmatic delivery method to introduce trainees at the start of their career to the principles. It is envisaged that they will go on to have further simulation training throughout their postgraduate careers. It is also hoped that participants will take a deeper interest in incidents occurring within their departments, and be encouraged to pursue and act on the report of investigations that happen. This course has now been added as a mandatory component of Foundation training within the region so that all doctors in their first postgraduate training year will attend.

The results from the mental agility testing demonstrate a significant degradation in the performance of the trainees from the start of the day to the end. The questions were aligned with the level of difficulty expected at the '11 plus' examination, comprising mental arithmetic and verbal reasoning questions expected to impose moderate cognitive load. With little time pressure and when the participants could be expected to be unfatigued at the start of the day, scores were high. The drop off in performance could be attributed to a combination of the effects of fatigue, increased time pressure and the anticipation of the imminent end of the course, resulting in increased distraction and a decrease in available cognitive reserve. This effect has been well documented, and studies have suggested that accident and error rates increase with increasing length of shift and distraction. It is not possible to infer from these data whether participant fatigue is the sole or main cause of this deterioration, or whether the other distracting factors contribute to a greater degree.

Limitations

We were unable to involve each participant on this course as an active participant of the clinical simulation, relying on volunteers whilst the other participants watched via video link in order to enable a full and thorough debriefing. Debriefing was targeted to examine the issues relevant and not individual performance. Given the number of trainees and resources available, this was felt to represent the most pragmatic solution.

The use of pre and post course confidence score measures represents evaluation of the effectiveness of learning at the lowest level of the Kirkpatrick hierarchy, and post course confidence was assessed immediately on completion, which did not allow any evaluation of retention[19]. Further studies should focus on assessment of whether this type of training has the potential to positively effect upon clinical practice of participants and the retention of skills. Qualitative analysis of the comments received was limited due to the unfocussed nature of the question. A more structured approach would allow for a more in depth analysis.

Conclusions

This study has demonstrated that the delivery of human factors training using the lessons learned from clinical incidents to a large cohort of doctors at UK foundation level is feasible, acceptable and results in a significant increase in confidence in the recognition and management of human factors affecting clinical practice, performance and patient safety. This fills an important gap in the knowledge and skills of our clinicians at the outset of their postgraduate training. The use of a mix of simulation methods, pre-recorded video scenarios and the experiences of a real patient who was able to recount their experience added value to the learning experience. Collaboration with other centres is planned. We are also looking at ways of increasing simulation at foundation level.

Competing Interests

The authors declare no competing interests for this study. Salary funding for JG, SP, FC, RM and IA was provided from Health Education Yorkshire and Humber which this work was performed for. MP is employed by Hull and East Yorkshire NHS Trust in the capacity of Director of Medical Education, and is responsible for supervision of JG, SP, FC, IA and RM.

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Ethical approval was not sought for this work. Participants attendance at the Human Factors day was mandated as part of their role, but all data collected was surrendered voluntarily, and no personal or identifying information was collected.

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