Examining the nature of interprofessional interventions designed to promote patient safety: A narrative review

Professor Scott Reeves
Centre for Health & Social Care Research
Kingston University & St George's, University of London

Ms Emma Clark
Midwifery Department
Central Manchester University Hospitals NHS Foundation Trust

Ms Sally Lawton
Project Support Officer (Patient Safety and Education & Training)
Health Innovation Network, Academic Health Science Network for South London

Ms Melissa Ream
Programme Lead, Patient Safety Collaborative
Health Innovation Network, Academic Health Science Network for South London

Professor Fiona Ross CBE
Director of Research, Leadership Foundation for Higher Education
Senior Responsible Officer (Education), Health Innovation Network
Professor, Kingston University and St George's, University of London

Corresponding author
Professor Scott Reeves
Centre for Health & Social Care Research
Kingston University & St George's, University of London
Hunter Wing, St George's Hospital, Cranmer Terrace, London, SW17 0BE
Email: s.reeves@sgul.kingston.ac.uk

Abstract

Purpose: This narrative review aimed to scope the patient safety literature to identify interprofessional intervention approaches, the sources of evidence and reported outcomes.

Data sources: Two major databases (MEDLINE, CINAHL) were searched from 2005 to 2015.

Study selection: A total of 1,552 abstracts were initially identified. After screening these abstracts, 129 full papers were obtained. Further screening resulted in a total of 89 papers included in this review.

Data extraction: The following information was extracted from each included paper: details on the patient safety intervention, study methods employed and outcomes reported.

Results of data synthesis: It was found that the bulk of the included studies were undertaken in a North American acute care context. Most often, studies involved qualified professionals from nursing and medicine collaborating in hospitals and medical centres. Nearly half the studies reported in this review employed educational interventions, such as TeamSTEPPS, aimed at enhancing practitioners' competence of delivering safe patient care. Nearly a third of studies involved practice-based interventions (e.g. checklists) aimed at improving the delivery of safe care. Most of the studies used a quasi-experimental design and typically gathered survey data. The majority reported outcomes related to changes in professionals' attitudes, knowledge and skills. There were, however, fewer studies reporting changes in practitioners' safety behaviours, organisational practices or patient benefit.

Conclusion: The use of different interprofessional interventions are key activities involved in promoting safe patient care practices. However, further work is needed to strengthen these interventions and their evaluations.

Key words: patient safety; Interprofessional education; interprofessional practice; intervention; narrative review

Introduction

The management of risk and patient safety are major drivers in the NHS (National Health Service) and other health systems in developed countries. The implementation of these activities are regarded as critical to prevent and ameliorate harm related to the delivery of health care [1,2]. The need to reduce avoidable harm and improve the delivery of safe patient care has been repeatedly highlighted in a number of reports around the world over the past 20 years [3-5]. Employing safe patient care practices requires input from all sections parts of the system: from managers to practitioners and unifies, like nothing else, health and social care professions.

A common underlying reason for failures in patient safety has been ineffective teamwork and communication, which has spawned an increased emphasis on improvement [6-7]. Effective interprofessional collaboration and teamwork is understood to rely on continuous and open communication, an understanding of different professional roles and responsibilities as well as respect for colleagues from different professional groups [8,9].

Various safety initiatives and interventions aimed at improving collaboration and the delivery of patient care have been implemented over the past decade. Examples include the introduction of tools for the safe handover of key clinical information [10], checklists designed to ensure effective communication and agreement within teams [11] and interprofessional team training sessions, such as simulation aimed at developing collaborative competencies which support effective teamwork [12]. However, patient safety remains a difficult problem to solve simply because the notion of safety is not simply a technical issue, but involves input from different people based on practices that are embedded in organizational and professional

cultures [13]. In order to achieve a safer environment for care delivery, team members need to feel confident to question, review and reflect on their interdependent work which involves a range of professional groups, and confront difficult issues like power imbalances, limited trust in relationships and interprofessional hierarchies [8].

This paper reports the results from a narrative review which mapped the available literature in relation to the use of interprofessional patient safety interventions.

Methods

The specific aim of this review was to scope the interprofessional patient safety intervention literature to identify what is known about intervention approaches, sources of evidence, reported outcomes and to identify current gaps in the literature. This form of narrative review (also called a scoping review) are being used increasingly by researchers to explore health research evidence [14,15], enable the clarification of complex concepts, and refine subsequent research enquiries [16]. Such reviews are useful because they are wide ranging and are therefore particularly relevant to examine areas in which evidence is emerging [17]. The findings of these types of narrative reviews can be particularly useful to inform subsequent systematic reviews aimed at generating more in-depth accounts of the nature of evidence.

Inclusion criteria

The following inclusion criteria related to the nature of interventions, participants, study designs and reported outcomes were employed.

Interventions: an interprofessional patient safety intervention was defined as: when members of more than one healthcare profession working/learning interactively together, for the explicit purpose of improving patient safety.

Participants: among the professional groups included were physicians, psychologists, psychotherapists, midwives, nurses, pharmacists, physiotherapists, occupational therapists, radiographers, speech therapists, social workers, care/case coordinators and managers.

Study designs: all research/evaluation designs (e.g. action research, case study, ethnographic, experimental, quasi-experimental studies) were included.

Reported outcomes: all outcomes reported in the included studies included and classified using a modified Kirkpatrick outcomes typology [18], which has six types of outcomes (see Table 1).

INSERT TABLE 1 ABOUT HERE

Searching and screening processes

In order to identify all the relevant literature an initial database search was undertaken using the broad key terms, for example, 'interprofessional and patient safety' or 'inter-professional and patient safety', 'teamwork and patient safety'. Two main electronic databases (MEDLINE and CINAHL) were searched for a decade (January 2005 to December 2015) during which there was a significant growth in patient safety studies. This resulted in 2,016 potential abstracts. See Figure 1.

INSERT FIGURE 1 ABOUT HERE

Once duplicates were removed, a total of 1,552 abstracts were assessed by one reviewer (EC) to determine if they met the inclusion criteria outlined above. To ensure consistency of decision making, a second reviewer (SR) reviewed all papers selected for inclusion as well as a 10% sample of excluded abstracts and papers.

Following this process, a total of 129 abstracts were identified as meeting the inclusion criteria. The full papers were obtained and screened independently by two of the reviewers (EC, SR). At this stage 40 papers were excluded as they did not meet the inclusion criteria. This process produced a total of 89 papers included in this review.

Analysis

Abstraction of key information was undertaken by three of the reviewers (EC, SL, SR). Details related to the patient safety intervention (e.g. location, professional mix, number of participants), study methods (e.g. design, data collection, data analysis) and study outcomes were collated. Based on prior analysis of interprofessional interventions [19] included studies were categorized into one of three different types:

- *Interprofessional education* defined as interventions that included a curriculum with explicitly stated learning objectives/outcomes and learning activities (e.g. seminars, simulation) aimed at improving collaboration;
- *Interprofessional practice* defined as interventions which aimed to improve how professionals interacted in practice through the use of activities such as meetings or checklists;
- *Interprofessional organisation* defined as interventions aimed to promote collaboration by the use of institutional policies, clinical guidelines or the redesign of workspaces.

A spreadsheet was created to chart relevant data and enable the identification of commonalities, themes, and gaps in the literature [14].

Results

The results are presented in two main sections. First, key details related to the nature of patient safety interventions contained in the 89 studies are described. Second, methodological and outcomes information connected to these studies are outlined. (See Appendix 1 for an overview of key details from the 89 included studies and a full reference list of these studies).

Patient Safety Interventions

We found that 68 of the included studies (76%) were undertaken in a North American context, whereas only 14 studies (16%) were from Europe, with the remaining studies undertaken in Iraq (n=2), Israel (n=2), Malaysia, Australia and Japan. Most of the included studies were published in the past few years – 50 studies (56%) published between 2012 and 2015, 34 studies (32%) published between 2008 and 2011 and five studies published between 2005 and 2007.

The overwhelming majority of studies reported on the implementation of interprofessional patient safety interventions in acute clinical organizations (73 studies, 82%) with most located in surgery, obstetrics, intensive care or emergency medicine settings. In contrast, only 10 studies (11%) based their interventions in university settings. In addition, four studies were undertaken in community organisations and two studies in mixed (acute/community) locations.

In relation to which professional groups were involved in these interprofessional patient safety interventions, we found that it was predominately medicine (82 studies) and nursing (80 studies).[1] In contrast, other professional groups, such as pharmacy (20 studies), respiratory therapy (12 studies) and physiotherapy (9 studies) were less frequently involved. In regards to level of the participants, most studies involved qualified practitioners (77 studies, 86%), with only 10 studies (11%) involving undergraduate students, and two studies which involved a mixture of practitioners and students.

Table 2 indicates the different types of intervention approaches used in the included studies. As outlined in this table, most studies employed a single interprofessional patient safety intervention activity, mostly interprofessional education (n=43, 48%) or interprofessional practice (n=24, 26%). In contrast, 22 studies of the included employed a mixture of different interprofessional intervention approaches.

INSERT TABLE 2 ABOUT HERE

These broad interprofessional intervention approaches employed a range of different educational, practice and organisational methods and activities. For example, studies that used interprofessional education activities involved interactive seminars, workshops or team-based simulation [20-23]. Often these educational interventions employed TeamSTEPPS or CRM (crisis resource management) approaches [24-27]. Studies reporting the use of interprofessional practice interventions tended to employ team checklists [28-29], team briefings [30,31] or patient safety rounds [32,33]. Those studies that employed multiple intervention methods blended, for example, team-based training with practice-based activities

such as the use of a team briefing [34-35]. The duration of these interventions ranged widely from a few hours of participation in a team training workshop [24] to practice-based interventions which lasted over a number of months [36].

Methods and outcomes

In relation to study designs employed in the included studies, overwhelmingly the most common used was the before-and-after design (48 studies, 54%), followed by the post-intervention design (16 studies, 18%) (see Table 3). In contrast other study designs such as randomised controlled trials, controlled before-and-after and mixed methods designs were employed much less often.

INSERT TABLE 3 ABOUT HERE

As Table 4 indicates, most studies (n=58) gathered a single form of data, whereas 28 studies collected two forms of data, two studies gathered three forms of data and one study collected four forms of data. Surveys were the most popular form of data used in the included studies, with the Safety Attitude Questionnaire [37], Teamwork and Safety Climate Survey [38] and the TeamSTEPPS Teamwork Attitudes Questionnaire [24] being used most frequently.

INSERT TABLE 4 ABOUT HERE

Table 5 displays the range of different outcomes reported in the included studies. As this table indicates, in total, across the 89 studies 143 outcomes were reported with the bulk (n=95) relating to cognitive outcomes (levels 1, 2a, 2b – reactions, perceptions/attitudes and knowledge/skills). This contrasts to a significantly lower number of studies (n=48) reporting outcomes linked to changes to behaviour, organisational practice and patient care (levels 3, 4a

and 4b). In relation to the number of outcomes reported by each study, 42 studies reported one outcome, 40 studies reported two outcomes and seven studies reported three outcomes linked to their evaluations of interprofessional patient safety interventions.

INSERT TABLE 5 ABOUT HERE

In terms of the nature of the outcomes from studies reporting at level 1 (see Table 1), these were usually linked to participant satisfaction of an interprofessional patient safety course [39-40]. For studies reporting level 2a outcomes, these were typically linked to improved perceptions about safety culture [41] or enhanced attitudes towards teamwork [24]. For studies reporting level 2b outcomes, these generally focused on self-report changes in knowledge and/or skills related to collaborative and patient safety [42-43]. Studies reporting level 3 outcomes usually employed observation tools or checklists to record behaviour change following a patient safety intervention [36, 44]. Studies that reported level 4a changes normally focused on increases to safety reporting practices and interprofessional team debriefings [30, 45]. Of the studies reporting level 4b outcomes these typically focused on changes in the health outcomes and delivery of care, including improvements to rates of morbidity, reduction of adverse event rates and timely delivery of patient medications [29, 46].

Discussion

This review was undertaken to scope the interprofessional patient safety literature in order to map the use of interventions, sources of evidence and reported outcomes. In doing so, the review aimed to understand the nature of this literature and identify gaps which need addressing in future research. As reported above, we found nearly a hundred studies that met our inclusion criteria. Of these studies, the bulk were undertaken in a North American acute

care context. Most often, these studies involved qualified nurses and physicians collaborating in clinics based in hospitals and medical centres. Nearly half the studies employed educational interventions aimed at enhancing individual practitioners' patient safety competence and nearly a third of studies involved practice-based interventions aimed at improving the delivery of safe patient care. Most of the included studies used a quasi-experimental (pre/post- or post-intervention) design and typically gathered survey data to evaluate the effects of their interprofessional interventions. In relation to reported outcomes, the bulk of studies focused on reporting changes to individuals' cognition, skills and behaviours (levels 1, 2a, 2b and 3), with far less reporting of changes to organisational practice or to patient benefit (levels 3, 4a and 4b).

As previously noted, interprofessional patient safety interventions were typically implemented in acute clinical settings (e.g. surgery, obstetrics departments or intensive care units). Upon closer inspection of these interventions (see Appendix 1) one can detect some possible trends across clinical settings. For example, studies undertaken in a surgical context tended to employ interprofessional practice interventions most often, whereas studies undertaken in obstetrics or emergency medical settings employed more interprofessional education interventions. Studies reporting hospital-wide patient safety interventions (i.e. those involving multiple departments within a single institution) and studies based in intensive care units employed equal numbers of interprofessional education or practice interventions (delivered as a single activity). In relation to the use of mixed interventions, studies based in surgical departments most regularly combined interprofessional education and practice interventions, followed by studies in general medicine departments and intensive care units. In contrast, other acute care settings used mixed interventions less often. Of the remaining (community care or mixed

setting) studies, these employed interprofessional education alone or interprofessional education/practice interventions combined with either an interprofessional practice or organisational intervention. While it is difficult to provide a rationale for the differing use of interprofessional interventions across clinical contexts, one key element appears to be central to why choices were made about what type(s) of interprofessional intervention were implemented. For the included studies, the design of their interventions appeared to highly influenced by local contextual factors. Repeatedly, study authors noted that a range of department or institutional pressures and problems compromised patient safety which required the input from a collaborative effort of staff. As a result, 'bespoke' interprofessional (education, practice and/or organisational) activities were developed and delivered. This focus on contextual factors reinforces arguments about the importance of paying close attention to local cultures to ensure improvement activities can be designed to be more effective in addressing their intended problems [8, 47].

In relation to interprofessional interventions which focused on patient benefit, as presented in Table 5, 30 studies reported that the use of an intervention led to changes in safe patient care (levels 4a and 4b). These studies reported changes to organisational practice (e.g. improved patient safety reporting) and health outcomes (e.g. timely delivery of patient medications). It was found that practice-based interventions, such as the use of interprofessional team meetings or checklists generated improvements to patients' safety [29, 45]. In general, these interventions were implemented as a single activity, however, they were also occasionally combined with an interprofessional organisation intervention [48] or an interprofessional education intervention [49]. In contrast, interprofessional education interventions implemented alone tended to only report changes in participants' abilities (attitudes,

knowledge, skills, behaviours) in regards to thinking about or engaging in collaboration for patient safety [39, 50]. This distinction between the use of different intervention approaches and their possible outcomes is helpful to consider when designing a future interprofessional intervention in relation to its desired aim(s) – improving participant abilities and/or improving the safe delivery of care to patients.

Collectively, the included 89 studies provide an encouraging indication that the use of interprofessional education, practice and/or organisational interventions can promote improvements to patient safety. This finding provides support for repeated policy calls focused on the need to strengthen interprofessional collaboration to minimalize unsafe patient practice [3, 5]. Moreover, as the review found, the use of interprofessional interventions to promote patient safety is expanding – with over 50% of included studies published between 2012 and 2015. While interprofessional interventions are increasingly being used for improving collaboration between professions to reduce patient harm, there are a number of issues related to the definition and application of interventions as well as methodological limitations which need to be acknowledged.

The review found a widespread use of single interventions, usually in the form of a short team training session or introduction of a one page checklist. While such activities may provide initial support and direction in identifying patient safety issues, their influence is limited due to the complex nature of delivering safe interprofessional care. Given these complexities, it has been argued that a more effective approach is to employ multi-faceted interventions [8]. Such approaches aim to address shortfalls by providing a package of different by complementary educational, practice-based and organisational interventions.

In addition, as noted above, the included studies tended to use self-report data in the form of a range of surveys reporting individuals' perspectives on possible changes associated to the use of an intervention. Given that individuals' *perceptions* of change can differ from *actual* change, data gathered from these surveys need to be questioned. The use of these surveys also overlooks the possible influence of complex contextual factors (e.g. professional dominance, hierarchical working arrangements, power imbalances) which have been reported to affect the implementation of interprofessional activities [13, 51].

Furthermore, given that most studies employed pre/post- or post-intervention designs, there was a limited attention on reporting the longer term outcomes related to the use of a patient safety intervention. As a result, it is difficult to tell whether the reported effects from an intervention were sustained over time. In addition, there is a need for interprofessional patient safety studies to gather short-term individual outcomes (changes to perceptions, knowledge, skills) as well as wider longer-term outcomes (changes to organisational practice and patient benefit) to provide more comprehensive insights in the effects of their interventions.

Based on the results presented in this paper a number of recommendations for the future use of interprofessional patient safety interventions can be offered. First, the use of multiple interprofessional (education, practice and organisational) interventions can be effective in addressing multifaceted issues relating to patient safety. Second, while the use of interprofessional education as a single intervention can affect changes in participants' abilities to engage more in interprofessional collaboration, the use of interprofessional practice interventions (implemented on their own or with another interprofessional activity) can help

improve the delivery of safe care to patients. Third, it is important to pay close attention to contextual factors in the design of education, practice and/or organisational interventions to ensure they can be effectively tailored to address local patient safety problems. Fourth, there is a need to improve the quality of interprofessional patient safety evaluations by combining self-report data with other more robust forms of data (e.g. observations, health outcomes) gathered over longer time periods to examine how interventions have sustained any initial improvements to patient safety.

In relation to the limitations of the review, the search was constrained by only searching two databases, excluding the grey literature, not searching the reference lists of included papers and only including studies published in English. As a result, it is possible that the review may have missed a small number of potential studies.

Conclusion

This review searched the patient safety literature to map use of interventions, sources of evidence and reported outcomes in order to identify gaps in the literature. We found that the use of interprofessional interventions are key activities involved in promoting safe patient care practices. However, further work is needed to strengthen these interventions and their evaluation. Interprofessional interventions should aim to combine education, practice and organisational activities that overcome the limitations inherent in the use of single interventions in making positive change to the delivery of care. In addition, future studies, should aim to employ more rigorous approaches in their evaluation of interventions, using mixed methods and longitudinal designs with outcomes focused on reporting wider organisational changes resulting from an interprofessional patient safety activity.

Note

1. Due to multiple reporting of different professional groups within each of the included studies, actual figures exceed 89.

References

1. Kohn L, Corrigan J, Donaldson M. *To err is human: building a safer health system*. Washington, DC: National Academy Press, 2000.

2. Vincent C. *Patient safety*. Chichester: Wiley-Blackwell, 2010.

3. Berwick D. *A promise to learn – a commitment to act: improving the safety of patients in England*. London: Department of Health, 2013.

4. Health Foundation. *The measurement and monitoring of safety*. Health Foundation: London, 2013.

5. Francis R. *Report of the Mid-Staffordshire NHS Foundation Trust Public Inquiry.* London: Stationery Office, 2013.

6. Manser T. Teamwork and patient safety in dynamic domains of healthcare: a review of the literature. *Acta Anaesthes Scand* 2009; 53:143-51.

7. Jones A, Jones D. Improving teamwork, trust and safety: An ethnographic study of an interprofessional initiative. *J Interprof Care* 2011; 25:175-181.

8. Reeves S, Lewin S, Espin S, et al. *Interprofessional teamwork for health and social care*. Oxford, Blackwell-Wiley, 2010.

9. Courtenay M, Nancarrow S, Dawson D. Interprofessional teamwork in the trauma setting: a scoping review. 2013 *Human Resource Health*; 11:57

10. Velji K, Baker G, Fancott C, et al. (2008) Effectiveness of an Adapted SBAR Communication Tool for a Rehabilitation Setting. *Health Quart* 2008; 11:72-9.

11. Kawano T, Taniwaki M, Ogata K, et al. Improvement of teamwork and safety climate following implementation of the WHO surgical safety checklist at a university hospital in Japan. *J Anesthes* 2014; 28:467-470.

12. Sandahl C, Gustafsson H, Wallin, C, et al. Simulation team training for improved teamwork in an intensive care unit. *Int J Health Care Qual Assur* 2013; 26:17488

13. Rowland P, Kitto S. Patient safety and professional discourses: implications for interprofessionalism. *J Interprof Care* 2014; 28:331-38.

14. Armstrong R, Hall B, Doyle J, et al. 'Scoping the scope' of a Cochrane review. *J Public Health* 2011; 33:147-50.

15. Arksey H, O'Malley L: Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005; 8:19-32.

16. Davis K, Drey N, Gould D: What are scoping studies? A review of the nursing literature. *Int J Nurs Stud* 2009; 46:1386-1400.

17. Levac D, Colquhoun H, O'Brien K. Scoping studies: advancing the methodology. *Implement Sci* 2010; 5:69.

18. Barr H, Koppel I, Reeves S, et al. *Effective interprofessional education: assumption, argument and evidence*. Oxford: Blackwell, 2005.

19. Reeves S, Goldman J, Gilbert J, et al. A scoping review to improve conceptual clarity of interprofessional interventions. *J Interprof Care* 2011; 25:167-174.

20. Figueroa M, Sepanski R, Goldberg S, et al. Improving teamwork: confidence and collaboration among members of a pediatric cardiovascular intensive care unit multidisciplinary team using simulation-based team training. *Pediatric Cardio* 2013; 34:612-19.

21. Galt K, Paschal K, O'Brien R, et al. Description and evaluation of an interprofessional patient safety course for health professions and related science students. *J Patient Saf* 2006; 2:207-16.

22. Nickel W, Saint S, Olmsterd R, et al. The interdisciplinary academy for coaching and teamwork (I-ACT): A novel approach for training faculty experts in preventing healthcare-associated infection. *Am J Infect Control* 2014; 42:S230-35.

23. Phipps M, Lindquist D, Mcconaughey E, et al. Outcomes from a labor and delivery team training program with simulation component. *Am J Obstet Gynec* 2012; 206:3-9.

24. Brock D, Abu-Rish E, Chiu C, et al. Interprofessional education in team communication: working together to improve patient safety. *BMJ Qual Saf* 2013; 22:414-23.

25. Deering S, Rosen M, Ludi V, et al. On the front lines of patient safety: implementation and evaluation of team training in Iraq. *Jt Comm J Qual Patient Saf* 2011; 37:350-6.

26. Robertson B, Kaplan B, Atallah H, et al. The use of simulation and a modified TeamSTEPPS curriculum for medical and nursing student team training, *Sim Healthcare* 2010; 5:332-7.

27. Weaver S, Rosen M, DiazGranados D, et al. Does teamwork improve performance in the operating room? A multilevel evaluation. *Jt Comm J Qual Patient Saf* 2010; 36:133-42.

28. Bohmer A, Wappler F, Tinschmann T, et al. The implementation of a perioperative checklist increases patients' perioperative safety and staff satisfaction. *Acta Anaesthes Scand* 2012; 56:332-38.

29. Bliss L, Ross-Richardson C, Sanzari L, et al. Thirty-day outcomes support implementation of a surgical safety checklist. *J Am Coll Surg* 2012; 215(6), pp.766-776.

30. Bandari J, Schumacher K, Simon M, et al. Surfacing safety hazards using standardized operating room briefings and debriefings at a large regional medical center. *Jt Comm J Qual Patient Saf* 2012; 38:154-60.

31. Paige J, Aaron D, Yang T, et al. Improved operating room teamwork via SAFETY prep: a rural community hospital's experience. *World J Surg* 2009; 33(6):1181-87.

32. Calder L, Kwok E, Cwinn A, et al. Enhancing the quality of morbidity and mortality rounds: the Ottawa M&M model. *Acad Emerg Med* 2014; 21:314-21.

33. O'Leary K, Wayne D, Haviley C, et al. Improving teamwork: impact of structured interdisciplinary rounds on a medical teaching unit. *J Gen Inter Med* 2010; 25:826-32.

34. Siegele P. Enhancing outcomes in a surgical intensive care unit by implementing daily goals tool. *Crit Care Nurs* 2009; 29:58-69.

35. Wallin C, Kalman S, Sandelin A, et al. Creating an environment for patient safety and teamwork training in the operating theatre: a quasi-experimental study. *Med Teach*, 2015; 37:267-76.

36. Nagelkerk J, Peterson T, Pawl B, et al. Patient safety culture transformation in a children's hospital: an interprofessional approach, *J Interprof Care* 2014; 28:358-64,

37. Sexton J, Helmreich R, Neilands T, et al. The safety attitudes questionnaire: Psychometric properties benchmarking data, and emerging research. *BMC Health Serv Res* 2006; 6:44

38 Sexton J, Holzmueller C, Pronovost P, et al. Variation in caregiver perception of teamwork climate in labor and delivery units. *J Perinatol* 2006; 26:463-470.

39. Ziesmann M, Widder S, Park J, et al. STARTT: development of a national, multidisciplinary trauma crisis resource management curriculum-results from the pilot course. *J Trauma Acute Care Surg* 2013; 75:753-8.

40. Achike F, Smith J, Leonard S, et al. Advancing safe drug use through interprofessional learning (IPL): A pilot study. *J Clin Pharm* 2014; 54:832-39.

41. Blegen M, Sehgal N, Alldredge B, et al. Improving safety culture on adult medical units through multidisciplinary teamwork and communication interventions: the TOPS project. *Qual Saf Health Care* 2010; 19:346-50.

42. Von Der Lancken S, Levenhagan K. Interprofessional teaching project with nursing and physical therapy students to promote caregiver and patient safety, *J Nurs Ed* 2014; 53:704-9.

43. Stead K, Kumar S, Schultz T, et al. Teams communicating through STEPPS. *Med J Aust* 2009; 190:S128-32

44. Halverson A, Andersson J, Anderson K, et al. Surgical team training: the northwestern memorial hospital experience. *Arch Surg* 2009; 144:107-12.

45. Andreoli A, Fancott C, Velji K, et al. Using SBAR to communicate falls risk and management in inter-professional rehabilitation teams. *Health Quart* 2010; 13: 94-101.

46. Awad S, Fagan S, Bellow C, et al. Bridging the communication gap in the operating room with medical tem training. *Am J Surg* 2005; 190:770-74.

47. Campbell NC, Murray E, Darbyshire J, et al. Designing and evaluating complex interventions to improve health care. *BMJ* 2007; 334:455.

48. Pettker CM, Thung SF, Lipkind HS, et al. A comprehensive obstetric patient safety program reduces liability claims and payments. *Am J Obstet Gynecol* 2014; 211:319-325.

49. Hoffmann B, Müller V, Rochon J, et al. Effects of a team-based assessment and intervention on patient safety culture in general practice: an open randomised controlled trial. *BMJ Qual Saf* 2014; 23:35-46.

50. Stewart M, Purdy J, Kennedy N, et al. An interprofessional approach to improving paediatric medication safety. *BMC Med Ed* 2010; 10:19.

51. Baker L, Egan-Lee E, Martimianakis MA, et al. Relationships of power: implications for interprofessional education. *J Interprof Care* 2011; 25:98-104.

Table 1: Classification of reported outcomes

Outcomes	Description
1. Reactions	These cover participant views on the nature of intervention
2a. Attitudes/perceptions	These relate to changes in reciprocal attitudes or perceptions between participant groups
2b. Knowledge/skills	These relates to the acquisition of concepts, procedures and principles and/or acquisition of problem-solving, clinical skills
3. Behavioural change	These cover the transfer of learning to changes in individuals behaviour
4a. Organisational practice	Outcomes that relate to wider changes in the organisation and delivery of care
4b. Patient benefit	Any improvements in the health and well-being of patients as a direct result of an intervention

Table 2: Types of interprofessional interventions used to promote patient safety

Intervention approach	Included studies	
	N	%
Interprofessional Education	43	48
Interprofessional Practice	24	26
Interprofessional Education & Practice	14	16
Interprofessional Education & Organization	4	5
Interprofessional Practice & Organization	4	5
Total	89	100

Table 3: Study designs employed in the included studies

Study Design	N	%
Before-and-after	48	54
Post-intervention	16	18
Longitudinal	8	9
Controlled before-and-after	5	6
Qualitative case study	4	5
Mixed methods	3	3
Randomised control trial	2	2
Not stated	2	2
Cohort study	1	1
Total	89	100

Table 4: Data collection methods

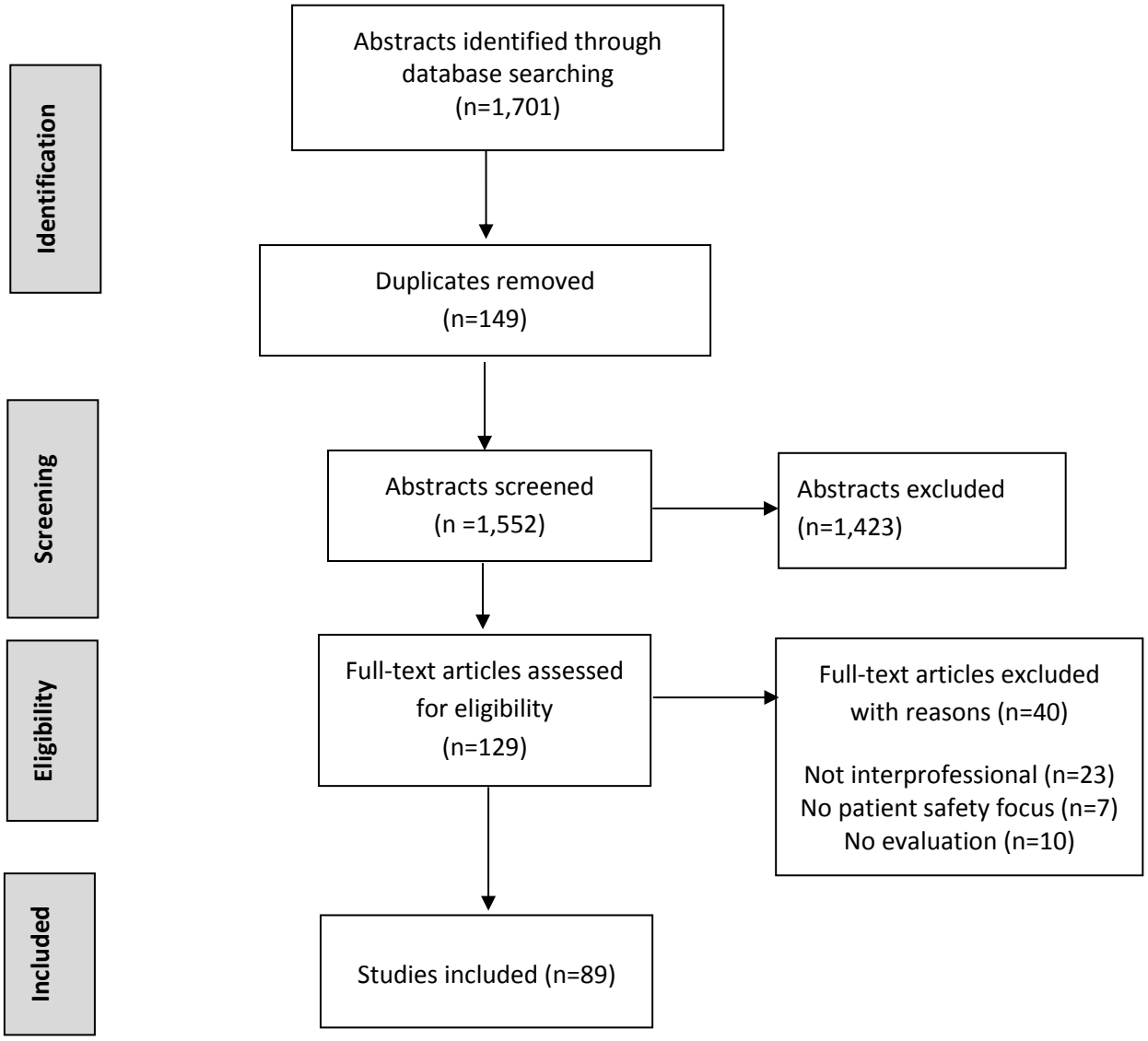
Data collected	N	%
Surveys	47	53
Surveys/Audit	16	18
Surveys/Observations	6	7
Audit	4	5
Observations	4	5
Interviews	3	3
Surveys/Interviews	3	3
Audit/Observations	2	2
Surveys/Interviews/Observations	2	2
Surveys/Interviews/Audit/Observations	1	1
Observations/Interviews	1	1
Total	89	100

Table 5: Reported outcomes

Reported Outcomes	N
Level 1 – Reaction	16
Level 2a – Perceptions & attitudes	48
Level 2b – Knowledge & skills	31
Level 3 – Behavioural change	18
Level 4a – organisational practice	19
Level 4b – Patient benefit	11
Total*	143

* This number exceeds the 89 as the included studies reported more than one outcome

Figure 1: Searching and screening results



Appendix 1

Overview of included studies

Citation	Country	Setting	Intervention approach[a]	Participating professions	Stage
Achike et al. 2014	US	University	IPE	Medicine, nursing	Pre-qualification
Andreoli et al. 2010	Canada	Rehabilitation department	IPP	Medicine, nursing, therapy, support staff	Post-qualification
Auerbach et. al. 2012[b]	US	General medicine department	IPE, IPP	Medicine, nursing, pharmacy	Post-qualification
Awad at al. 2005	US	Surgery department	IPE, IPP	Medicine, nursing	Post-qualification
Baker & Durham, 2013	US	University	IPE	Medicine, nursing, pharmacy	Pre-qualification
Bandari et al. 2012	US	Surgery department	IPP	Medicine, nursing	Post-qualification
Blegen et al. 2010	US	General medicine department	IPE, IPP	Medicine, nursing, pharmacy	Post-qualification
Bliss et al. 2012	US	Surgery department	IPP	'surgical team' (not specified)	Post-qualification
Bohmer et al. 2013[c]	Germany	Surgery department	IPP	Medicine, nursing	Post-qualification
Bohmer et al. 2012	Germany	Surgery department	IPP	Medicine, nursing	Post-qualification
Brock et al. 2013	US	University	IPE	Medicine, nursing, pharmacy, physician assistants	Pre-qualification
Budin et al. 2014	US	Obstetrics department	IPE	Medicine, nursing	Post-qualification
Bunnell et al. 2013	US	Oncology department	IPE	Medicine, nursing, pharmacy, support staff	Post-qualification
Burström et al. 2014	Sweden	Emergency department	IPP, IPO	Medicine, nursing	Post-qualification
Calder et al. 2014	Canada	Emergency department	IPE	Medicine, nursing, social work	Post-qualification
Campbell & Thompson, 2007	US	Hospital wide	IPP	'Clinical staff' (not specified)	Post-qualification
Catchpole et al. 2010	UK	Surgery department	IPE, IPP	Medicine, nursing	Post-qualification

Deering et al. 2011	Iraq	Military unit (acute)	IPE	Medicine, nursing, support staff	Post-qualification
DuPree et al. 2011	US	Obstetrics department	IPE, IPO	Medicine, midwifery , nursing, support staff	Post-qualification
Einav et al. 2010	Israel	Surgery department	IPP	Medicine, nursing	Post-qualification
Evans et al. 2014	UK	Intensive care unit	IPE	Medicine, nursing, paramedicine, pharmacy, physiotherapy	Post-qualification
Figueroa et al. 2013	US	Intensive care unit	IPE	Medicine, nursing, respiratory therapy, 'allied staff' (not specified)	Post-qualification
Freeth et al. 2009	UK	Obstetrics department	IPE	Medicine, midwifery	Post-qualification
Galt et al. 2006	US	University	IPE	Dentistry, law, medicine, nursing, occupational therapy, pharmacy, physiotherapy, social work	Pre-qualification
Gardner et al. 2008	US	Obstetrics department	IPE	Medicine, midwifery nursing	Post-qualification
Gore et al. 2010	US	Surgery department	IPE, IPP	Medicine, nursing	Post-qualification
Gough et al. 2013	UK	University	IPE	Medicine, nursing, pharmacy, physiotherapy	Pre-qualification
Hallman et al. 2014	US	Mental health facility	IPE	Activity therapy, medicine, nursing, social work, teaching	Post-qualification
Halverson et al. 2009	US	Surgery department	IPE	Medicine, nursing, support staff	Post-qualification
Hellings et al. 2010	Belgium	Hospital wide	IPP	Medicine, nursing, paramedicine, Pharmacy	Post-qualification
Henrickson et al. 2009	US	Surgery department	IPP	Medicine, nursing	Post-qualification
Hoffman et al. 2014	Germany	Primary care centre	IPE, IPP	Health care assistants, medicine	Post-qualification
Hughes et al. 2014	US	Emergency department	IPE	'Trauma team' (not specified)	Post-qualification
Jeffs et al. 2013	Canada	Hospital wide	IPE, IPO	Dietetics, medicine, nursing, occupational therapy, physiotherapy, administrators	Post-qualification
Jones, Podila et	US	Emergency	IPE	Medicine, nursing,	Post-

al. 2013		department		technicians	qualification
Jones, Skinner et al. 2013	US	Hospital wide	IPE	Medicine, nursing, support staff, 'allied health' (not specified)	Post-qualification
Kawano et al. 2014	Japan	Surgery department	IPP	Medicine, nursing	Post-qualification
Kellicut et al. 2014	Iraq	Military unit (acute)	IPE	Medicine, nursing, physician assistant, support staff, technicians	Post-qualification
Kilday et al. 2013	US	Neonatal unit	IPE	Medicine, nursing, respiratory therapy	Post-qualification
Kleiner et al. 2014	US	Surgery department	IPE	Medicine, nursing, technicians	Post-qualification
Klipfel et al. 2014	US	Urology department	IPE	Medicine, nursing	Post-qualification
Kolbe et al. 2013	Switzerland	Anaesthesia department	IPE	Medicine, nursing	Post-qualification
Krimsky et al. 2009	US	Intensive care unit	IPP	Dietetics, medicine, nursing, pharmacy	Post-qualification
Liaw et al. 2014	Malaysia	University	IPE	Medicine, nursing	Pre-qualification
Lingard et al. 2005	Canada	Surgery department	IPP	Medicine, nursing	Post-qualification
Low et al. 2013	US	Surgery department	IPP	Medicine, nursing, technicians	Post-qualification
MacEachin et al. 2009	US	Obstetrics department	IPE	Medicine, nursing, technicians	Post-qualification
Mahoney et al. 2012	US	Mental health facility	IPE	Chaplaincy, dietetics, medicine, nursing, pharmacy, administration	
Mayer et al. 2011	US	Intensive care unit	IPP	Medicine, nursing	Post-qualification
Meurling et al.2013	Sweden	Intensive care unit	IPE	Medicine, nursing	Post-qualification
Mikkelsen Kyrkjeb et al. 2006	Norway	University	IPE	Medicine, nursing	Pre-qualification
Morag et al. 2012	Israel	Hospital wide	IPE, IPP	Medicine, nursing	Post-qualification
Nagelkerk et al. 2014	US	Hospital wide	IPE, IPP	Medicine, nursing	Pre & post-qualification
Nickel et al. 2014	US	Hospital wide	IPE	Medicine, nursing, 'other	Post-

				professionals' (not specified)	qualification
O'Leary et al. 2011[d]	US	General medicine department	IPP	Medicine, nursing, pharmacy, social work	Post-qualification
O'Leary et al. 2010	US	General medicine department	IPP	Medicine, nursing, pharmacy, social work	Post-qualification
Paige et al. 2009	US	Surgery department	IPP	Medicine, nursing, technicians	Post-qualification
Paine et al. 2010	US	Hospital wide	IPP	dietetics, medicine, nursing, occupational therapy, physiotherapy, respiratory therapy, support staff	Post-qualification
Patterson et al. 2013a[e]	US	Emergency department	IPE	Chaplaincy, medicine, nursing, paramedicine, respiratory therapy	Post-qualification
Patterson et al. 2013b	US	Emergency department	IPE	Chaplaincy, medicine, nursing, paramedicine, respiratory therapy	Post-qualification
Pettker et al. 2014[f]	US	Obstetrics department	IPP, IPO	Medicine, midwifery, nursing, support staff	Post-qualification
Pettker et al. 2011	US	Obstetrics department	IPP, IPO	Medicine, midwifery, nursing, support staff	Post-qualification
Phipps et al. 2012	US	Obstetrics department	IPE	Medicine, midwifery, nursing	Post-qualification
Rice Simpson et al. 2011	US	Obstetrics department	IPP	Medicine, midwifery, nursing	Post-qualification
Riley et al. 2011	US	Obstetrics department	IPE	Medicine, midwifery, nursing	Post-qualification
Robertson et al. 2010	US	University	IPE	Medicine, nursing	Pre-qualification
Ross et al, 2014	US	Radiology department	IPE, IPP	Medicine, nurses, technicians	Post-qualification
Sandahl et al. 2013	Sweden	Intensive care unit	IPE, IPP	Medicine, nurses	Post-qualification
Sawyer et al. 2013	US	Neonatal unit	IPE, IPP	Medicine, nurses, respiratory therapists	Post-qualification
Sehgal et al 2008	US	General medicine department	IPE	Medicine, nursing, occupational therapy, pharmacy, physiotherapy, speech therapy, respiratory therapy, social workers, support	Post-qualification

				staff	
Sexton et al. 2011	US	Intensive care unit	IPP	Medicine, nursing, pharmacy, respiratory therapy, support staff	Post-qualification
Siegele 2009	US	Intensive care unit	IPP	Administration, medicine, nursing	Post-qualification
Slater et al. 2012	UK	Hospital, mental health, general practice	IPE, IPO	Administration, medicine, nursing, occupational therapy, pharmacy, social work	Post-qualification
Spiva et al 2014	US	Surgery department	IPE	Medicine, nursing, pharmacy, physiotherapy	Post-qualification
Stead et al. 2009	Australia	Mental health facility	IPE, IPP	Medicine, nursing	Post-qualification
Stewart et al. 2010	US	Paediatric department	IPE	Medicine, nursing	Pre-qualification
Taylor et al. 2013	US	Paediatric department	IPE, IPO	Medicine, nursing, respiratory therapy, pharmacy, technicians	Post-qualification
Thomas & Galla, 2013	US	Hospital wide	IPE	'Interdisciplinary teams' (not specified)	Post-qualification
Timmel et al. 2010	US	Surgery department	IPP	Medicine, nursing	Post-qualification
Velji et al. 2008	Canada	Rehabilitation department	IPP	Medicine, nursing, 'other healthcare providers' (not specified)	Post-qualification
Vigorito et al. 2011	US	Intensive care unit	IPP, IPO	Medicine, nursing, respiratory therapy, pharmacy, 'others' (not specified)	Post-qualification
von der Lancken & Levenhagan, 2014	US	University	IPE	Nursing, physiotherapy	Pre-qualification
Wallin et al. 2015	Sweden	Surgery department	IPE	Medicine, nursing	Post-qualification
Weaver et al. 2010	US	Surgery department	IPE	Medicine, nursing	Post-qualification
Wheeler et al. 2013	US	Intensive care unit	IPE, IPP	Medicine, nursing, respiratory therapy, pharmacy, support staff	Post-qualification
White et al. 2008	Canada	Hospital, geriatrics, rehabilitation	IPP	Nursing, physiotherapy, 'other providers' (not specified)	Post-qualification
Wilson et al. 2012	US	University	IPE	Medicine, nursing	Pre & Post-

					qualification
Wolf et al. 2010	US	Surgery department	IPE, IPP	Medicine, nursing, technicians	Post-qualification
Ziesmann et al. 2013	Canada	Intensive care unit	IPE	Medicine, nursing, respiratory therapists	Post-qualification

Notes
(a) IPE = Interprofessional education; IPP = Interprofessional practice; IPO = Interprofessional organisation
(b) Auerbach et al. 2012, Blegen et al 2010 and Sehgal et al 2008 are linked intervention papers
(c) Bohmer et al. 2013 and Bohmer et al. 2012 are linked intervention papers
(d) O'Leary et al. 2011 and O'Leary et al. 2010 are linked intervention papers
(e) Patterson et al. 2013(a) and Patterson et al. 2013(b) are linked intervention papers
(f) Pettker et al. 2014 and Pettker et al. 2011 are linked intervention papers

References for included studies

1. Achike F, Smith J, Leonard S, et al. Advancing safe drug use through interprofessional learning (IPL): A pilot study. *J Clinic Pharm* 2014; 54:832–839.

2. Andreoli A, Fancott C, Velji K, et al. Using SBAR to communicate falls risk and management in inter-professional rehabilitation teams. *Health Quart* 2010; 13:94-101.

3. Auerbach A, Sehgal N, Blegen M, et al. Effects of a multicentre teamwork and communication programme on patient outcomes: results from the Triad for Optimal Patient Safety (TOPS) project. *BMJ Qual Saf* 2012; 21:118-126.

4. Awad S, Fagan S, Bellow C, et al. Bridging the communication gap in the operating room with medical team training. *Am J Surg* 2005; 190:770-774.

5. Baker MJ, Durham CF. Interprofessional education: a survey of students' collaborative competency outcomes. *J Nurs Ed* 2013; 52:713-718.

6. Bandari J, Schumacher K, Simon M, et al. Surfacing safety hazards using standardized operating room briefings and debriefings at a large regional medical center. *Jt Comm J Qual Patient Saf* 2012 38:154-160.

7. Blegen MA, Sehgal NL, Alldredge BK, et al. Improving safety culture on adult medical units through multidisciplinary teamwork and communication interventions: the TOPS project. *Qual Saf Health Care* 2010; 19:346-350.

8. Bliss LA, Ross-Richardson CB, Sanzari LJ, et al. Thirty-Day Outcomes Support Implementation of a Surgical Safety Checklist. *J Am College Surg* 2012; 215:766-776.

9. Bohmer AB, Kindermann P, Schwanke U, et al. Long-term effects of a peripoperative safety checklist from the viewpoint of personnel. *Acta Anaest Scand* 2013; 57:150-157.

10. Bohmer AB, Wappler F, Tinschmann T, et al. The implementation of a perioperative checklist increases patients' perioperative safety and staff satisfaction. *Acta Anaest Scand* 2012; 56:332-338.

11. Brock, D., Abu-Rish, E., Chiu, C et al. Interprofessional education in team communication: working together to improve patient safety. *BMJ Qual Saf* 2013; 22:414-423.

12. Budin W, Gennaro S, O'Connor C et al. Sustainability of improvements in perinatal teamwork and safety climate. *J Nurs Care Qual* 2014; 29:363-370

13. Bunnell, CA, Gross AH, Weingart SN, et al. High performance teamwork training and systems redesign in outpatient oncology. *BMJ Qual & Saf* 2013; 22:405-413.

14. Burström L, Letterstål A, Engström M, et al. The patient safety culture as perceived by staff at two different emergency departments before and after introducing a flow-orientated working model with team triage and lean principles: a repeated cross-sectional study. *BMC Health Serv Res* 2014; 14:296.

15. Calder LA, Kwok ES, Cwinn A, et al. Enhancing the Quality of Morbidity and Mortality Rounds: The Ottawa M&M Model. *Acad Emerg Med* 2014; 21:314-321.

16. Campbell, DA, Thompson, M. Patient safety rounds: description of an inexpensive but important strategy to improve safety culture. *Am J Med Qual* 2007; 22:26-33.

17. Catchpole KR, Dale TJ, Hirst DG, et al. A multicentre trial of aviation-style training. *J Patient Saf* 2010; 6:180-186.

18. Deering S, Rosen MA, Ludi V, et al. On the front lines of patient safety: implementation and evaluation of team training in Iraq. *Jt Comm J Qual Patient Saf* 2011; 37(8):350-6.

19. DuPree E, Anderson R, McEvoy MD, et al. Professionalism: a necessary ingredient in a culture of safety. *Jt Comm J Qual Patient Saf* 2011; 37:447-455.

20. Einav Y, Gopher D, Kara I, et al. Preoperative briefing in the operating room: shared cognition, teamwork and patient safety. *Chest* 2010; 137:443-449.

21. Evans AM, Ellis G., Norman S, et al. Patient safety education – A description and evaluation of an international, interdisciplinary e-learning programme. *Nurs Ed Today* 2014 34:248-251.

22. Figueroa M, Sepanski R, Goldberg S, et al. Improving Teamwork, Confidence and Collaboration Among Members of a Pediatric Cardiovascular Intensive Care Unit Multidisciplinary Team Using Simulation-Based Team Training. *Pediat Cardio* 2013; 34:612-619

23. Freeth D, Avida G, Berridge EJ, et al. Multidisciplinary obstetric simulated emergency scenarios (MOSES): promoting patient safety in obstetrics with teamwork-focused interprofessional simulations. *J Contin Educ Health Prof* 2009; 29:98-104.

24. Galt KA, Paschal KA, O'Brien RL, et al. Description and Evaluation of an Interprofessional Patient Safety Course for Health Professions and Related Science Students, *J Patient Saf* 2006; 2:207-216

25. Gardner R, Walzer TB, Simon R, et al. Obstetric simulation as a risk control strategy: course design and evaluation. *Sim Health* 2008; 3:119-127.

26. Gore D, Powell JM, Baer JG, et al. Crew Resource Management Improved Perception of Patient Safety in the Operating Room. *Am J Med Qual* 2010; 25:60-63.

27. Gough, S., Jones, N, Hellaby M. Innovations in interprofessional learning and teaching: providing opportunities to embed patient safety within the pre-registration physiotherapy curriculum. A Pilot Study. *Phys Ther Rev* 2013; 18:416-430

28. Hallman IS, O'Connor N, Hasenau S, et al. Improving the Culture of Safety on a High-Acuity Inpatient Child/Adolescent Psychiatric Unit by Mindfulness-Based Stress Reduction Training of Staff. *J Child Adoles Psych Nurs* 2014; 27:183-189.

29. Halverson Al, Andersson JL, Anderson K, et al. Surgical team training: the Northwestern Memorial Hospital experience, *Arch Surg* 2009; 144:107-112.

30. Hellings J, Schrooten W, Klazinga NS, et al. Improving patient safety culture. *Internat J Health Care Qual Assur* 2010; 23:489-506.

31. Henrickson SE, Wadhera RK, El Bardissi AW, et al. Development and pilot evaluation of a preoperative briefing protocol for cardiovascular surgery. *J Am Coll Surg* 2009; 208:1115-1123.

32. Hoffmann B, Müller V, Rochon J, et al. Effects of a team-based assessment and intervention on patient safety culture in general practice: an open randomised controlled trial. *BMJ Qual Saf* 2014; 23:35-46.

33. Hughes KM, Benenson RS, Krichten AE, et al. A crew resource management program tailored to trauma resuscitation improves team behavior and communication. *J Am Coll Surg* 2014; 219:545-551.

34. Jeffs L, Abramovich IA, Hayes C, et al. Implementing an interprofessional patient safety learning initiative: insights from participants, project leads and steering committee members. *BMJ Qual Saf* 2013; 22:923-930.

35. Jones F, Podila P, Powers C. Creating a culture of safety in the emergency department: the value of teamwork training. *J Nurs Admin* 2013; 43:194-200.

36. Jones KJ, Skinner AM, High R, et al. A theory-driven, longitudinal evaluation of the impact of team training on safety culture in 24 hospitals. *BMJ Qual Saf* 2013; 22:394-404.

37. Kawano T, Taniwaki M, Ogata K, et al. Improvement of teamwork and safety climate following implementation of the WHO surgical safety checklist at a university hospital in Japan. *J Anesth* 2014; 28:467-470.

38. Kellicut DC, Kuncir E, Williamson HM, et al. Surgical Team Assessment Training: improving surgical teams during deployment. *J Am Coll Surg* 2014; 208, 275-283.

39. Kilday, D., Spiva, L., Barnett, J, et al. The Effectiveness of Combined Training Modalities on Neonatal Rapid Response Teams. *Clin Sim Nurs* 2013; 9:e249-e256.

40. Kleiner C, Link T, Maynard TM, et al. Coaching to Improve the Quality of Communication During Briefings and Debriefings. *AORN* 2014; 100:358-368.

41. Klipfel JM, Carolan BJ, Brytowski N, et al. Patient safety improvement through in situ simulation interdisciplinary team training. *Urologic Nurs* 2014; 34:39-46.

42. Kolbe M, Weiss M, Grote G, et al. TeamGAINS: a tool for structured debriefings for simulation-based team trainings. *BMJ Qual Saf* 2013; 22:541-553.

43. Krimsky WS, Mroz IB, Mcilwaine JK, et al. A model for increasing patient safety in the intensive care unit: increasing the implementation rates of proven safety measures. *Qual Saf Health Care* 2009; 18:74-80.

44. Liaw SK, Zhou WT, Lau TC, et al. An interprofessional communication training using simulation to enhance safe care for a deteriorating patient. *Nurs Ed Today* 2014; 34:259-264.

45. Lingard L, Espin S, Rubin B, et al. Getting teams to talk: development and pilot implementation of a checklist to promote interprofessional communication in the OR. *Qual Saf Health Care* 2005; 14:340-346.

46. Low DK, Reed MA, Geiduschek JM, et al. Striving for a zero-error patient surgical journey through adoption of aviation-style challenge and response flow checklists: a quality improvement project. *Paediatr Anaesth* 2013; 23:571-578.

47. MacEachin SR, Lopez CM, Powell KJ, et al. The fetal heart rate collaborative practice project: situational awareness in electronic fetal monitoring-a Kaiser Permanente Perinatal Patient Safety Program Initiative. *J Perinatal Neonatal Nurs* 2009; 23:314-323.

48. Mahoney JS, Ellis TE, Garland G, et al. Supporting a Psychiatric Hospital Culture of Safety. *J Am Psych Nurs Assoc* 2012; 18:299-306.

49. Mayer CM, Cluff L, Lin WT, et al. Evaluating efforts to optimize TeamSTEPPS implementation in surgical and pediatric intensive care units. *Jt Comm J Qual Patient Saf* 2011; 37:365-374.

50. Meurling L, Hedman L, Sandahl C, et al. Systematic simulation-based team training in a Swedish intensive care unit: a diverse response among critical care professions. *BMJ Qual Saf* 2013; 22:485-494.

51. Mikkelsen Kyrkjeb J, Bratteb G, Smith-Strm H. Improving patient safety by using interprofessional simulation training in health professional education. *J Interprof Care* 2006; 20:507-516.

52. Morag, I., Gopher, D., Spillinger, A, et al. Human factors-focused reporting system for improving care quality and safety in hospital wards. *Human Factors* 2012; 54:195-213.

53. Nagelkerk J, Peterson T, Pawl B, et al. Patient safety culture transformation in a children's hospital: an interprofessional approach. *J Interprof Care* 2014; 28:358-364.

54. Nickel W, Saint S, Olmsterd R, et al. The Interdisciplinary Academy for Coaching and Teamwork (I-ACT): A novel approach for training faculty experts in preventing healthcare-associated infection. *Am J Infect Contr* 2014;42:S230-S235

55. O'Leary K, Buck R, Fligiel H, et al. Structured interdisciplinary rounds in a medical teaching unit: improving patient safety. *Arch Intern Med* 2011; 171:678-684.

56. O'Leary K, Wayne D, Haviley C, et al. Improving teamwork: impact of structured interdisciplinary rounds on a medical teaching unit. *J Gen Intern Med* 2010; 25:826-832.

57. Paige, J., Aaron, D., Yang, T, et al. Improved operating room teamwork via Safety Prep: a rural community hospital's experience. *World J Surg* 2009; 33:1181-1187.

58. Paine, L., Rosenstein, B., Sexton, B, et al. Assessing and improving safety culture throughout an academic medical centre: a prospective cohort study. *Qual Saf Health Care* 2010; 19:547-554.

59. Patterson MD, Geis GL, Falcone RA, et al. Impact of multidisciplinary simulation-based training on patient safety in a paediatric emergency department. *BMJ Qual Saf* 2013; 22:383-393.

60. Patterson MD, Geis GL, Falcone RA, et al. In situ simulation: detection of safety threats and teamwork training in a high risk emergency department. *BMJ Qual & Saf* 2013; 22:468-477.

61. Pettker CM, Thung SF, Lipkind HS, et al. A comprehensive obstetric patient safety program reduces liability claims and payments. *Am J Obstet Gynecol* 2014; 211:319-325

62. Pettker CM, Thung SF, Raab CA, et al. A comprehensive obstetrics patient safety program improves safety climate and culture. *Am J Obstet Gynecol* 2011; 204:216.e1-6.

63. Phipps MG, Lindquist DG, Mcconaughey E, et al. Outcomes from a labor and delivery team training program with simulation component. *Am J Obstet Gynecol* 2012; 206:3-9.

64. Rice Simpson KR, Knox GE, Martin M, et al. Michigan Health & Hospital Association Keystone Obstetrics: A Statewide Collaborative for Perinatal Patient Safety in Michigan. *Jt Comm J Qual Patient Saf* 2011; 37:544-551.

65. Riley W, Davis S, Miller K, et al. Didactic and simulation nontechnical skills team training to improve perinatal patient outcomes in a community hospital. *Jt Comm J Qual Patient Saf* 2011; 37:357-364.

66. Robertson B, Kaplan B, Atallah H, et al. The use of simulation and a modified TeamSTEPPS curriculum for medical and nursing student team training. *Sim Healthcare* 2010; 5:332-337.

67. Ross J, Wolf D, Reece K. Highly reliable procedural teams: the journey to spread the universal protocol in diagnostic imaging. *Perm J* 2014; 18:33-37.

68. Sandahl C, Gustafsson H, Wallin CJ, et al. Simulation team training for improved teamwork in an intensive care unit. *Int J Health Care Qual Assur* 2013; **26**:174-188.

69. Sawyer T, Laubach VA, Hudak J, et al. Improvements in teamwork during neonatal resuscitation after interprofessional TeamSTEPPS training. *Neonatal Netw* 2013; 32:26-33.

70. Sehgal N, Fox M, Vidyarthi A, et al. A multidisciplinary teamwork training program: the Triad for Optimal Patient Safety (TOPS) experience Improvements in teamwork during neonatal resuscitation after interprofessional TeamSTEPPS training. *J Gen Intern Med* 2008; 23:2053-2057.

71. Sexton BJ, Berenholtz SM, Goeschel CA, et al. Assessing and improving safety climate in a large cohort of intensive care units. *Crit Care Med* 2011; 39:934-939.

72. Siegele, P. Enhancing outcomes in a surgical intensive care unit by implementing daily goals tool. *Crit Care Nurs* 2009; 29:58-69.

73. Slater B, Lawton R, Armitage G, et al. Training and action for patient safety: embedding interprofessional education for patient safety within an improvement methodology. *J Cont Ed Health Prof* 2012; 32:80-89.

74. Spiva L, Robertson B, Delk ML, et al. Effectiveness of Team Training on Fall Prevention. *J Nurs Care Qual* 2014; 29:164-173.

75. Stead K, Kumar S, Schultz TJ, et al. Teams communicating through STEPPS. *Med J Aust* 2009; 190: S128-S132.

76. Stewart M, Purdy J, Kennedy N, et al. An interprofessional approach to improving paediatric medication safety. *BMC Med Ed* 2010; 10:19.

77. Taylor AM, Chuo J, Figueria-Altman A, et al. Using four-phased unit-based patient safety walkrounds to uncover correctable system flaws. *Jt Comm J Qual Patient Saf* 2013; 39:396-403.

78. Thomas L, Galla C. Building a culture of safety through team training and engagement. *BMJ Qual & Saf* 2013; 22:425-434.

79. Timmel J, Kent PS, Holzmueller CG, et al. Impact of the Comprehensive Unit-based Safety Program (CUSP) on safety culture in a surgical inpatient unit. *Jt Comm J Qual Patient Saf* 2010; 36:252-260.

80. Velji K, Baker GR, Fancott C, et al. Effectiveness of an Adapted SBAR communication tool for a rehabilitation setting. *Health Quart* 2008; 11:72-79.

81. Vigorito M, McNicoll L Adams L, et al. Improving safety culture results in Rhode Island ICUs: lessons learned from the development of action-oriented plans. *Jt Comm J Qual Patient Saf* 2011; 37:509-515.

82. von der Lancken S, Levenhagan K. Interprofessional teaching project with nursing and physical therapy students to promote caregiver and patient safety. *J Nurs Ed* 2014; 53:704-709.

83. Wallin C, Kalman S, Sandelin A, et al. Creating an environment for patient safety and teamwork training in the operating theatre: A quasi-experimental study. *Med Teach* 2015; 37:267-276.

84. Weaver SJ, Rosen MA, DiazGranados D, et al. Does teamwork improve performance in the operating room? A multilevel evaluation. *Jt Comm J Qual Patient Saf* 2010; 36:133-142.

85. Wheeler, DS., Geis, G., Mack, EH., Lemaster, T. and Patterson, MD. High-reliability emergency response teams in the hospital: improving quality and safety using in situ simulation training. *BMJ Qual & Saf* 2013; 22:507-514.

86. White D, Suter E, Parboosingh J, et al. Communities of practice: creating opportunities to enhance quality of care and safe practices. *Health Quart* 2008; 11:80-84.

87. Wilson A, Fabri P, Wolfson, P. Human error and patient safety: interdisciplinary course, *Teach Learn Med* 2012; 24:18-25.

88. Wolf FA, Way LW, Stewart L. The efficacy of medical team training: improved team performance and decreased operating room delays: a detailed analysis of 4863 cases. *Ann Surg* 2010; 252:477-783.

89. Ziesmann, MT, Widder, S., Park, J, et al. STARTT: development of a national, multidisciplinary trauma crisis resource management curriculum-results from the pilot course. *J Trauma Acute Care Surg* 2013; 75:753-758.