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The Introduction of "Safety Science" into an Undergraduate Nursing Programme at a Large University in the United Kingdom

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Abstract: Implementing safety science {a term adopted by the authors which incorporates both patient safety and human factors (Sherwood, G. (2011). Integrating quality and safety science in nursing education and practice. *Journal of Research in Nursing*, 16(3), 226–240. doi: 10.1177/1744987111400960)} into healthcare programmes is a major challenge facing healthcare educators worldwide (National Advisory Group on the Safety of Patients in England, 2013; World Health Organisation, 2009). Patient safety concerns relating to human factors have been well-documented over the years, and the root cause(s) of as many as 65–80% of these events are linked to human error (Dunn et al., 2007; Reason, 2005). This paper will describe how safety science education was embedded into a pre-registration nursing programme at a large UK university. The authors argue that the processes described in this paper, may be successfully applied to other pre-registration healthcare programmes in addition to nursing.

Keywords: patient safety, human Factors, pre-registration, nurs*, nursing curriculum

Introduction

Understanding the concept of human factors is now recognised as a key element in improving patient safety (Dekker, 2011; National Advisory Group on the Safety of Patients in England, 2013) and helps in understanding how healthcare systems can "minimise the patient's exposure to hazards and near-misses, reducing the risk of unnecessary harm associated within healthcare to an acceptable minimum" (Kohn, Corrigan, & Donaldson, 1999, p. 34). Human factors theory also provides an understanding of the interface between human and tasks, teams, equipment, workspaces, environments and organisations, the effect of these on human behaviour and performance, and the application of that knowledge to healthcare settings (Fletcher, 2015).

A safety science approach to patient safety now underpins much current thinking as it offers an evidence-based, coherent approach to reducing avoidable harm (Rabøl et al., 2011; Sherwood, 2011; UK National Quality Board, 2013). In recent years, reports from the UK, Germany, New Zealand, Canada, the United States, Denmark, and the Netherlands have all described the need to incorporate safety science into their healthcare systems (Rabøl et al., 2011; White, 2012). In the UK, Professor Don Berwick also stated that: "... quality and patient safety sciences and practices should be part of the initial preparation and lifelong education of all health care professionals ..." (National Advisory Group on the Safety of Patients in England, 2013, p. 24). To create a common understanding, the two topics of *patient safety* and *human factors* were combined into one new subject heading called *safety science*. This term is based on work undertaken by Quality and Safety Education for Nurses team (2005).

Literature search

As a result, the decision was taken to incorporate safety science content into the undergraduate pre-registration nursing programme. The first stage of the process was a comprehensive literature review of the current literature on *human factors, patient safety* and *pre-registration nurse education*. Using the Population, Intervention, Comparison and Outcome (P.I.C.O.) framework (Richardson, Wilson, Nishikawa, & Hayward, 1995) the following searchable question was devised: "What programme developments may be used to improve pre-registration student nurses' learning about patient safety and human factors?" (see Table 1).

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Table 1: PICO search strategy.

	Key Words	Synonyms And Other Terms
Population	Pre-registration student nurses	Student nurs*. Pre-registration nurs*. Undergraduate nurs*.
Intervention	Patient safety and human factors	Crew resource management. Team training. Non-technical skills. Ergonomics
Comparison	Programme development	Course development Programme development
Outcome	Not required for this search	Not required for this search

The databases selected for the purpose of this review reflected the broad nature of the subject: Nursing and Health (CINAHL, Medline), Education (ProQuest education), Social Sciences, including Organisational Psychology (Scopus).

Search terms were combined using Boolean logic and following the search, abstracts were reviewed and relevant papers collated. A total of 14 papers were identified and reviewed (see Table 2).

Table 2: Database search.

Database	Number of results	Relevant results from title	Relevant results from abstract
CINAHL	63	13	5
Medline.	63	13	5
Scopus.	7	3	1
ProQuest education.	127	19	3

Wakefield et al. (2005) looked at safety science within healthcare education provision. They found that there was little evidence that pre-registration nursing programmes equipped students with the necessary safety science knowledge, skills and attitudes for their practice. Attree, Cook, and Wakefield (2007), Mansour (2012), and Tella, Jamookeeah, & Partanen (2014) found that safety science as a discrete concept was also not clearly identified within many pre-registration nursing programmes, however they did find that it was included as an integral part of other educational content. They discussed the need to revise pre-registration nursing education in order to address the lack of explicit safety science content.

This perceived lack of safety science content could be explained by the inability of nurse educators themselves to define safety science as a distinct and separate concept (Armitage et al., 2008; Cronenwett et al., 2007; Pearson & Steven, 2009), which may also help to explain why healthcare students find it difficult to conceptualise safety science (Mansour, 2012; Pacini, 2005). In the light of these findings, Robson, Clark, Pinnock, White, & Baxendale (2013), undertook a survey of 13 UK Universities that provide pre-registration nursing programmes. The study found that all 13 universities surveyed included more than 4 hours of safety science teaching and twelve of the universities included specific safety science subjects.

Safety science content should, therefore, be explicitly embedded within pre-registration nurse education from the outset (Mansour, 2012; Milligan, 2007) because professional attitudes and beliefs are almost fully formed by the point of registration (Duhn et al., 2012; Mansour, 2012). Milligan (2007) also suggested that safety science education helped student nurses to become more aware of their pivotal role in maintaining patient safety. Milligan described student nurses as small but important parts of a much larger system, which frequently placed them at the "sharp-end" of patient care delivery. In this position student nurses were uniquely placed to identify and mitigate safety risks to patients (DeBourgh & Prion, 2012).

Sherwood (2011) described a framework for safety science that included many of the subject areas that were subsequently adopted by the authors. The framework was based on the Quality and Safety Education for Nurses (QSEN) project, but it lacked sufficient detail (see Table 3 for details). A search of the grey literature revealed The World Health Organisation [WHO] (2011) Multi Programme Patient Safety Programme Guide. This was a comprehensive and detailed safety programme and contained specific safety science content. The WHO guide was intended to be used by healthcare educators as a tool for embedding safety science into healthcare programmes. It proved to be valuable when planning the new programme content. The search also identified the Institute for Healthcare Improvement (IHI) Open School (2014) programme. This is a United States-based, certified modular programme that healthcare students can access online, at no cost.

Developing programme content

Following the completion of the searches, the safety science content for the new programme was established. It included *human error* and its causes (IHI, 2014;

Table 3: Existing safety science programmes.

Programme	Publisher/Sponsor	Resources	How the resources were used (*column added*)
The Multi-professional Patient Safety Programme Guide	WHO (2011)	– Programmes Guide – Multi-professional	– Informed general programme development in real world manner. – Provided principles for teaching safety science – Topic guide
Foresight	UK National Reporting and Learning System (2008)	– Case studies	– Some cases studies used within individual sessions
Quality and Safety Education for Nurses (QSEN)	Robert Wood Johnson Foundation (2005); Sherwood (2011)	– Website – Competency based resource – Programmes guide – pre and post reg. – Teaching Resources	Excellent resource but did not offer any benefit over the WHO multi-programme guide (2011) May be inaccessible due to some terminology.
IHI Open School	IHI (2014).	– On line courses – Videos – Audio – Improvement stories – Publications	– Provides information about key principles of safety science. – Conducted a peer and student review of online modules. – Quality of online resources excellent but concerns about the volume of work involved. – Decision to use two online modules by the IHI which complement the topics being covered in each year of study.
Canadian Patient Safety Institute Safety Competencies	Canadian Patient Safety Institute (2012)	– Website. – Safety competencies across six domains. Implementation guide. – Multi-professional	Reviewed but not used. Excellent resource but did not offer any benefit over the WHO multi-programme guide (2011)
TeamStepps	Agency for Healthcare Research and Quality (2008)	– Video – Vignettes	– Some resources used within individual sessions
Safer care: Human factors for Healthcare	UK Health Foundation (2013), Northeast Strategic Health Authority (2013)	– Non-technical skills sessions – Vignettes – Narratives from industry.	– Some resources used within individual sessions
Patient Safety Resource Centre	UK Health Foundation (2013)	– Tools – Research	– Some resources used within individual sessions

Reason, 2005), *safety cultures* (IHI, 2014; Vincent, 2010; WHO, 2014), *error chains* (Dekker, 2011, 2014), *incident reporting* and *learning from error* (IHI, 2014; Vincent, 2010) and *non-technical skills* (Flin, O'Conner, & Crichton, 2008). Furthermore, there was an emphasis on the implementation of safety science and preparing students for clinical practice. The subject areas of *human performance*, *teamwork*, *latent failures*, *cognitive biases*, *system design*, *authority gradients* and *avoidable harm*, were also incorporated into the programme (Croskerry, 2003; Flin et al., 2008; Clark, White, & Robson 2013; WHO, 2014; IHI, 2014; White, Lowes, & Hormis, 2015).

A blended-learning approach to content delivery was used, in keeping with the pedagogical philosophy underpinning the programme. The newly developed safety science content was mapped to the programme, identifying where additional safety science content could be included. The safety science content was embedded in two different ways. Firstly, key standalone safety science sessions were developed. For example, one workshop used the sinking of the HMS Titanic as a metaphor to explore how system failures might cause avoidable harm to patients. Secondly, safety science learning outcomes were mapped into other subjects that were not specifically safety science, such as *measuring vital signs*, *infection control*, *nutrition*

and hydration, record keeping and *documentation*. A minimum of one explicit safety science-orientated learning outcome was added to each of these sessions (Tella et al., 2014). Additionally, student nurses were asked to complete two online e-learning modules from the IHI Open School (2014) for each year of study. Table 3 identifies some of the grey literature resources and describes how these were used for this programme development.

Developing the theoretical framework

The UK Institute for Innovation and Improvement (2010) offered a safety science competency framework which included increasing levels of safety science competence, from a basic *awareness* then *application*, through to *mastery* (see http://goo.gl/wtfAsA). Based upon an analysis of this framework, an application level of safety science knowledge, skills and attitudes was considered to be an appropriate level for newly registered nurses to have achieved. The depth of knowledge, skills and attitudes expected of the students increased incrementally with each academic year, as they worked towards the required standard.

Explicit links were also made to the UK Nursing & Midwifery Council *Pre-registration Standards* (2010) domains. These domains were *professional values, communication and interpersonal skills, nursing practice and decision making and leadership, management and teamworking*. The new framework also offered a visual conceptualisation of safety science mapped against these standards (see Figure 1).

Implementing programme change

According to the WHO's (2011) Multi-professional Patient Safety Programme Guide, change management principles should be used to successfully incorporate safety science into any new programme. Kotter's (2008) eight-stage organisational change model (see below, where the eight stages are identified in italics) was adopted because it is a straightforward, easy to follow process for managing change within large organisations. This enabled the development of a systematic approach to building faculty capacity and ensured that departmental support is sustained.

Fortuitously, the proposed changes to the programme coincided with the publication of key national and international safety science documents and position papers (National Advisory Group on the Safety of Patients in England, 2013; WHO, 2014). In keeping with Kotter's (2008) model and the stage of *creating a vision*, a vision document highlighting safety science as a global healthcare concern (Kohn et al., 1999; White, 2012; WHO, 2009; National Advisory Group on the Safety of Patients in England 2013; WHO, 2014), was further used to *create a*

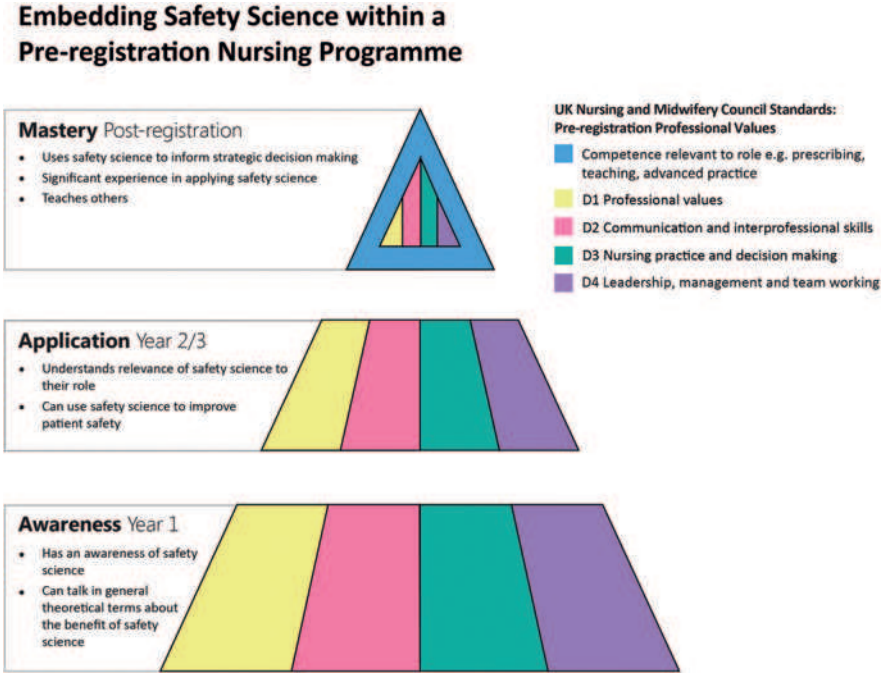

Figure 1: A visual conceptualisation of safety science, as mapped against the UK Nursing and Midwifery Council standards for competence.

sense of urgency within the department (Kotter, 2008, 2012;). Kotter (2008) discussed the need for change management teams to have credibility and expertise. *Building a guiding coalition* of influential colleagues and partners was therefore created to drive forward the safety science agenda within the department (Barr & Dowding, 2012).

Kotter (2008) also identified the need for the guiding coalition to be in a position of influence and power. Therefore the new safety science programme was presented to senior management within the department to gain their approval and support. Training and development needs were met by the delivery of a two-day training course, facilitated by an established safety science education and training company. Twenty nurse educators from the department attended the training for their development needs.

To *communicate the vision*, staff information sessions provided a further opportunity for nurse educators to engage with the new safety science agenda. Furthermore, meetings with the education, patient safety and governance teams at local hospitals ensured the proposed programme development had both a "real world" perspective and stakeholder support. To assist with *removing barriers and obstacles to success*, sustained senior support from within the department and the continuing support of influential colleagues were both vital to this success. In line with Kotter (2008, 2012), the authors also created *short term motivational wins* and these are identified in Table 4 below. If the new safety science programme was to become fully embedded, then the final parts of Kotter's model *never letting up* and *incorporating changes into culture* were key to its success.

Table 4: Key Milestones for the project.

Project overall aim	**For the University to be able to effectively deliver the additional safety science content in the new Batchelor of Science (BSc) [pre-registration] Nursing Studies Programme**
Outcomes	**Strategy**
A number Nursing & Midwifery lecturers will have been trained to deliver the new safety science content (by end 2015)	– Recruit a number (20 if possible) of key faculty to undertake safety science training so that they are able to deliver the programme – Support interested faculty in developing a greater understanding of safety science by: use of IHI Open School free online courses, in-house information sessions, and signposting to resources using new programme virtual learning environment site.
The safety science overview for the new programme will be fully and firmly embedded into the BSc programme (by July 2016- end of year 3 of the first itteration of the course)	– Safety science content mapped to new programme at academic Years 1–3 – Framework for embedding safety science in years 1–3 developed – Engagement with module leaders/lecturers to write session aims and objectives. – All teaching and learning materials relating to the new revised safety science will be prepared for: – Year 1 by Sept 2013. – Year 2 by Sept 2014 – Year 3 by Sept 2015
Identified goals for short-terms wins (Kotter 2008, 2012) (*moved from the main text and added here to make more succinct*)	– Recruit 20 faculty members to be part of the safety science delivery team – Complete writing of learning outcomes for each session affected. First of all, working on year one of the safety science scheme of work – Working with module teams to integrate the schemes of work. – Design and deliver safety science champions training for the department. – Getting an IHI Open School Chapter established for inter-professional education

(*continued*)

Table 4: (*continued*)

Project overall aim	For the University to be able to effectively deliver the additional safety science content in the new Batchelor of Science (BSc) [pre-registration] Nursing Studies Programme
Nursing students completing the BSC in nursing at SHU will have appropriate knowledge, skills and attitudes in relation to human factors and safety)	– Sessions will be developed and delivered. – Faculty will be enthusiatic and commited to delivering new content. – Interprofessional Education provision will be explored to enhance opportunities for teaching safety science in an inter-professional context
Evaluate each session (level 1) at the end of year three (level 2).	– Evaluate the first two levels of learning using Kirkpatrick and Kirkpatrick's (2005) *Transferring Learning to Behaviour: Using the Four Levels to Improve Performance*. Evaluate: 1. Reaction: How well the sessions are liked by the students that attend- this measures their enjoyment of the programme. This is ongoing after each session 2. Learning: This would measure the knowledge, skills and attitudes of the students; what was absorbed and taken in from the sessions delivered by the chapter educators. This can be done using questionnaire and focus group techniques 3. Behaviour: This would measure how the students' behaviour had changed in clinical practice and will also be evaluated using questionnaire and focus group techniques

Note: In an ideal world, the project would be evaluated through all four levels of Kirkpatrick and Kirkpatrick's (2005) typology. However, to evaluate level 4 (to measure to what extent have the resultant behaviour changes occurred due to the programme) would be a longer term research goal.

Discussion

The safety science issues raised in this paper are an international phenomenon and affect all healthcare settings (Kohn et al., 1999; UK Department of Health, 2000; White, 2012). Healthcare educators are asked to respond to constantly changing developments in healthcare to ensure that their healthcare students are equipped with the most up-to-date knowledge, skills and attitudes. Safety science is now a global priority and all pre-registration student nurses must be equipped with an understanding of how error and avoidable harm may occur and what may be done to prevent it. The delivery of safety science education within pre-registration nursing programmes is an integral part of this process.

The development of a practical, pragmatic approach to managing change using a recognised model (Kotter, 2008), helped to ensure that the identified safety science goals were achieved and were not merely aspirational. The authors argue that the processes described in this paper are not exclusive to pre-registration nursing programmes, and may be successfully applied to other pre-registration healthcare programmes.

There are however limitations to the clinical effectiveness of any type of healthcare education. Most errors that cause harm have latent conditions that directly affect the ability of the practitioner at the sharp end of healthcare delivery, to influence patient outcomes (Reason, 2005; Vincent, 2010). For this reason, safety science education alone is unlikely to make the difference required to achieve zero harm. Furthermore, the impact of this safety science programme on the prevailing patient safety culture has yet to be formally evaluated (see Table 4). In spite of this, maintaining the *status quo* is clearly unacceptable and that due to the serious nature of avoidable harm to patients, it may be better to *act now and study later*.

Conclusion

The authors' work is being shared in the hope that it may act as a working guide to assist others in implementing safety science into pre-registration nursing programmes and may also be used by other healthcare programmes facing similar challenges. However, ensuring that pre-registration nurses graduate with an *application* level of safety science knowledge, skills and attitudes is only the first step to achieving sustainable change in patient safety culture (IHI, 2014). The pre-registration healthcare

students of today are the workforce leaders of tomorrow, and it is important that they are encouraged to understand the impact that they can have on changing their work-based safety culture in the longer term.

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