Title: THE USE OF INTERPROFESSIONAL LEARNING AND SIMULATION IN UNDERGRADUATE NURSING PROGRAMS TO ADDRESS INTERPROFESSIONAL COMMUNICATION AND COLLABORATION: AN INTEGRATIVE REVIEW OF THE LITERATURE

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ABSTRACT

Objective: To identify how simulation and interprofessional learning are used together in undergraduate nursing programs and undertaken in schools of nursing to address interprofessional communication and collaboration.

Design: An integrative literature review

Data Sources: The databases CINAHL, ProQuest, PubMed, Scopus, PsycInfo and Science Direct were searched to identify articles from 2006-2016 that reported on the use of IPL and simulation together in undergraduate nursing education.

Review Method: Whittemore and Knafl's five step process was used to guide the integrative review of quantitative and qualitative literature. Only peer reviewed articles written in English that addressed undergraduate nursing studies, were included in the review. Articles that did not aim to improve communication and collaboration were excluded. All articles selected were examined to determine their contribution to interprofessional learning and simulation in undergraduate nursing knowledge.

Results: The faculties of nursing used interprofessional learning and simulation in undergraduate nursing programs that in some cases were connected to a specific course. A total of nine articles, eight research papers and one narrative report, that focussed on collaboration and communication were selected for this review. Studies predominantly used nursing and medical student participants. None of the included studies identified prior student experience with interprofessional learning and simulation. Four key themes were identified: communication, collaboration/teamwork, learning in practice and understanding of roles, and communication

Conclusion: This review highlights the identified research relating to the combined teaching strategy of interprofessional learning and simulation that addressed communication and collaboration in undergraduate nursing programs. Further research into the implementation of interprofessional learning and simulation may benefit the emergent challenges. Information drawn from this review can be used in informing education and educational development in the future.

Keywords: “Interprofessional learning”, “simulation”, “literature review”, “nursing” “education”

INTRODUCTION

Errors and adverse events in health care frequently originate from poor communication between members, resulting in negative outcomes for patients and the health team (Eggertson, 2012). To improve the quality of care and to minimise the risk of errors, effective communication and collaboration is fundamental (Edwards & Siassakos, 2012). The World Health Organization (WHO) (2010) promoted interprofessional learning in undergraduate health studies as one effective approach to address collaboration and communication to improve safety and promote positive patient outcomes.

In 2013 the WHO released a report that highlighted the need for a new approach to the education of health students. The report promoted both interprofessional learning and simulation as a means of improving student learning in health programs (WHO, 2013) and asserted that interprofessional learning would improve communication and collaboration between students and prepare them for interdisciplinary teamwork after graduation. Interprofessional education and interprofessional learning will be used interchangeably throughout this review and may be referred to by the acronym ‘IPL’.

Both IPL and simulation are important in health education, although there is limited information in the literature on how both are used together in nursing education. The focus until recently has been on investigating the usefulness of interprofessional learning or clinical simulation on their own (O'Connor, 2014; Thistlethwaite & Moran, 2010). There is a need to examine the impact of IPL and simulation used together in health professional education, specifically in schools of nursing.

BACKGROUND

Simulation

Simulation imitates a procedure that would occur in reality (O'Connor, 2014). Recent research shows that simulation-based education and positive learning outcomes are related (Thomas & Mackey, 2012; Weller et al., 2012). Simulation provides the opportunity to repeat procedures in a safe environment, allowing students to try and fail and learn while doing so. It is therefore a possibility to improve skills without putting patients at risk, which implies that simulation is a way of working towards safe care (Brier et al., 2015; Mullen & Byrd, 2013). Bashaw's (2016), study investigating the integration of simulation into nursing education, showed that students increased their confidence with simulation indicating that simulation is beneficial to the students' learning.

The strategy of using simulation in education has been used for decades, it is the manner that simulation is used and the type of simulation that has changed (Nehring & Lashley, 2009; Weller et al., 2012). Fast evolving technology has made it possible to use simulation in a more complex form, ranging from low- to high-fidelity, with high-fidelity using more realistic technology (O'Connor, 2014). As the technology continues to develop, simulation scenarios are predicted to improve in the reflection of reality (Weller et.al., 2012) including working with other health professionals.

Interprofessional education

The WHO (2010) stated that after nearly 50 years of examination there is enough evidence to state that IPL positively affects the effectiveness of collaboration. IPL is broadly defined as a process whereby two or more students, with different learning backgrounds, learn together by

interacting with each other (WHO, 2010). IPL is relevant both to the quality and the quantity of students' skills and is effective in allowing students to work together and to improve their understanding of other occupations (WHO, 2013).

The ability to work together with different health professionals has become a fundamental skill and if students are going to obtain these skills then IPL needs to be implemented in the education of health professionals (WHO, 2013). One specific Australian example of integration is that of Griffith University which implemented a framework for IPL in undergraduate health education. The framework details the process to incorporate interprofessional skills to ensure that during their undergraduate education health students experience a simulated professional team activity as well as a real service experience (Griffith Health Institute for the Development of Education and Scholarship, 2014).

Communication and collaboration

Effective communication and collaboration is the basis for safe nursing care and working in teams with other health professionals. The importance of communication is identified internationally by the following significant bodies: The Joint Commission on Patient Safety (2015) which reported that human factors, leadership, and communication were first three major root causes of sentinel events in the USA in 2014; The Parliamentary and Health Service Ombudsman of the United Kingdom (2017) identified inaccurate and poor quality communication in the National Health Service as one of the top three causes of complaints; and the Australian Commission on Safety and Quality in Health Care (2017) is focussing on communication amongst members of the health team to improve safety and quality in health care. Logically it follows that undergraduate health professional learning focus on developing student skills and confidence with interprofessional communication and collaboration

IPL is essential for the delivery of safe care and for positive patient outcomes (Kalisch et al., 2009). Failure to communicate and collaborate can lead to serious negative outcomes in healthcare teams, therefore the communication that takes place between professionals needs to be taught and practiced (O'Daniel & Rosenstein, 2008; Owen et al., 2015). Collaboration and teamwork are often used simultaneously, where health professionals have a close bond and may be defined similarly although teamwork is accomplished through collaboration (Brock et al., 2013). Collaboration is important in health care, not only for patient outcomes, but also organisational and economic outcomes (Procter & Currie, 2004; Xyrichis & Ream, 2008). Hence in reviewing the IPL and simulation literature, it follows that the focus of the review includes communication and collaboration.

Brashers et al., (2016) demonstrated that IPL and simulation are necessary for effective collaborative practice. Different health professionals learning together benefits all involved with the sharing of knowledge, opinions and skills (E. J. Thomas et.al., 2003). Lundberg (2008) assert that clinical confidence cannot always be developed in the classroom and that understanding and skillset will improve when a student masters a skill in practice, furthermore it is the educational facility's responsibility to promote mastery via learning in practice. This assertion is supported by Billett (2010) who stated that knowledge and skill mastery can be achieved through the practice of an occupation's role hence supporting the educational strategy of simulation and IPL in undergraduate health education.

THE REVIEW

Aim

The aim of the review is to identify how simulation and interprofessional learning are used together in undergraduate nursing programs and undertaken in schools of nursing to address interprofessional communication and collaboration.

Objectives

The objectives of this review are to: (1) identify and appraise published accounts of IPL and simulation in undergraduate nursing programs, undertaken in schools of nursing that improve interprofessional communication and collaboration; (2) identify the proportion of IPL and simulation research undertaken in schools of nursing that focuses on communication and collaboration; (3) conduct an appraisal of the selected literature.

METHOD

Design

An integrative review was established to provide current knowledge of how IPL and simulation are used together in undergraduate nursing programs. Integrative reviews allow for a variety of literature to be included thus providing for a broad understanding of the topic (Whittemore & Knafl, 2005). Whittemore and Knafl's (2005) five step strategy for integrative reviews was adopted and used throughout the current review to provide methodological rigour. The five steps being problem identification, literature search, data evaluation, data analysis and presentation.

Problem identification

The first step is addressed by the aim of the review which as stated previously is to identify how simulation and interprofessional learning are used together in undergraduate nursing programs and undertaken in schools of nursing to address interprofessional communication and collaboration.

Literature search

The second step was addressed by sourcing the relevant literature in the databases CINAHL, ProQuest, PubMed, Scopus, PsycInfo and Science Direct. Key words for the search included 'simulation' AND ("interprofessional learning" OR "interprofessional education") AND 'nursing'.

Communication and collaboration were discarded from the search phrase as there are a variety of ways of expressing communication; as well it was of interest to see how many of the studies focused on these communication and collaboration.

Articles were included in the review if they were peer reviewed scholarly articles, written in the English language, investigated both simulation and IPL in undergraduate nursing courses undertaken in schools of nursing, focused on communication and collaboration outcomes and published between 2006 and 2016. Articles were excluded if they: did not have undergraduate nursing students as participants; did not include both IPL and simulation; focussed on virtual (on-line) simulation; or reported on the testing of tools related to IPL and simulation.

Data evaluation

The third step involved evaluation of the literature and commenced immediately following the primary literature search. The initial evaluation of the literature was conducted by the first author (BMG) who consulted with the other two authors when concerns arose regarding inclusion/exclusion of articles. Articles were included after discussion and agreement by all authors. The search resulted in 149 articles being found with 83 being left after removal of duplicates. Of these, 83 articles 27 did not meet the inclusion criteria on review of the titles that is, the papers were clearly not about the topic. If it was unclear whether the papers met the inclusion criteria, then these papers were more closely screened in the following step of reviewing the abstract or the full article. The abstracts of the remaining 56 articles were examined with 21 articles not meeting the inclusion criteria. The remaining 35 articles were reviewed in full. At completion of the screening a total of nine papers remained for analysis (see Figure 1).

Data analysis

Step four involved analysis of the selected articles which were considered on the basis of methodological quality, relevance to the topic, and the quality of information. In summarising the descriptive methodological data, a standardised summary table, as suggested by Whitemore and Knafl (2005), was created (see Table 1). A summary of participants' previous experience with simulation and IPL is provided in Table 2. Further, key themes were derived from thematic analysis of the reviewed papers. This involved developing an outline with the most common characteristics of the main findings in the articles.

FINDINGS

The general findings for this review were drawn from the nine selected papers, eight of which were research reports and one narrative report. Two studies based their results on quantitative measures alone (Liaw et al., 2014; Sigalet et al., 2015) while the six remaining used a mixed method approach incorporating both quantitative and qualitative measures (King et al., 2016; New et al., 2015; Scherer et al., 2013; Stewart et al., 2010; Titzer et al., 2012; Wagner et al., 2011). The articles selected for the review were published between 2010 and 2016, with over half published within the last three years indicating an increase of IPL in undergraduate nursing education (see Table 1). Five of the nine studies were undertaken in the USA (Horsley et al., 2016; New et al.; Scherer et al.; Titzer et al.; Wagner et al.). Participants were predominantly nursing and medical students with nursing students participating in all of the included studies and medical students participating in seven out of eight studies (see Table 1).

Methodological quality

The studies included in the review were of different methodological design and quality. All students consented to participate in the studies. In some studies, the participants volunteered to participate in the programs (King et al., 2016; Scherer et al., 2013; Wagner et al., 2011). In others, students were required to participate in the activities as a part of course studies (Liaw et al., 2014; Sigalet et al., 2015) but may not have contributed to the study data. In the studies by New et al., (2015), Titzer et al., (2012) and Stewart et al., (2010) the simulation was a part of an elective program, therefore open to all undergraduate students, but if a student was enrolled in the course, participation in the simulation experience was mandatory, thereby promoting self-selection in the sampling.

Most popular in the research was a pre-post study design, five out of eight research papers used this approach (King et al., 2016; Liaw et al., 2014; Scherer et al., 2013; Sigalet et al., 2015; Titzer et al., 2012). The pre-post design studies analysed measurement prior to and post simulation, enabling identification of intervention impact. The remaining three studies (New et al., 2015; Stewart et al., 2010; Wagner et al., 2011) used a post-study approach only which prevented comparisons between results. This method of measuring then relied on the student's feelings of improvement, which presupposes that the students had the ability to reflect on their own knowledge (Portney & Watkins, 2000).

Surveys were the most common form of data collection with six out of the eight research studies using a Likert scale as one of the tools for measuring outcomes (King et al., 2016; Liaw et al., 2014; New et al., 2015; Scherer et al., 2013; Stewart et al., 2010; Titzer et al., 2012). The data collected in seven out of eight studies were self-reported (see Table 1) showing that the researchers did not directly draw information from observing the participants, but recorded the participants' self-reported experiences. The remaining study used a performance score allocated by an observer (Sigalet et al., 2015). Observational studies provide insight into the level of participant improvement

when ranked (US National Library of Medicine, 2004) however bias may arise in relation to the objectivity of the assessment (Grimes & Schulz, 2002). In addressing validity, Sigalet et al., (2015) used a performance scale and six reviewers blindly measured the outcomes to minimise subjectivity as scales have been shown to have high reliability (Portney & Watkins, 2000).

IPL and simulation programs

In addressing the review question; all included articles used IPL and simulation together in scenario based situations to measure their findings (see Table 1). The faculties in the studies used IPL and simulation in undergraduate nursing programs that in some cases were connected to a specific course (Liaw et al., 2014) and in other cases not, (Horsley et al., 2016). None of the studies directly reported previous participant experiences with IPL and simulation. One study by King et al. (2016) stated that it was a new experience for 'most' students, which suggests that there were some students that had previous exposure to the situation.

Horsley et al. (2016) identified that to change the students mind from thinking "us" and "them" to thinking "we", was together with scheduling the activities, the most challenging aspects of the strategy implementation. Further challenges of timetabling and programme structures were identified by both Horsley et al., and New et al., (2015) and supports the notion upheld in the literature that the implementation of IPL is challenging and not to be underestimated (Lewy, 2010).

Defining key themes

Findings were analysed in accordance with Whitemore and Knafl's (2005) guidelines discussed earlier under Method and Data analysis in addition - the use of tables and figures aimed to provide a transparent record of the review process. Thematic analysis identified the major benefits for students of learning with other disciplines. Four themes arose from the analysis of the benefits of

these simulation and IPL activities. The four key themes identified included: Collaboration, learning in practice, understanding of roles, and communication.

Collaboration

A combination of simulation and IPL activities appear to improve the collaboration of students (Sigalet et al., 2015). This is supported by the survey results in Titzer et al. (2012) where students noted that they worked better together with other disciplines after the simulation. The student's evaluations showed that the team performance score had a mean of 4.40, where a score of 4.0 or over qualified as significant (Titzer et al., 2012). Students benefited greatly in relation to teamwork from simulation based IPL workshops in all studies (Liaw et al., 2014; New et al., 2015; Scherer et al., 2013; Stewart et al., 2010; Wagner et al., 2011). The results in King et al., (2016) showed that in relation to the workshop, the students' team functionality'. Arguably, collaboration between schools to incorporate IPL simulations allowed students to improve team performance and provide safe care (Horsley et al., 2016).

Learning in practice

The IPL simulated activities provided the students with the opportunity to practice and improve skills (Stewart et al., 2010; Wagner et al., 2011). The study by New et al., (2015) showed that 98.5% of the students thought the experience was effective. Student responses in Titzer et al., (2012) showed that simulation allowed students to make mistakes without impacting patients. The student's felt encouraged to explore patient care, and scored a mean score of 4.33 on the importance of exploring possibilities, where a result of 4 or more was considered significant. Stewart et al., (2010) provided simple statistical analysis that showed that nurses scored 81.9% as a mean score of attitudes to this type of learning (see Table 1), and the qualitative evaluations indicated that students valued this way of learning. Liaw et al., (2014) identified that the practical learning

experience resulted in significant improvement ($P<0.001$) in post-test scores of the students' confidence and perception.

Understanding of roles

Stewart et al., (2010) and Wagner et al., (2011) found that simulation based exercises used in IPL encourage students to engage with other professions and learn about one another as well as from one other. King et al. (2016) identified that in managing conflict, it is important to understand the different roles in a team, and reported significant student improvement in conflict management after a simulation experience with a P-value of $p<0.001$. The scenarios and workshops in Wagner et al., (2011) and Titzer et al., (2012) were shown to improve the students understanding of the different health professional roles, and reinforced the participants' understanding of the need to work collaboratively. Stewart et al., (2010) reported that students scored between 73% and 85% on a test in all the domains; knowledge, communication, teamwork, role awareness and attitude to shared learning, after the interprofessional simulation experience (see Table 1).

Communication

Communication was addressed in all studies indicating that combining IPL and simulation as an education strategy is useful. For example, Horsley et al., (2016) demonstrated that when IPL and simulation are used together in education, communication was enhanced; Scherer et al. (2013) fostered collaboration by improving communication between student disciplines. In Scherer et al's (2013) study the nursing student' in collaboration with medical students, scored higher (mean=44.67) on post confidence than the nursing students who did not collaborate with medical students (mean=41.58). Wagner et al., (2011) used IPL and simulation with the aim to highlight the weaknesses that may occur. In turn, the recognition of a weakness would be useful in addressing those weaknesses or to making a change to prevent them arising.

Liaw et al., (2014) aimed to improve communication in the IPL simulated scenarios using a communication tool; Situation, Background, Assessment, and Recommendation (SBAR). The study findings indicated that the use of SBAR improved interprofessional communication demonstrated by an increase in students' communication confidence by 13% post-test (Liaw et al.). In contrast, King et al., (2016), who did not use a communication tool, identified that the improvement in communication was not significant.

DISCUSSION

The review identified that IPL and simulation is commonly undertaken in schools of nursing with nine papers from the years 2010 to 2016 clearly reporting on the use of communication and collaboration. The findings suggest that undergraduate nursing students mostly engaged with medical students in IPL and simulation activities undertaken in schools of nursing. Studies that focused on communication and collaboration, made up 26% (n=9) of the literature reviewed. Commonly in the studies self-reported measures were used to assess communication and collaboration outcomes. Whilst the studies reviewed focussed on the themes of 'collaboration/teamwork' and 'communication', the other themes 'learning in practice' and 'understanding of roles' were also evident. Surprisingly, whilst the WHO (2010) had identified IPL and simulation in undergraduate studies as important strategies in improving communication and collaboration in the health care arena, most of the students had not experienced IPL and simulation before participating in the review studies.

The findings indicated that medical students made up the group that most commonly participated in interprofessional and simulation activities with nursing students. This is both logical and appropriate and reflects the close collaboration of nurses and doctors in practice. More simply this may also reflect timetabling which has also been identified as a major challenge of implementation (Horsley et al., 2016; Lewy, 2010; New et al., 2015). It is reasonable to assume that

the timetabling challenges will increase along with an increase in the number of participating disciplines.

Methodological rigour of studies can always be improved to minimise bias. Convenience sampling was predominantly used as it provides the simplest approach to obtaining participants for research, although this may create a bias as volunteers are often considered the 'best' participants (Lunsford & Lunsford, 1995). There is concern that those students participating on a mandatory basis in activities may cause bias in the study either positively or negatively as participants may, or may not, be interested in the study (Lunsford & Lunsford, 1995; Moore et al., 2006). Self-reported measures may also lead to bias, however, self-reported measures generally have high validity, especially when collecting data on participants' attitudes (Portney & Watkins, 2000).

IPL and simulation have a positive impact on developing students' skills in communication and collaboration, as anticipated by the WHO (2010; 2013). The degree of impact is affected by the simulation activity and the measures used to assess the communication and collaboration. The different studies of the review had different aims resulting in differing study foci and outcomes. Communication and collaboration were common foci of the reviewed papers (26%; n=9) and highlight the importance of communication between professionals and in teamwork. The findings of the review suggest that combining IPL and simulation activities is a good approach to improving team communication as it is easy to recognise weaknesses in communication, therefore easier to address communication problems (Liaw et al., 2014; Wagner et al., 2011). IPL and simulation experiences, especially those that use communication tools, provide one avenue to improve health care communication. It is equally apparent in the present research that combining IPL and simulation in education is a sound strategy to improve teamwork and collaboration (King et al., 2016; Scherer et al., 2013; Sigalet et al., 2015; Titzer et al., 2012).

Another outcome of combining interprofessional and simulation activities identified was improved student confidence (Liaw et al., 2014). As previously discussed, Lundberg (2008) discusses

that this type of clinical confidence needs to be taught in a clinical setting highlighting a responsibility of faculties to provide students with an opportunity to promote these skills. As for learning in practice and understanding of disciplinary roles, it is clear from the research that students appreciate this type of learning (Stewart et al., 2010; Titzer et al., 2012; Wagner et al., 2011).

Development of an understanding of other professions practice was also identified as a consequence of the interprofessional and simulation experience (New et al., 2015; Stewart et al., 2010; Wagner et al., 2011). An improved understanding of health professional roles will benefit learning outcomes as well as safe quality health care (WHO, 2013).

Interestingly, despite the strong recommendations by the WHO (2013) for IPL and simulation in undergraduate education, not one of the reviewed studies clearly identified that students had previous experience. Quite the opposite was noted for example, New et al. (2015) clearly stated that they had never collaborated across disciplines prior to their study; and Titzer et al. (2012) stated that students acknowledged not having any knowledge of other disciplines. These results were surprising in view of the proven improvement of collaboration between students after IPL workshops (WHO, 2010) and previous experience in interprofessional simulation has been proven to be important to student's confidence and ability to implement skills (Smith & Roehrs, 2009; C. Thomas & Mackey, 2012). Reasons for this lack of IPL and simulation use can be explained by the identified challenges of implementation for example, timetabling and resources (Horsley et al., 2016). Additionally, the search strategy resulted in articles that were predominantly published after the year 2013.

Implementation of teaching strategies and changes in education takes time, it is therefore logical that there will be a phase where change is planned after the guidelines from the WHO (2013) were published. Over half of the articles were published within the last three years highlighting that research in this field is relatively new and ongoing and this may be an explanation for why students have not previously experienced IPL and simulation.

Strengths and limitations

This review provides valuable insight in to the use of IPL and simulation to improve undergraduate nursing students' interprofessional communication and collaboration. Being an integrative review, it did not limit the research by methodology allowing a broad spectrum of literature. Taking this approach facilitated the identification of more examples assisting in determining how IPL and simulation are used together in undergraduate nursing studies. As well the initial literature search included all studies of IPL and simulation in nursing allowing the determination of the percentage of IPL and simulation literature that focussed on communication and collaboration.

Whilst all efforts to provide a valid and accurate review were undertaken, the review is not without limitations. Unavoidable limitations exist for example, the literature searches were limited to literature published online and written in English. Despite communication and collaboration being an important outcome of IPL and simulation activities, providing a review limited to these outcomes may limit the strength of the findings. Additionally, it is acknowledged that even though the review was undertaken systematically, some relevant articles may have been overlooked.

Implications

The implications from the findings suggest that more rigorous research be undertaken including: investigating the trend of schools of nursing combining IPL and simulation activities with medical schools to see if this has implications for health team collaboration; the use of a performance scale as a measure to provide evidence of participant skill improvement to strengthen the evidence of IPL and simulation; and the use of a communication tool to prepare students for communication in IPL and simulation activities. Further recommendations include investigations of whether or not there is an increase in the clinical capacity of the students who have undertaken these simulations.

CONCLUSION

This review has highlighted the identified research related to combining IPL and simulation activities to address communication and collaboration in undergraduate nursing programs undertaken in schools of nursing. It has been noted that these activities are increasing. Approximately 26% of the IPL and simulation studies undertaken in undergraduate nursing studies focus on communication and collaboration. IPL and simulation are mainly used in collaboration between nursing students and medical students, as a workshop or exercise to prepare for practice. The way interprofessional simulation is implemented in undergraduate education varies for example, in some cases it is mandatory and others not. The findings of this review illustrates that the use of IPL and simulation together in undergraduate programs might not be as integrated in the curriculums as anticipated and reflects the short time since the WHO (2013) released its IPL guidelines. It is noted that educational changes take time and recent research points towards an increase in the use of IPL and simulation in undergraduate nursing studies. The use of IPL and simulation together in undergraduate nursing education is developing and is often used to address communication and collaboration issues between the health disciplines of the future.

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Figure 1: Search strategy

Table 1: Characteristics of literature

Author Country Year	Methodology Sample Aim	Accessed	Use of IPL+S	Findings # Limitations	Comments
Quantitative research					
Liaw et al., Singapore 2014	Exploratory descriptive study. Pre-test and post-test Self-reported measurements. 127 students <ul style="list-style-type: none"> ○ Nursing n= 92 ○ Medical n= 33 Describe development, implementation and evaluation of a simulated-based IPL program, for improving medical and nursing students' communication skills in caring for a patient with physiological deterioration	Managed and developed by faculty of nursing, medicine and anaesthesiology.	Used a Healthcare Simulation centre. Used in a program for undergraduate nursing and medicine students. Used in training with a focus to develop skills in communication. Program was integrated into a third year undergraduate nursing module.	Students confidence in communication increased by 13 % post-test survey. No differences between groups. Significant improvement in post-test scores in self-confidence and perception ($p < 0.001$). # Evidence of effectiveness was limited to pre-test and post-test design # Self-reported measures to evaluate the program. # Did not evaluate retention of behaviours in clinical setting # Focused on Interprofessional communication skills and outcome of study was limited to this specific topic.	Used SBAR as a tool and strategy in the program to improve communication. Compulsory for nursing students. Used presage-process-product model for development on the program focusing on communication. Interprofessional collaboration between facilities is an important education factor of undergraduate studies.

Sigalet et al., Canada 2015	<p>Quasi-experimental study. Pre and post-test design</p> <p>Measures rated by observers.</p> <p>196 students</p> <ul style="list-style-type: none"> ○ Medicine n= 35 ○ Nursing n= 127 ○ Respiratory n = 34 <p>To understand more about the competence level of an undergraduate IP team with respect to leadership, roles and responsibilities, communication and situation awareness.</p>	<p>Initiative occurred at Alberta Children's Hospital, initiated by educators, faculty and researchers.</p>	<p>All students were required to participate as part of their studies. The study provided information for educators</p>	<p>Team performance results were improved with a significant level of $p < 0.001$ which qualifies as significant findings.</p> <p>The highest mean score found were in post-test of intervention group on the item "role clarity" mean= 4.2.</p> <p># Students need to be secure in own role before supporting another team member, it is unsure if all students were prepared for the activity.</p> <p># Students of different occupations were not in the same year of training.</p>	<p>Used as a part of the curriculum.</p> <p>Used observational scores.</p> <p>A relationship between simulation IPL and improved team performance in teams for undergraduate interprofessional students.</p>
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Mixed-method research					
King et al., Canada 2016	<p>Quasi-experimental study. Pre-post survey and open ended questionnaires. Self-reported measurements.</p> <p>13 students in 2013</p> <ul style="list-style-type: none"> ○ Nursing n=5 ○ Respiratory n= 4 ○ Physiotherapy n= 4 <p>43 students in 2014</p> <ul style="list-style-type: none"> ○ Nursing n=15 ○ Respiratory n= 19 ○ Physiotherapy n= 9 <p>Compare two different methods of patient simulation in improving interprofessional competencies for students in nursing, physiotherapy and respiratory therapy programs.</p>	<p>Funded through Academic Health Council.</p> <p>An interprofessional faculty team planned the workshops</p>	<p>Compared two different interprofessional simulations that are used in programs.</p> <p>Workshops</p> <p>Combination of standardized patients and mannequins VS only standardized patients.</p>	<p>Biggest improvement in both methods were in conflict management and team function ($p<0.001$).</p> <p>The smallest improvements in both cohorts was communication.</p> <p>Qualitative findings report that the students said that the groups communicated and collaborated well.</p> <p>Students reported that they felt nervous.</p> <p>Method with both mannequin and standardized patient had largest pre-post improvements in 4/6 competencies.</p> <p>No significant difference between the methods.</p> <p># Small number of students</p> <p># Unsure about participant's representativeness of programs.</p> <p># Self-developed questionnaire to capture perceptions.</p>	<p>Data can be used to design and plan future IPL activities.</p>

New et al., USA 2015	<p>Descriptive experimental study.</p> <p>Quantitative survey and qualitative reflective notes.</p> <p>Self-reported measurements.</p> <p>69 students</p> <ul style="list-style-type: none"> ○ Nursing n= 53 ○ Pharmacy n = unknown ○ Medicine n= unknown <p>Interprofessional simulation for the purpose of enhancing communication, developing mutual respect and identifying role clarity through team learning.</p>	Developed by health care faculty.	<p>Used in Simulation centre</p> <p>IPL simulation introduced across academic settings.</p> <p>Scenario based activity to enhance teamwork.</p> <p>This was the students' first interprofessional training during education.</p>	<p>98.5 % of students said simulation was helpful and effective.</p> <p>Almost equal scores between disciplines.</p> <p>Qualitative results showed that students said that they gained experience in communication and teamwork. Students also reported a better understanding of how a team works together.</p> <p># Not all participants had the same knowledge and skills.</p>	<p>Indicated that experience provided empowerment when communicating and interacting with other disciplines.</p> <p>Enriching educational experience</p> <p>There are challenges in scheduling but the faculty found that is worth the effort.</p> <p>Students have limited opportunities to use IPL in their education.</p>
Scherer et al., USA 2013	<p>Quasi experimental pilot study.</p> <p>Pre-post-test design.</p> <p>Self-reported measurements, including a knowledge test, survey and open ended evaluation.</p> <p>108 students</p> <ul style="list-style-type: none"> ○ Nursing n= 85 ○ Medicine n= 23 	Funded and organised by the school of nursing.	<p>Used as teaching strategy</p> <p>Used to foster and support collaboration and improve communication.</p>	<p>Mean knowledge scores in the knowledge test improved significantly ($p<0.05$) between students who had a collaborative learning opportunity.</p> <p>Nursing student's in experimental group scored the highest post-test on the knowledge test (mean=0,733).</p> <p>100% of nurses said they could implement this into practice.</p>	<p>Simulation is effective strategy to support IPL.</p> <p>Findings support IPL and simulation in nursing education improve communication and teamwork.</p>

	Compare the effect of inter vs interprofessional simulation toward interprofessional learning, teamwork and collaboration.			<p>Nurses in experimental group experienced highest post intervention confidence (mean=44,67). Reported improved collaboration and teamwork for the nurses. Students had positive belief in teamwork and collaboration. Improved student attitudes to cooperation.</p> <p># Sample size was small for convenience sample in pilot study # unequal number of nursing students in experimental and control groups. # interaction took place in one interprofessional simulation experience.</p>	
Stewart et al., UK 2010	<p>Descriptive experimental study. Quantitative surveys and qualitative evaluations. Post - evaluations Self-reported measurements. 95 students</p> <ul style="list-style-type: none"> ○ Medical n=49 ○ Nursing n=46 <p>Develop, implement and evaluate an interprofessional undergraduate program</p>	<p>Medical and nurse educators and research staff from the Centre of Excellence in Interprofessional education (CEIPE) determined components</p>	<p>Workshops conducted as a part of overall research program for CEIPE</p> <p>Workshop for students who are undertaking a module in healthcare of children.</p>	<p>Students reported positive statements. Scored between 73% to 85% on all domains (knowledge, communication, teamwork, role awareness, attitude to shared learning.) No difference between medical and nursing students. Students reported IPL and simulation as a better way of learning</p> <p># Logistical constraints in delivery of workshops. #Students would not have achieved the skills demanded in the scenarios without</p>	<p>Provided a safe learning environment. Provided an opportunity for students to learn from other health professionals. Qualifies as important in team learning.</p>

	using high-fidelity paediatric simulation to learn clinical competencies, communication and team working skills.	of the workshop. The simulation was run at the clinical skill centre.		previous learning in assessing parameters.	
Titzer et al., USA 2012	<p>Descriptive experimental study.</p> <p>Post intervention surveys</p> <p>Self-reported measurements.</p> <p>131 students</p> <ul style="list-style-type: none"> ○ Nursing n= 79 ○ Occupational therapy n=27 ○ Radiology n=15 ○ Respiratory n= 10 <p>Improve collaboration and problem solving among health disciplines.</p>	<p>Managed and developed by the school of Nursing.</p> <p>An interprofessional team of health care faculty developed the scenario targeting collaboration.</p>	<p>Used in high-fidelity simulation unit. Exercise to improve communication between the students.</p> <p>Prior to activities simulation briefing and objectives.</p> <p>Scenario based.</p> <p>Debriefing.</p>	<p>Qualitative results showed that students said that simulation provided interdisciplinary teamwork.</p> <p>Team performance score was mean=4,40 and the use simulation in problem-solving scored mean= 4.12. A score above 4.0 qualified as significant.</p> <p>95% of students scored the possibility to work together at 4 or higher on a 5-point Likert scale.</p> <p>Collaboration noted by students.</p> <p>Students thought scenario information was inadequate.</p> <p>Students felt that they were encouraged to explore patient care.</p> <p>Nursing students admitted not knowing another occupations role.</p> <p># Did not accommodate for level of student discipline education or clinical exposure.</p> <p># No pretest or pre evaluation of the perception of other disciplines.</p>	<p>Reinforced the need to work collaboratively.</p> <p>Created a supportive working environment.</p>

Wagner et al., USA 2011	<p>Simple descriptive pilot study.</p> <p>Scenario based, feedback session.</p> <p>Quantitative and qualitative Self-reported measurements.</p> <p>20 students</p> <ul style="list-style-type: none"> ○ Nursing n= 10 ○ Medical n= 10 <p>Aim to describe development and implementation of a pilot educational IPL teaching/learning simulation exercise designed to promote teamwork and collaboration</p>	<p>Developed by nursing education and medical school faculty, as well as Ohio State University Clinical Skill Centre.</p> <p>Run in Clinical skills Centre of OSU College.</p>	<p>Used in an educational exercise</p> <p>Scenario based Experiment - then feedback regarding communication.</p>	<p>The highest average response from the quantitative findings were 4.8 on a five-point Likert scale relating that student's recommended the experience to other students.</p> <p>Qualitative results showed that students reported that they felt better prepared to discuss advanced directives and the experience made them better at working in an interdisciplinary team in the future. Also, students reported that they felt improved confidence.</p> <p># Volunteer laboratory experience</p> <p># Money barrier – facilities and reality of simulation</p> <p># Professional attitudes and preconceptions could have made the teams unequal</p>	<p>Learned through feedback and watching each other.</p> <p>Helped noticing weaknesses in communication.</p> <p>Opportunity to practice communication.</p> <p>Learned different perspectives.</p> <p>Allows teamwork.</p> <p>Preconceptions were deleted.</p>
Opinion piece, narrative report or discussion paper					

Horsley et.al USA 2016	<p>Narrative report.</p> <p>This article describes how a nursing and medical school collaborated to systematically integrate IPL simulations into the curricula using a IPE simulation experience.</p> <p>Ratio of 1:1 of all nursing students in in the undergraduate program.</p>	<p>Developed and integrated by nursing and medical school.</p>	<p>Used in curricula Required for medical students.</p> <p>For nursing students, it is not yet linked to a clinical course, but it is a formal requirement for graduation.</p>	<p>Leadership, clear communication, unwavering mutual support are lessons learned.</p> <p>Acknowledgements of sharing knowledge.</p> <p>Allowed students to keep focus on improving the team performance.</p>	<p>First time the students have collaborated together in a high fidelity simulation.</p>
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Table 2: Students base knowledge

Author Year	Previous experience simulation	Previous experience IPL	Previous experience with IPL + S
Horsley et al., 2016	Yes	Have required knowledge to be successful in IPL training.	No experience
King et al., 2016	Yes	First meeting with IPL activity for most students.	No experience for most students
Liaw et al., 2014	All students had simulation training in respective courses.	No formal training on IPL.	No experience
New et al., 2015	Unknown	First interprofessional training during their education.	No experience
Scherer et al., 2013	Students had prior exposure o simulation	First time they participated in IPL scenarios.	No experience
Sigalet et al., 2015	Had experience with team based learning.	No participation in IPL initiative prior to study	No experience
Stewart et al., 2010	Have had training in life support.	Have ability to reflect on the roles and contributions of other health care professionals.	No experience
Titzer et al., 2012	Previous experience with simulation	Clinical experience of the students varied. No notice of previous IPL.	No experience
Wagner et al., 2011	Unknown	No IPL experiences. Students stated that they had not spoken to any other disciplines students before throughout their education.	No experience

HIGHLIGHTS

IPL and simulation are increasingly undertaken in schools of nursing to develop communication and collaboration amongst health students

Studies that focused on communication and collaboration, made up 26% of the literature that combined IPL and simulation together in undergraduate nursing programs

Implementation of the combined IPL and simulation teaching strategy varies

Currently students lack experience in combined interprofessional and simulation activities

Implementation of combined interprofessional and simulation activities can be challenging

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The use of interprofessional learning and simulation in undergraduate nursing programs to address interprofessional communication and collaboration: An integrative review of the literature

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