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Simulation-Based Interprofessional Education in a Rural Setting

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SIMULATION-BASED INTERPROFESSIONAL EDUCATION IN A RURAL SETTING

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DEDICATION

First and foremost, I would like to thank my husband who supported and encouraged me throughout this journey. He edited all of my work and was a shoulder to lean and rely on when I needed him. I also want to give a shout out to my children who encouraged me to go back to school (even at my age), as my family was my biggest cheerleader and supporter. I also would like to thank all my extended family, friends, and peers for believing in my and encouraging me throughout this journey. And to my students that motivated me along the way, thank you. I only wish my mom and dad could have been a part of this incredible journey, but I know they were looking down at me from heaven. I am thankful to God for directing each and every step of my journey, and for carrying me when I needed Him most.

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ABSTRACT

The purpose of this project was to examine the feasibility and acceptability of a simulation-based IPE experience for pre-licensure nursing, pharmacy, and medical students on a rurally-located campus. Using a mixed-methods, explanatory sequential approach, this project: 1) examined the feasibility of implementing a simulation-based IPE experience using telehealth tools; and 2) evaluated student perceptions of inter-professional teamwork, roles and responsibilities, and patient outcomes for collaborative practice, both pre- and post-scenario.

Quantitative data were analyzed using SPSS. Results revealed 94% agreed/strongly agreed the IPE experience resembled a real-life situation. 100% of nursing/medical students and 80% of the pharmacy students indicated they would recommend this experience to their peers. Significant positive changes in attitudes towards using an inter-professional team approach were noted for pharmacy students, especially in regards to patient outcomes, reduced costs, and improved patient-centered care. Qualitative data were transcribed and analyzed using thematic analysis. Four themes emerged: 1) better understanding of technology; 2) improved communication among team members; 3) benefit of true to life experience; and 4) increased knowledge level and confidence. Participant suggestions for improvement included: 1) improve the simulation/telehealth equipment orientation; 2) consider a grand round-type simulation; and 3) address technical challenges with the robot.

Although limited by a small sample size, this project confirmed it is feasible and acceptable to offer simulation-based IPE in a rural setting facilitated by the use of telehealth tools, and collaborative teamwork is enhanced by using “remote in” technology during a simulation-based IPE activity. Complex healthcare now requires a collaborative and team approach to patient care. A simulation-based IPE approach using “remote in” technology allows for the development and mastery of these competencies. Future work will incorporate student suggestions to improve the experience, as well as integrate students from other healthcare disciplines, such as physician assistant students.

Keywords: Interprofessional education, simulation, teamwork, collaboration, rural, and telehealth

PREFACE

The goal of any Evidence-Based Practice Project is to integrate best research into clinical practice evidence thereby enhancing the knowledge base thus improving quality care and patient outcomes. The project is designed to identify the scope of the clinical practice problem, analyze the current evidence, synthesize the research as it relates to the issue, and subsequently determine recommendations for best practices for clinical care. Additionally, the Evidenced-based Practice Project has been identified as a requirement for partial fulfillment of the Doctor of Nursing Practice Program. The intent is to examine the feasibility and acceptability of a simulation-based IPE experience for pre-licensure nursing, pharmacy, and medical students on a rurally-located campus using telehealth tools, and to evaluate student perceptions of inter-professional teamwork, roles and responsibilities, and patient outcomes for collaborative practice, both pre- and post-scenario.

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CHAPTER 1

INTRODUCTION

Introduction and Background

Historically, healthcare education has been delivered in isolated silos of care. Nursing students learned from a nursing perspective, and likewise medical, pharmacy, and other healthcare professionals learned about patient care in clinical settings individualized to those disciplines. Students were not afforded the opportunity to learn effective communication and teamwork collaboration between the various professions during their educational experience (Smithburger, Kane-Gill, Kloet, Lohr, & Seybert, 2013). When students approach a situation from these single points of view, their perspective of the roles and contributions of others may be limited and lacking in scope. It is no longer acceptable to deliver isolated healthcare education, as complex patient care now requires a collaborative and team approach. Interprofessional education (IPE) addresses this need by training professional healthcare students to work as part of a healthcare team. The premise of IPE is that students who learn from one another, about one another, and with one another will develop competencies needed to work together in teams to provide higher quality care to their patients improving overall outcomes (Pippitt, Moloney-Johns, Jalilibahabadi, & Gren, 2015). Traditionally, IPE experiences are administered face to face, with students from different disciplines coming together to

clinical simulation labs to practice patient scenarios. However, the logistics of coordinating student schedules and travel times present challenges for faculty of rurally located training programs. Technology-based tools currently used to address healthcare access issues for rural patients may be an innovative approach to offering IPE experiences for students in these programs.

Telehealth is a technology-based tool designed to increase access to care for isolated rural residents. According to the Center for Connected Health Policy (CCHP) and the Health Resources and Services Administration (HRSA), telehealth is defined as: "The use of electronic information and telecommunications technologies to support long-distance clinical healthcare, patient and professional health-related education, public health and health administration" (CCHP, 2014, para 3; HRSA, 2015). One telehealth format referred to as remote patient monitoring (RPM) or "remoting in", uses audio and video equipment permitting two-way live, real time interactive communication between a patient in a distance site and the practitioner (CCHP, 2017; HRSA, 2015). Telehealth increases access to care and improves rural health in many ways. Through telehealth, patients and other healthcare professionals, can gain access to providers through a virtual network. Utilizing telehealth technology for consultations saves both time and money as neither the patient nor the provider have to travel long distances to access services (HRSA, 2014).

Preparing students to work in interprofessional teams with technology such as telehealth is a crucial skill for rural settings, as rural primary practitioners often coordinate care for patients with multiple specialists. While the concept of telehealth has been incorporated into nursing curricula to educate students how this technology can

bridge the access gaps in patient care (Gallagher-Lepak, Scheibel, & Gibson,2009), the components have not been integrated into a comprehensive IPE learning experience. A collaborative IPE experience combined with simulation activities using telehealth technology can not only provide nursing students skills needed to care for rural populations, but also address issues inherent in providing IPE experiences to students in rurally located educational programs.

Scope of the Clinical Problem

Although IPE and simulation have existed for some time, research involving each field is relatively new but continues to evolve over time (Palaganas, Epps, & Raemer, 2014). In the traditional education model, learning takes place in an individual clinical or classroom setting using traditional educational methods of teaching (Palaganas et al., 2014). Traditional IPE centered around groups of students, led by one or more faculty members, in which discussion of case-based scenarios in a classroom setting is facilitated by lectures, power-point presentations, and other faculty-centered models of education. Additionally, McGahie, Issenberg, Cohen, Barsuk, and Wayne (2011) compared traditional clinical education, specifically the Halstedian approach, which is “see one, do one, teach one” to simulation-based education with deliberate practice. Deliberate practice involves effortful activity with the goal of maximizing performance. According to the World Health Organization (WHO), this siloed approach to education has fostered a culture of poor collaboration among team members (WHO, 2010). The research comparisons concluded that simulation-based education using deliberate practice was superior to traditional educational methods (McGahie et al., 2011). Studies indicate that active, experiential learning facilitates the educational process, and patient simulators

require learners to incorporate several actions into learning, including knowing, doing, and being in the learning process (Baker, Pulling, McGraw, Dagnone, Hopkins-Rosseel, & Medves, 2008). Simulation-enhanced IPE materialized as early as the 1950s using standardized patients (i.e., human actors playing the role of patients or family members), low technology mannequins such as task trainers, and computerized simulations in the behavioral sciences (Palaganas et al., 2014). In the 1980s, computerized screen-based anesthesia training simulators were used to train staff in emergency management of crisis situations. Training was focused on capitalizing on teamwork and enhancing collaboration (Palaganas et al., 2014). Propelled by the 1999 Institute of Medicine (IOM) report, *To Err is Human* (2010), the trend of team-based training continues. The Agency for Healthcare Research and Quality (AHRQ) also released TeamSTEPPS in 2006 which again focused on the importance of quality collaborative team training (AHRQ, 2008). This trend now includes using high fidelity human patient simulation, (HFHPS), or a controlled and structure learning experience using computerized life-like mannequins with advanced technology (Hicks, Coke, & Li, 2009). Students are challenged to think critically while using HFHPS in an environment similar to the clinical setting. As the scenario unfolds, instructors control the HFHPS responses based on the student interventions (Hicks et al., 2009).

IPE is proven to promote teamwork and enhance interprofessional attitudes towards one another. Previous research demonstrated using simulation-based IPE developed teamwork, communication skills and changed stereotype perceptions that exist between professional healthcare undergraduates, especially between nursing and medical students (Liaw et al., 2014). Improved collaboration among simulation team members has

also been associated with reduction in medical errors, with a potential to improve patient outcomes. For example, researchers at the University of Virginia used a simulation "room of errors" to explore the issue of patient safety. In this mock-up of a pediatric intensive care room, participants (representing several professional healthcare roles) were given seven minutes to identify as many of the purposely placed errors as possible. When the participants worked as teams, they could identify many more errors than individually. The researchers concluded that when teams work together and collaborate effectively, patient care is improved and quality of care is enhanced (Haizlip & Neumayr, 2016; Hausman, 2014).

There are barriers to incorporation of simulation into IPE, including a lack of administrative support, multiple learner needs, lack of qualified faculty to lead the experience, and lack of structured reflection after the experience (Palaganas et al., 2014). Administrative support is critical in scheduling students and coordinating the various professions. Matching students and faculty with different levels of experience and various curriculum can be logistically challenging. An experienced and dedicated faculty with expertise in writing scenario takes time to develop, and without a structured debriefing process post-simulation, student engagement is minimized (Palaganas et al., 2014). Other barriers to IPE include budgeting constraints, varying timetables, and it is resource intensive to implement correctly (Lawlis, Anson, &Greenfield, 2014). Additionally, in a rural setting, barriers to IPE are even more apparent as fewer opportunities exist for undergraduate nursing, medical and pharmacy program students to work and learn together in preparing for team based practice (Whelan, Spencer, & Dalton, 2008a). It is difficult finding interprofessional opportunities for various

healthcare students to come together in one place to problem solve case studies, work on group projects, or work in teams during simulation-based activities due to the geography in a rural landscape.

Significance

The IOM has charged academic institutions to incorporate interprofessional education into the curriculum focused on developing and sustaining collaborative skills (IOM, 2010). Additionally, accreditation agencies such as the Commission on Collegiate Nursing Education, the Accreditation Council for Pharmacy Education, and the Liaison Committee on Medical Education recognize IPE as a vital form of education to achieve safe, quality patient-centered care (Decker et al., 2015). Patient simulation, using both high-fidelity simulators and standardized patients, has proven to be an operative tool for spanning the gap between didactic material learned in the classroom and its application in the clinical setting. Patient safety and quality healthcare depends on the ability of the healthcare team to collaborate (cooperate, communicate), and share skills and knowledge appropriately (Decker et al., 2015). In simulation activities, the student uses a hand on approach through various learning modes simultaneously. With a simulation-based experiential learning approach, IPE allows for the development and mastery of these competencies, which promotes collaboration and teamwork while protecting patients when practicing.

Shortages in the workforce, limited access to care, and sky rocketing healthcare costs continues to be a national issue and even more so in rural areas. As these trends continue, faculty must find new ways to train healthcare students to work more efficiently and collaboratively (Whelan et al., 2008a). Collaborative teamwork is defined as two or

more people working together to create or produce something (Webster, 2016). In rural areas, the shortage in healthcare professionals continues to increase as access to specialists and specialty services is limited, resulting in a broader case-mix of patients. More collaborative teamwork is needed to care for these patients; the development of remote IPE experiences to train healthcare professionals to work collaboratively and be prepared to use technology designed to enhance access for rurally located patients is even more critical (Whelan et al., 2008a).

Literature Review

Introduction

A wide variety of types and quality of evidence were reviewed to answer the PICOT question "Among pre-licensure interprofessional education students (nursing, medical, pharmacy, and other allied healthcare students) in a rural setting, can an IPE simulation based scenario using "remote in" technology enhance collaborative teamwork among team members?" An evidence table (see Appendix A) was generated to organize the critical aspects of the study findings including source, design, limitations, findings and conclusions. Next, *John Hopkin's Nursing Evidence-Based Practice: Model and Guidelines* by Dearholt and Dang (2012) was used to categorize the various sources of evidence into levels and by quality rating (see Appendix B). The method of literature analysis, the outcomes of the type and strength of evidence, and limitations to the studies are explained below.

Description of Search Process

A thorough search of the literature was conducted in 2016 to uncover evidence on the topic of IPE with simulation-based training for interprofessional students. The initial

database included CINAHL (2006-2016), MEDLINE, PubMed-Medline, Joanna Briggs Institute, and Cochrane Library database. To further enhance the search, several IPE websites were reviewed. The searches were conducted using combinations of the following key words: interprofessional education, simulation, and rural. The modifiers of collaboration and teamwork were added as a means of refining and targeting the findings.

Inclusion criteria were established to determine which evidence would be evaluated and utilized in the evidenced-based table. In addition, exclusion criteria were also established which included simulation studies which did not include some form of human patient simulation using medium to high fidelity simulation. Since the target population was pre-licensure interprofessional students, IPE simulation studies targeting post-licensure personnel were excluded. The search was also limited to articles written in English and those written before 2006 were excluded in an attempt to disclose the most current and up to date information. Articles from other countries and regions were included to provide a diverse viewpoint and expanded application. Each article was analyzed for inclusion and based on the population (professional healthcare students), the intervention (simulation – using human patient simulation), and the outcome (improved collaboration and teamwork among team members), 22 articles were used in the literature review. Because interprofessional education is being driven by accrediting bodies and finding new ways to deliver IPE is relatively new in healthcare curriculum, IPE with simulation-based training continues to be a growing body of literature to explore.

The initial CINAHL search limited to 2006-2016 using interprofessional education and simulation revealed 106 articles. When the additional modifiers of collaboration and teamwork were added, the results were narrowed to 42 articles. Of

those, five articles provided information about improved collaboration because of IPE with simulation-based training. Of those five articles, two were quasi-experimental; two were pilot studies including an experimental feasibility study and a cohort study; and one was a retrospective qualitative case report. PubMed provided a variety of useful resources; 509 results were returned initially when using the search terms interprofessional education and simulation. When adding the modifiers, collaboration and teamwork as in earlier research, the results narrowed to 357. Of those, 17 were found to be useful to the PICOT question including two systematic reviews of the literature, one randomized control trial (RCT), four quasi-experimental studies, five pilot studies, three case reports, and two action research studies. One RCT supported the use of simulation as providing a positive impact on learning (Wang, Shi, Bai, Zheng, & Zhao, 2015). Two systematic reviews concluded simulation provides students with a learning environment where mistakes can be made and learned from and patient safety is not jeopardized (Lawlis et al., 2014; Lewis et al., 2012). An evidence table is included for complete listing of research (Appendix A).

A search of Joanna Briggs Institute Evidence Based Practice (EBP) returned three results but none that pertained to the PICOT question as they did not meet inclusion criteria. The Cochrane search yielded 17 results of which 2 quasi-experimental studies pertained to the PICOT question. An Ovid database search limited to 2006-2016 using interprofessional education and simulation returned 344 articles, narrowing to 42 when the additional modifiers of collaboration and teamwork was added. Of those, two articles provided information about improved collaboration because of IPE with simulation-based training using a quasi-experimental study design.

Finally, several IPE websites were reviewed including The University of Virginia ASPIRE Institute, the Canadian Interprofessional Health Collaborative Practice, and the Interprofessional Education Collaborative. These websites were searched for various recommendations regarding implementation of IPE with simulation-based training using various combinations of the search terms “interprofessional education”, “simulation”, collaboration”, and “teamwork” and many high-quality studies were found. The results included two case study reports, and the information on current best practices for implementing IPE with simulation-based training was helpful in incorporating IPE with simulation into curriculum.

Analysis and Limitations of Evidence

The 22 studies included in the search were divided into three categories based on the John Hopkins rating system (see Appendix B for full explanations of the scales). This system rates the type of study, ranging from Level I-C to Level III-B, as well as the quality of the evidence ranging from A to C (Dearholt and Dang, 2012). Level I studies are experimental and include randomized control trials (RCT) or a systematic review of RCTs with or without meta-analysis. Level II evidence includes quasi-experimental studies or systematic review in combination of RCTs and quasi-experimental with or without meta-analysis. Level III studies include non-experimental studies, systematic review of a combination of RCTs and quasi-experimental and non-experimental studies with or without meta-analysis. Level III also includes qualitative studies or systematic reviews with or without meta-synthesis. A quality rating of A is considered high quality with consistent evidence, generalizable results, sufficient sample size, definitive conclusions, and adequate control. A good quality rating (B) is given when results are

reasonably consistent, sample size is adequate, some control seen, and fairly definitive results; whereas a low-quality rating (C) is given when results are inconsistent, sample size is small, and conclusions are not drawn.

One study was rated as a Level I-C (Wang et al., 2015). The RCT was well conducted, but the sample size was small for the study design. There were six Level II-A studies conducted. These quasi-experimental designs demonstrated consistent results, adequate sample size, and definitive conclusions (Dearholt & Dang, 2012). There was one Level II-B and two Level II-C studies as well. All were quasi-experimental designs with reasonably consistent results and fairly definitive conclusions. However, the Level II-C studies were graded poor due to sample size for the design (Dearholt & Dang, 2012). The review of literature revealed ten Level III-B studies. These non-experimental designs were studies with reasonably consistent results, fairly definitive conclusions, and adequate sample size. Also noted were two Level III-C studies. These non-experimental designs were studies with reasonably consistent results but very small sample size.

The highest level of research used was a Level I-C randomized controlled trial supporting the use of simulation in IPE as providing a positive impact towards learning including better teamwork, improved communication, and enhanced clinical knowledge (Wang et al., 2015). A low quality C-rating was given as the sample size was small for the study, and the authors did note that further longitudinal studies were needed to see if interprofessional simulation education (IPSE) would translate into enhanced workplace improvements.

Several Level II – A studies were found and classified as highest quality based on consistent and generalizable results with a sufficient sample size (Dearholt & Dang,

2012). As mentioned, several quasi-experimental studies were analyzed, and Vyas, McCulloh, Dyer, Gregory, and Higbee (2012) concluded after a simulated IPE experience, student's scores on team building improved over pre-simulation scores, and 90% of student commented simulation increased their understanding of professional roles and the importance of interprofessional education. The results were significant ($p < .0001$) on knowledge, skills, and attitudes towards IPE. Students felt their training in IPE did not dilute their own training ($p < 0.001$), determined competent professionals do not make errors leading to harm ($p < 0.001$), felt staff should be reprimanded when an error occurs ($p < 0.001$), and sensed increased comfort when disclosing an error ($p < 0.002$). This study also found simulation provided an opportunity to recognize and react to patient safety issues and to enhance their interprofessional collaboration. Of note, in order to be successful in implementing IPSE, faculty must be well-rounded, become involved early in the process, have adequate faculty and staff to support the program, and be flexible when it comes to coordinating all the discipline schedules (Vyas et al., 2012). Watters, Reedy, Ross, Morgan, Handslip, and Jaye (2015) Level II-A study also concluded simulation training enhances self-efficacy and leads to increases in perceived ability to communicate/work as a team and leadership/management of clinical situations. However, time limitations during the study did not allow for measuring nurses in-depth as it did for physicians. Another Level II-A pilot study looking at 6 universities over a 1-year time frame, found schools using IPE with simulation can better prepare students to work in interprofessional teams that deliver improved and safer care. They also concluded schools that participated in the Retooling for Quality and Safety initiative made major progress toward the integrations of healthcare improvement and safety when

incorporating IPE and simulation into their curricula (Headrick et al., 2012). Shrader, McRae, King, and Kern (2011) also concluded improved teamwork and increased student satisfaction occurred when using simulation as a component of IPE.

Other Level II-A studies support simulation-based IPE as having an impact on collaborative patient centered care with significant correlations in positive attitudes, increased competency and autonomy, and actual collaboration of students (Liaw et al., 2014; Mohaupt, van Soeren, Andrusyszyn, MacMillan, Devlin-Cop, & Reeves, 2012). Whelan, Spencer, and Rooney (2008) conducted a Level II-B study called the "RIPPER" project which focused on a multi-station learning circuit using team based IPE scenarios. The authors concluded the program is an effective IPE model resulting in increased awareness and importance of collaboration among team members. Sustainability of the project was deemed difficult as resources, time constraints, and commitments were ongoing issues (Whelan et al., 2008).

Le et al. (2008) conducted a Level II-C quasi-experimental design pilot program and found through factor analysis three aspects were identified as keys to enhancing clinical practice to include: appreciation of professional roles, improved teamwork, and importance of working together. They concluded that all three factors were enhanced through the use of simulation-based IPE. Smithburger et al. (2013) also concluded improved teamwork, enhanced communication, and increased student satisfaction occurred when using simulation as a component of IPE. This study was classified as a Level II-C as confounding factors might have occurred as improvements in scores increased due to factors outside the control of the investigators. Over the four-week

feasibility study, they noted students became more comfortable with one another because of working together previously in teams (Smithburger et al., 2013).

In analyzing the literature review of IPE with a simulation-based educational component, it is evident that collaboration among team members is enhanced, which translates to improved patient outcomes. As previously mentioned, two Level III-B systematic literature reviews were conducted. Lewis et al. (2012) found simulation was associated with significantly improved communication skills which enhanced team performance and management in crisis situations. Lawlis et al. (2014) concluded programs must attain several key essential components (funding, institutional support, good communication, and shared vision) for programs to be successful in implementing and sustaining IPE. Both studies were rated as Level III-B due to the array of studies included which lead to lack of uniformity. In a Level III-B non-experimental longitudinal cohort study of 312 students, improved confidence in crisis communication (91.7%), situational awareness (85.7%), safe practice (85.2%), triage (85.2%), and crisis leadership (79.2%) were identified by the students when simulation-based IPE occurred (Miller, Rambeck, & Snyder, 2014). The authors did conclude possible maturation of students occurred with repeated simulations as the fourth time around, scores improved due to repetition in anchoring behaviors (Miller, et al., 2014).

Several other Level III-B studies supported using simulation-based IPE experiences to enhance student awareness of maintaining patient safety and improving communication among students as team roles were better understood after a simulated experience (Bolesta & Chmil, 2014; Booth & McMullen-Fix, 2012; Neville, Petro, Mitchell, & Brady, 2013; Robins et al., 2008). In these non-experimental studies, the

investigators concluded students demonstrated positive attitudes towards IPE allowing students to work in a team environment contributing to better patient outcomes (Haizlip & Neumayr, 2016). IPE with simulation provided a realistic teaching opportunity demonstrating the importance of being able to communicate and practice as a team as critical elements to any patient care encounter (Bolesta & Chmil, 2014; Booth & McMullen-Fix, 2012; Neville et al., 2013; Robins et al., 2008). Other non-experimental studies also concluded simulation as an effective technique in teaching interprofessional teams the art of difficult communications, in reinforcing the importance of collaboration and teamwork in delivering effective care, and preparing students to bridge the gap across silos of care (Baker et al., 2008; Balogun, Rose, Thomas, Owen, & Brasher, 2014; Marken, Zimmerman, Kennedy, Schremmer, & Smith, 2010; Shoemaker, Platko, Cleghorn, & Booth, 2014).

Synthesis of Literature and Recommendations

A review of the existing research on collaborative teamwork advocates the presence of collaboration can result in improved patient outcomes, and simulation-based IPE has proven to provide students with a learning environment in which skills can be developed, mistakes can be made and learned from, and patient safety is not jeopardized (Lewis et al., 2012). One study using simulation found patient safety improves when nurses and pharmacists collaborate in relation to drug prescription (Walters, Robertson-Malt, & Stern, 2015). This study also found collaborative teamwork is a key communication strategy of effective healthcare delivery as it helps to minimize errors and increase patient safety. Healthcare policy makers and administrators are increasingly promoting the importance of IPE, and using simulation is an effective way to measure

collaboration. Liaw et al. (2014) found after an IPE simulated clinical experience, there was a significant improvement on the medical students' perception of the nursing profession in terms of decision making and academic abilities and the nursing students' opinion of the medical profession on interpersonal skills and team-player capabilities.

Also noted there was a positive correlation in IPE with simulation in terms of improved collaboration and communication among team members which translates to better patient care and outcomes (Baker et al., 2008; Balogun et al., 2014; Booth & McMullen-Fix, 2012; Headrick et al., 2012; Le et al., 2008; Lewis et al., 2012; Liaw et al., 2014; Marken et al., 2010; Mohaupt et al., 2012; Neville et al., 2013; Shoemaker et al., 2014; Smithburger et al., 2013; Wang et al., 2015; Watters et al., 2015; Whelan et al., 2008; Vyas et al., 2012). The literature suggests for an IPE program to be successful, several key elements are necessary including funding, institutional support, good communication, and shared vision among the key stakeholders and interprofessional teams (Lawlis et al., 2014). In terms of stakeholders, the faculty involved from the School of Nursing, Medicine, and Pharmacy schools must work together in a coordinated effort to support the simulation-based IPE program. These are critical elements needed to implement and sustain a program over time.

Several other key factors such as flexibility in scheduling, motivated faculty to facilitate, and early involvement of stakeholders (faculty, local partners, and students) are required when employing and maintaining a simulation-based IPE program (Vyas et al., 2012). Studies also concluded schools using IPE with simulation can better prepare students to work in interprofessional teams delivering safer patient care (Baker et al.,

2008; Headrick et al., 2012; Mohaupt et al., 2012; Neville et al.,2013; Shrader et al., 2011).

Statement of the Purpose

During my experiences as an educator interested in best practices, my students reported to me they wished they had more opportunity to work in interprofessional teams in activities. Based on the review of the literature, simulation-based IPE enhances the educational experience and leads to improved collaboration among team members, which translates to improved quality care and better patient outcomes. To address the challenges of delivering this educational experience on a rural distance campus, this project addressed pre-licensure students in nursing, pharmacy, and medicine, and explored the question "In a rural setting, can an IPE simulation-based scenario using "remote in" technology enhance collaborative teamwork among team members?"

PICOT Questions and Definitions

The PICOT design for scientific inquiry as identified by Melnyk and Fineout-Overholt (2015) was used to create the clinical question as well as provide best evidence for this project. The five components incorporated in the PICOT format include population of interest, intervention of interest, comparison intervention, outcome, and time (Melnyk and Fineout-Overholt, 2015, p. 28-29). The PICOT question is "Among pre-licensure interprofessional education students (nursing, medical, pharmacy, and other allied healthcare students) in a rural setting, can an IPE simulation-based scenario using "remote in" technology enhance collaborative teamwork among team members?"

The population of interest was IPE students in nursing, medical, and pharmacy disciplines. The intervention of interest was conducting simulation-based training as an

adjunct component to IPE in rural settings. The comparison of interest was looking at the perceptions of IPE students prior to a simulation–based training as compared to post simulation-based training. The outcome was the expected result achieved from the introduction of the intervention on the group and in this study, is improved collaborative teamwork among team. The time frame was from completion of the pre-questionnaire to completion of the post-questionnaire post simulation.

Methodology

This project 1) examined the feasibility of adding an IPE component to current simulation experiences in the rural setting at USCL; 2) determined necessary resources to implement simulation as a component to IPE; and 3) measured student perception of interprofessional teamwork, roles and responsibilities, and patient outcomes for collaborative practice. Challenges included 1) participant recruitment, 2) potential student and lab scheduling conflicts, and 3) adequate clinical resources to meet the multidisciplinary team needs. This chapter describes the theoretical framework underlying this project; setting, sample, and methods of participant recruitment; project design; instrumentation; data analysis; and feasibility.

Theoretical Framework

The Stetler Model for evidenced based practice (EBP) has five phases including preparation, validation, decision making, translation/application, and evaluation (Melnyk & Fineout-Overholt, 2015). Phase I (preparation phase) consists of identifying potential barriers or catalysts, reaffirming the current problems with practice at hand, considering influences on timelines, prioritizing the issues, developing a team of stakeholders, defining outcomes, and selecting research sources. Phase II (validation) involves

assessing the literature review for credibility of evidence, rating the level and quality of evidence, and determining the qualifiers and limiters for the research. Phase III (decision making) is a critical phase and addresses the synthesis of the findings to determine recommendations of the criteria as they relate to feasibility and applicability. Phase IV (translation into practice) considers how the research will be used either informally in practice or formally through EBP documents or protocols. Phase V (evaluation) obtains evidence regarding the implementation approach (system change, change of practice, end result) to obtain outcome results of the identified goals. Based on Stetler's model, the project described in this paper was implemented.

Description of the Setting, Sample, and Participant Recruitment

This project was conducted in the University of South Carolina (USCL) Nursing Simulation Lab on the USCL campus. At present the University of South Carolina (USC) College of Nursing (CON) has two distance campuses. USCL is located in a rural setting and students must travel to USC Columbia to participate in case-study based IPE exercises without a simulation component. In the study, simulation was introduced as a component of IPE to a group of interprofessional students consisting of fourth year nursing students, third year medical students, and third year pharmacy students that were placed in the local rural clinical setting in the surrounding counties. Based on the review of literature, scheduling and coordination of groups of students from three different disciplines in three separate colleges is challenging (Lawlis et al., 2014). In a rural setting where students are spread out in various clinical sites, "remote in" technology via telehealth was used by the medical students during the simulation. This allowed for the

medical students to be a part of the simulation without being there in person. They were able to utilize two-way audio and video capability during the simulation activity.

CON students enrolled at USCL during their last semester of senior year were study participants. The sample also included rurally placed medical and pharmacy students recruited through Mid-Carolina Area Health Education Consortium (AHEC). All students were recruited on a voluntary basis, with the goal of having ten senior nursing students from USCL, five fourth year medical students, and five third year pharmacy students. Both the pharmacy and medical students were recruited with the help of Mid-Carolina AHEC representatives, who schedule clinical rotations for healthcare students in the Lancaster area. These representatives have already agreed to participate. A total of 29 students participated, including 16 senior nursing students from USCL, 8 third-year VCU medical students, and 5 fourth-year USC pharmacy students. Five IPE groups consisting of 5-6 students (3-4 nursing, 1 medical, and 1 pharmacy student) participated in a simulated advanced cardiac IPE scenario held in the USCL Nursing Simulation Lab. The medical students attended remotely via a robot and the other students were present in person during the simulation exercise.

Project Design

The design of the project was a non-experimental feasibility study using an explanatory sequential mixed methods approach (Creswell, 2015). In this approach, quantitative data are collected first; qualitative data gathered subsequently are used to more thoroughly explain the quantitative results, especially if there are unexpected findings (Ivankova, Creswell, & Stick, 2006). The results from both phases are then

integrated during the analysis process to more robustly represent the process under evaluation.

Instrumentation

A pre- and post-simulation questionnaire was utilized to gather quantitative and qualitative data about student's perceptions of the experience in regards to their understanding and view of collaborative teamwork among the team members. Student experiences were assessed using the Student Perceptions of Interprofessional Clinical Education-revised (SPICE-R2) instrument (Appendix C), a 10-item questionnaire using a five-point Likert scale. This scale contains three factors dedicated to interprofessional teamwork and team-based practice, roles and responsibilities for collaborative practice, and patient outcomes for collaborative practice (Dominquez, Fike, MacLaughlin, & Zorek, 2016). Additionally, students were given a 20 item National League for Nursing (NLN) Simulation design scale (**Appendix D**), and were asked to rate the simulated- IPE experience on a five-point Likert scale. The survey addresses five categories including information, support, problem-solving, feedback/guided reflection, and realism (NLN, 2005). Both questionnaires are proven to be valid and reliable (Dominquez et al., 2016 & NLN, 2005). Each simulation was video recorded for review later.

Data Analysis

Quantitative

Pre- and post-scenario SPICE-R2 survey results were analyzed using SPSS (version 21). Non-parametric Wilcoxon signed-rank tests were calculated to assess improvements in students' scores in relation to interprofessional teamwork and team-based practice, roles and responsibilities for collaborative practice, and patient outcomes

for collaborative practice. Wilcoxon signed-rank tests are appropriate for small samples in which data comes from repeated measures such as pre- and post-test data from the same subjects, and is not normally distributed. For the normally distributed data, we employed a t-test, as this approach has more power to test statistically significant differences between groups than non-parametric tests.

Qualitative

Qualitative data were used to inform more robust understanding of the quantitative results. A qualitative descriptive approach using a thematic analysis as described by Clarke and Braun (2013) was used to analyze the debriefing session video data and post-scenario narrative responses. First, the audio from the debriefing sessions were transcribed verbatim and de-identified by the first author. The first two authors then independently read and coded the transcripts; subsequently they met to reconcile the minor differences in coding and identify relevant themes.

Data integration

The final phase of a mixed-methods approach is data integration, in which the quantitative and qualitative data are brought together, usually in the form of a joint display (Creswell, 2015). The strength of this approach is that the statistical information provides a general understanding of the problem under analysis, while the qualitative information explores the participants' perceptions of that problem.

Feasibility

The feasibility of a project is determined by reasonability of time frame for project, recruiting adequate numbers of participants, accessibility of recruitment setting, qualifications of the investigator, adequate time allotted for investigator to conduct the

study, ethical or legal considerations, and availability of adequate resources (Melnyk and Fineout-Overholt, 2015). If the answer is no to any of these questions, then the feasibility of the project is in question. In terms of this project, time frame and resources are the most feasible.

USCL houses a new nursing simulation lab, although it was lacking some key equipment. A grant was submitted to the J. Marion Sims Foundation and $36,000 was secured for the necessary items. These items included emergency equipment such as crash carts, defibrillators, and advanced airway management items. Other items included advanced cardiac monitoring, intravenous therapy equipment, and robotics items used for remoting in. At present the equipment and items have been ordered and have either arrived or are in the process of being shipped to the lab and tested for functionality.

Limiting factors included recruiting the needed volunteers at USCL. USC currently offers an IPE course and USCL nursing students are taught in the spring semester. At present, USC does incorporate IPE into the curriculum, but there is limited exposure on the rural campus with simulation as a component in the course. To address this limitation, recruitment of the other healthcare team students (medicine and pharmacy) was enhanced by partnering with AHEC. Successful implementation of simulation- based IPE requires buy-in from all stakeholders with flexibility and adaptability of key players a must. Partnerships were in place including a strong working relationship with Dr. Sizemore, a local surgeon who precepts many of the medical students. In addition, Mid-Carolina's AHEC was excited and committed to work with USCL in developing simulation-based IPE experiences with locally placed healthcare students. Creativity was also required in coordinating all the various discipline

schedules. Using the robot to “remote in” medical students assisted with coordination efforts as this allowed the medical student to stay at their assigned rural clinical setting and to “remote in” once the consultation was initiated by the other team members of the group. In addition, adding a "buffer period" into the time frame allowed for extra time in case recruitment of these participants took longer than anticipated (Melnyk and Fineout-Overholt, 2015).

Chapter 1 presented an overview of the problem, a review and synthesis of the literature, a description of the methodology, including theoretical framework, project design, participant recruitment, data collection, data analysis, and project feasibility. Chapter 2 presents the project results in manuscript form.

CHAPTER 2

PROJECT RESULTS

MANUSCRIPT ONE

SIMULATION-BASED INTERPROFESSIONAL EDUCATION IN A RURAL SETTING USING REMOTE-IN TECHNOLOGY

[1]Scott, A. D., Estrada, R. D., Catledge, C. B., & Mitchell, S. Submitted to *The Journal of Interprofessional Care*

ABSTRACT

The purpose of this project was to examine the feasibility and acceptability of a simulation-based IPE experience for pre-licensure nursing, pharmacy, and medical students on a rurally-located campus. Using a mixed-methods, explanatory sequential approach, this project: 1) examined the feasibility of implementing a simulation-based IPE experience using telehealth tools; and 2) evaluated student perceptions of inter-professional teamwork, roles and responsibilities, and patient outcomes for collaborative practice, both pre- and post-scenario.

Quantitative data were analyzed using SPSS. Results revealed 94% agreed/strongly agreed the IPE experience resembled a real-life situation. 100% of nursing/medical students and 80% of the pharmacy students indicated they would recommend this experience to their peers. Significant positive changes in attitudes towards using an inter-professional team approach were noted for pharmacy students, especially in regards to patient outcomes, reduced costs, and improved patient-centered care.

Qualitative data were transcribed and analyzed using thematic analysis. Four themes emerged: 1) better understanding of technology; 2) improved communication among team members; 3) benefit of true to life experience; and 4) increased knowledge level and confidence.

Participant suggestions for improvement included: 1) improve the simulation/telehealth equipment orientation; 2) consider a grand round-type simulation; and 3) address technical challenges with the robot.

Although limited by a small sample size, this project confirmed it is feasible and acceptable to offer simulation-based IPE in a rural setting facilitated by the use of telehealth tools, and collaborative teamwork is enhanced by using “remote in” technology during a simulation-based IPE activity.

Complex healthcare now requires a collaborative and team approach to patient care. A simulation-based IPE approach using “remote in” technology allows for the development and mastery of these competencies. Future work will incorporate student suggestions to improve the experience, as well as integrate students from other healthcare disciplines, such as physician assistant students.

Keywords: Interprofessional education, simulation, teamwork, collaboration, rural, and telehealth

Introduction and Background

A single-disciplinary approach to healthcare education does not give students the opportunity to practice effective communication and collaborative strategies essential to complex, real-world patient care (Smithburger, Kane-Gill, Kloet, Lohr, & Seybert, 2013). To address this need, healthcare educators use interprofessional education (IPE), an interdisciplinary educational approach. Students from a variety of healthcare disciplines, including nursing, medicine, and pharmacy, work collaboratively to develop skills necessary for efficient healthcare teamwork, which can lead to higher quality patient care and improved patient outcomes (Pippitt, Moloney-Johns, Jalilibahabadi, & Gren, 2015). Traditional IPE centers around groups of students, led by one or more faculty members, in which discussion of case-based scenarios in a classroom setting is facilitated by lectures, power-point presentations, and other faculty-centered models of education. Shifting to a student-centered model, healthcare educators are beginning to employ experiential learning through the incorporation of patient simulators. Simulation-based education with deliberate practice (effortful activity with the goal of maximizing performance) requires students to incorporate several actions, including knowing, doing, and being in the learning process (Baker, Pulling, McGraw, Dagnone, Hopkins-Rosseel, & Medves, 2008), and has been demonstrated as superior to traditional clinical education methods (McGahie, Issenberg, Cohen, Barsuk, & Wayne, 2011). IPE *combined* with simulation-based experiential patient scenarios represents an innovative approach in enhancing learning, as hands-on practice allows students to develop and master core competencies, promotes interdisciplinary collaboration and communication skills, and protects patients. However, implementation of this approach may be challenging for programs serving certain student populations.

Currently simulation-based IPE experiences are administered face-to-face, with students from different disciplines coming together in clinical simulation labs to practice patient scenarios. However, the logistics of coordinating student schedules and travel times may be problematic for faculty at regional campuses, who often must utilize clinical simulation labs located on the main campus. New and innovative training approaches may overcome these barriers, and may be especially beneficial for rural healthcare students (Whelan et al., 2008), as workforce shortages and access barriers to care are particularly pronounced in rural areas (Rural Health Information Hub, 2017). Additionally, as healthcare students in rurally-located training programs are more likely to live and eventually practice in the rural community (RHI Hub, 2017), IPE experiences that prepare healthcare students to use technology designed to enhance access for rurally-located patients is even more critical (Whelan et al., 2008).

Telehealth is remote healthcare provision to patients at distant sites using technology-based tools. Remote patient monitoring (RPM), or "remoting in", uses audio and video equipment to permit two-way live, real time interactive communication between a patient in a distance site and the practitioner (Center for Connected Health Policy, 2017; Health Resources and Services Administration, 2014). Through telehealth, patients and other healthcare professionals can gain access to providers and specialists through a virtual network, saving time and money (HRSA, 2014). Preparing students to work in interprofessional teams with technology such as telehealth is a crucial skill for rural settings. Though the concept of telehealth has been incorporated into nursing curricula to educate students on how this technology can bridge the access gaps in patient care (Gallagher-Lepak, Scheibel, & Gibson,2009), the components have not been

integrated into a comprehensive IPE learning experience. A simulation-based IPE experience using telehealth tools not only provides students the opportunity to work with the technology, but addresses issues inherent in providing IPE experiences to rurally-located students. The purpose of this project was to examine the feasibility and acceptability of a simulation-based IPE experience for pre-licensure nursing, pharmacy, and medical students on a rurally-located, regional campus.

Methods

Research Design

Using a mixed-methods, explanatory sequential approach (Fetters, Curry, and Creswell, 2013), this feasibility study 1) examined the feasibility of adding an IPE component to current simulation experiences in a rurally-located program; 2) determined necessary resources to implement simulation as a component to IPE; and 3) measured student perception of interprofessional teamwork, roles and responsibilities, and patient outcomes for collaborative practice **(Figure 2.1)**.

Setting and Sample

This project was conducted in Lancaster, SC, a rural setting 70 miles north of Columbia, SC. SC in general is rural and poor; in Lancaster County, twenty percent of residents live in poverty. Healthcare access is problematic for rural SC residents, including Lancaster. For example, 21 of 46 SC counties only have between 1 and 2.9 family practice physicians per 10,000 residents. Further, there are 8.9 nurses per 1000 residents, but in rural areas, only 36 percent of nurses are bachelor's prepared (Bureau of Labor Statistics, 2017).

The University of South Carolina (USC) College of Nursing (CON), located in

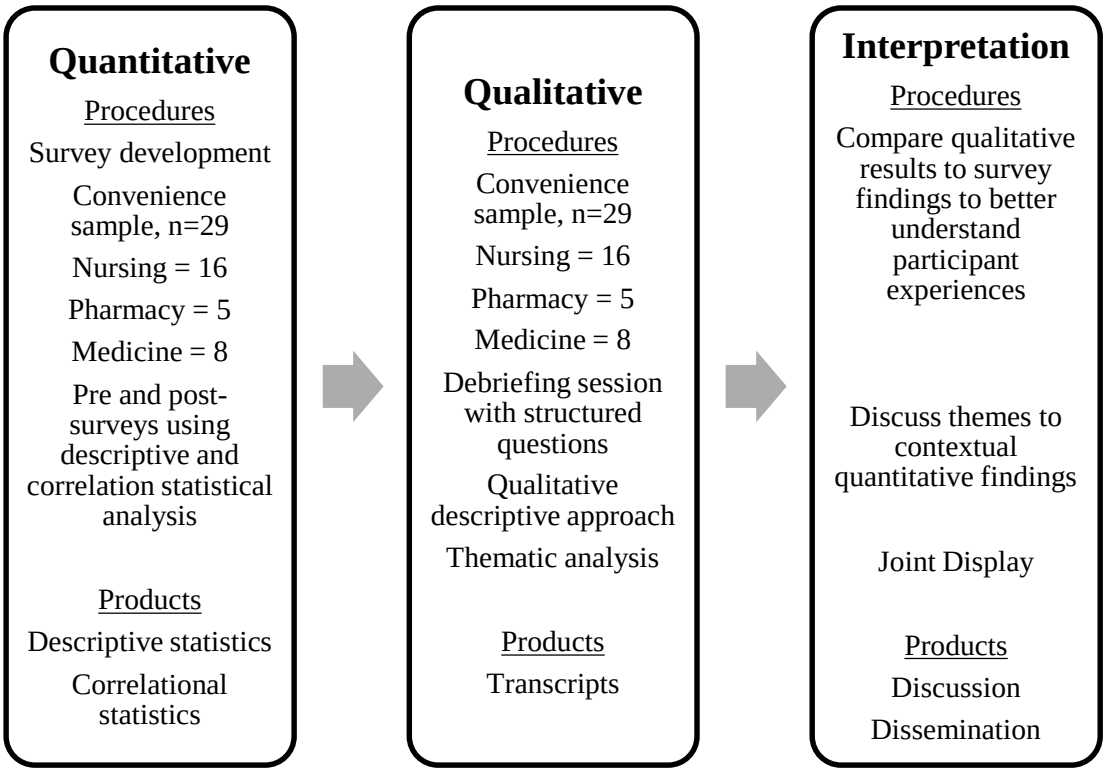

Figure 2.1: Study Overview

Columbia, SC, offers a collaborative nursing program on two distance campuses, including USC Lancaster (USCL). Students attending these regional campuses can stay on their local campus all four years and earn a Bachelor's of Science in Nursing (BSN) in collaboration with USC Columbia. USCL is unique in that it houses a clinical simulation lab, minimizing the need to travel to the main campus for some of the experiential learning activities.

After obtaining Institutional Review Board approval (exempt-status), a convenience sample of pre-licensure healthcare students were recruited through 1) USCL nursing program; 2) USC School of Pharmacy; and 3) Mid-Carolinas Allied Health Education Consortium (AHEC), which helps to arrange rotation sites for Virginia Commonwealth University (VCU) medical students. A total of 29 students participated,

including 16 senior nursing students from USCL, 8 third-year VCU medical students, and 5 fourth-year USC pharmacy students. The students were randomly assigned to one of five IPE groups consisting of 5-7 students comprised of 3-4 nursing, 1-2 medical, and 1 pharmacy student.

Five of the nursing students had experience with telehealth in the local facilities since they precepted in the local Intensive Care Unit or the Emergency Department. Seven of the rurally placed medical students had no experience with telehealth. Many students had some form of IPE during school, but the experiences varied by discipline and by college. The medical students reported that in their previous IPE experiences, they simulated the roles of the other professions while participating in the IPE scenario though they were unsure of the specifics of the role. For instance, if they drew an index card labeled “RN”, they administered medications, or if they pulled the card labeled “respiratory therapy” they were responsible for administering oxygen. The pharmacy students did have two simulation-based IPE experiences during their third year of school in which 6 pharmacy students were paired with 1 medical and 1 nursing student to run various scenarios. During the simulation, it was necessary to role-play at times as not all of the medical equipment was functional. None of the nursing students had any simulation-based IPE; their previous experiences were traditional in nature.

Data Collection

Quantitative Instrumentation. Student experiences were assessed pre- and post-scenario using the Student Perceptions of Interprofessional Clinical Education-revised (SPICE-R2), a 10-item questionnaire using a five-point Likert scale (Dominquez, Fike, MacLaughlin, & Zorek, 2016). This scale measures three factors dedicated to

interprofessional teamwork and team-based practice, roles and responsibilities for collaborative practice, and patient outcomes for collaborative practice. The SPICE-R2 addresses the teamwork domain by evaluating participant's assessment of enhanced educational and teamwork factors. The roles and responsibility domain is evaluated using criteria that looks at role definition, training requirements of others, and understanding of others' roles. Using an interprofessional team approach, the patient outcome domain is assessed by measuring factors addressing patient centeredness of care, improved care delivery, and reduced cost of care.

Additionally, students were also asked to rate the simulated IPE experience using the five category, 20 item National League for Nursing (NLN) Simulation design scale, a five-point Likert scale addressing information, support, problem-solving, feedback/guided reflection, and realism (NLN, 2005). Both questionnaires have been proven to be valid and reliable.

Qualitative Instrumentation. Student perceptions of the IPE experience were explored through a faculty-led, video-recorded debriefing exercise addressing 1) first thoughts regarding the experience, 2) what went right and why, and 3) what would you do differently and why. Additionally, the post-assessment, the SPICE-R2 questionnaire included narrative response questions.

Simulation Scenario

An informational packet containing an overview of the project, a consent to participate, a link to a brief video on team communication to view prior to attending, and pre-simulation information including simulation tips and an advanced cardiac life support (ACLS) pocket guide was emailed to all participants two weeks prior to the simulation.

On the day of the project, the participants attended a brief orientation to the lab, robot, simulation room and emergency equipment, then completed the pre-scenario, SPICE-R2 questionnaire.

To ensure integrity of the simulation and to avoid influencing the results, students were asked to wait in the assigned areas including a pre-simulation waiting area, a simulation ready room, and a debriefing area. For the simulation, three faculty members assisted with the project: one faculty member facilitated the simulation, one facilitated the debriefing sessions, and one served as the overall communication facilitator making sure each group was in the assigned area. Once all groups completed the orientation, group one remained in the simulation area, and the other groups went to a pre-simulation waiting area.

The simulation was designed to mimic how telehealth might be utilized in a real-life, emergent situation, with each student performing their disciplinary roles. In the scenario, the simulation patient experiences an acute cardiac event while the nursing students are at the bedside gathering information and performing a general assessment. Approximately two minutes into the scenario, the faculty facilitator initiates cardiac arrest, requiring the nursing students to call a code. The other nursing students and pharmacy students (code team members), waiting in a simulation ready room, respond with resuscitation equipment. The code team members then consult with the medical students, located in a room outside the lab. The medical students utilized two-way audio and video via a commonly-used telehealth robot **(Figure 2.2)**, simulating how distance healthcare providers typically provide consults in SC. Each simulation was video recorded via Simview and ran for approximately twelve minutes.

Figure 2.2: Double Robotics robot

The entire group, including the “code team” and remotely-located medical students, performed CPR, defibrillated the patient twice, and gave emergency drugs including epinephrine **(Figure 2.3)**. At the conclusion of the scenario, each student attended the faculty-facilitated, video-recorded debriefing session and completed both the post-scenario SPICE-R2 and NLN questionnaires.

Figure 2.3. Simulation scenario view from Simview

Data Analysis

Quantitative. Pre- and post-scenario SPICE-R2 survey results were analyzed using SPSS (version 21). A t-test was run on normally distributed data, as this provided more power to test for statistically significant difference between groups. Non-parametric Wilcoxon signed-rank tests were calculated to assess improvements in students' scores in relation to interprofessional teamwork and team-based practice, roles and responsibilities for collaborative practice, and patient outcomes for collaborative practice for data that was not normally distributed. Wilcoxon signed-rank tests are appropriate for small samples in which data comes from repeated measures such as pre- and post-test data from the same subjects.

Qualitative. Qualitative data were used to inform more robust understanding of the qualitative results. A qualitative descriptive approach using a thematic analysis as described by Clarke and Braun (2013) was used to analyze the debriefing session video data and post-scenario narrative responses. First, the audio from the debriefing sessions were transcribed verbatim and de-identified by the first author. The first two authors then independently read and coded the transcripts; subsequently they met to reconcile the minor differences in coding and identify relevant themes.

Data integration. The final phase of a mixed-methods approach is data integration, in which the quantitative and qualitative data are brought together, usually in the form of a joint display (Creswell, 2015). The strength of this approach is that the statistical information provides a general understanding of the problem under analysis, while the qualitative information explores the participants' perceptions of that problem. After quantitative and qualitative data analysis, the first two authors reconvened to

explore how the qualitative themes mapped to the factors examined by the quantitative surveys.

Results

Quantitative Results

All students completed both pre- and post-scenario SPICE-R2 surveys. The NLN Simulation Design Scale evaluates in two parts: 1) elements in the simulation; and 2) student-perceived importance of these elements. For example, in section A of the survey, one question asked "the scenario resembled a real-life situation"; in the corresponding question in section B, the participant ranked the importance of that element to him/her. 100 percent of the students completed section A of the NLN survey and 96.5 percent completed section B. For the purposes of this study, questions on the fidelity of the simulation equipment and the scenario content and process were evaluated. Descriptive statistics were used to characterize the sample and summarize the findings including age, race, gender, and discipline **(Table 2.1)**.

Table 2.1. Participant Demographics

	All Students (N=29)	**Medical Students N (%)**	**Pharmacy Students N (%)**	**Nursing Students N (%)**
Discipline		8 (27.5%)	5 (17.2%)	16 (55.1%)
Mean Age	23.8 years	26.3 years	23.4 years	22.6 years
Race				
White	20 (69%)	2 (25%)	4 (80%)	14 (87.5%)
African American	3 (11%)	3 (37.5%)	0	0
Other	6 (21%)	6 (37.5%)	1(20%)	2 (12.5%)
Gender				
Male	6 (20.7%)	5 (62.5%)	1 (20%)	2 (12.5%)
Female	23 (79.3%)	3 (37.5%)	4 (80%)	14 (87.5%)

SPICE-R2. Correlational statistics did not reveal any significant gender or race/ethnicity-based differences in the pre- and post-scenario SPICE-R2 surveys. However, notable findings were observed when the modifier of discipline was added.

While there was no statistical difference between the nurse-medicine groups or between the pharmacy-medicine groups outcomes using an interprofessional team approach. Pharmacy students reported improved care, reduced costs, and patient centered care increases when an interprofessional team delivers the care to patients. Additionally, the t-test showed a marginal significance for the same group in response to roles and responsibilities for collaborative practice. Again, the pharmacy students reported higher scores in role definitions of self and others, and increased understanding of the training requirements of others, and increased understanding of others roles after the intervention. In the nursing students, no significant difference was appreciated.

NLN Simulation Design Scale. The NLN Simulation Design Scale was used for purposes of determining feasibility and acceptability of the simulation equipment, as well as the scenario enacted with the equipment. First, students were asked to rate, using a 5-point Likert-type scale (1= “strongly disagree”, 5 = “strongly agree”) the statement “the scenario resembled a real life situation”, an item which measured the fidelity, or realism, of the advanced cardiac scenario. They were then asked, using a similar Likert-type scale (1= “not important”, 5 = “very important”), how important it was to them that the scenario resemble real life. The second statement, “real life factors, situations, and variables were built into the simulation”, was then evaluated by the students in a similar fashion. This statement measured the realism of the equipment (manikins, monitors, defibrillator, and medications).

All students rated it was “important” or “very important” to have real-life factors, situations, and variables built into the simulation. Ninety-four percent of students surveyed post-simulation rated “agree” or “strongly agree” that the simulation included

all three items. Additionally, all students rated it was important or very important to them that the scenario resembled a real-life situation. Ninety-three percent of students surveyed post-simulation rated agree or strongly agree that the scenario resembled a real-life situation **(Table 2.2)**.

Table 2.2. NLN Simulation Design Scale responses for Fidelity of Simulation

All Students (N=29) N (%)	**Importance of item to you**	**Simulation design elements delivered**
Scenario resembled real-life situation		
Agree	4 (17.4%)	4 (13.8%)
Strongly Agree	25 (82.8%)	23 (80%)
Overall	29 (100%)	27 (94%)
Real life factors, situations, and variables were built into the simulation		
Agree	4 (86%)	3 (10%)
Strongly Agree	25 (14%)	24 (82.8)
Overall	29 (100%)	27 (93%)

Qualitative Results

Thematic analysis of the debriefing sessions and the post-survey responses revealed the following four themes: 1) Better understanding of technology, 2) Improved communication among team members, 3) Benefit of true to life experience, and 4) Increased knowledge level and confidence.

Better understanding of technology. In the debriefing process students commented that initially they wished they had a better orientation as they felt nervous, lost, but still liked the experience. They also commented on the technical challenges that came with the robot and equipment. For instance, the students commented they felt lost and nervous because they did not know their team members and did not feel fully oriented to the rooms, robots, and equipment.

Technical challenges with the robot included that at times it was both hard to hear what the robot was saying and hard to see from the robot perspective. The students in the room complained the sound from the robot was not loud enough to hear the medical student over the noise of the room, and the medical students using the robot felt it was hard to visualize the others roles in the room which they felt delayed care. Two medical students stated “because we had to rely on other members of the team to help us identify what was happening (due to technical issues), this made us feel vulnerable and uncomfortable because we had to ask for information we did not feel was readily accessible to us”. The same students also commented “they like the robot and felt that if they had more practice using it, they would master the learning curve and could embrace technology because this is the future”. When the students were asked if the robot added to the simulation the responses were mixed. Almost all students commented “not in this scenario because of the technical difficulties…but it could have been good if the robot sound and view were improved”. Many students commented that the robot was beneficial as it “added to real life experience especially in a rural area where the provider is not always there”.

Despite the technical challenges with the equipment, faculty allowed the simulation to continue without intervention or modification as these challenges mimic real-life scenarios. One benefit of allowing the students to work through the technical challenges was being able to observe collaborative teamwork and creative critical thinking used by each of the teams. They had to be creative in problem-solving, and had to trust and rely on the other team members.

Improved Communication Among Team Members. Students reported enhanced communication among team members despite technology challenges, better understanding of the roles of others, and increased value of the experience of learning outside their silo of care, which reinforced the importance of collaborative teamwork. A student commented "patient care requires a team approach and it is not done in isolation (silos). It requires good communication and this experience allowed for that to happen." Other comments were "it made me get out of my silo and I was able to see what others did as I interacted with them…it was great having other team members at the same clinical level to work with as we had like experiences to draw from."

Benefit of True to Life Experience. Overall, 100 percent of nursing and medical students and 80% of the pharmacy students indicated they would recommend this experience to other students in their profession. In the debriefing session and in the post-simulation survey questions, students commented "this should be required… loved it… it was great!" "This experience allowed me to see the whole picture of the patient… I wish we did more of this… in the past we pretended and role played the other roles, today we observed the other roles first hand". Many of the students had participated in IPE experiences in the past through group discussions of case-based scenarios in a classroom setting. They felt the simulation-based IPE scenario was superior to just talking about a case because they could have hands-on practice and see the whole picture unfolding as they worked with other disciplines first hand.

Increased knowledge Level and Confidence. Most students reported feeling increased trust among the team members and felt as a team that participants were prepared which led to quick responses and the correct decisions were made for the patient. One student

shared “because we all relied on one another, it helped us to realize what we know and now I feel prepared for the workforce”. Another reported “the simulation strengthened my trust in other professions, because you got to see three disciplines in one scenario providing team-based care to one patient…and they lived”.

The student responses confirm the utility of a simulation-based IPE experience as it enhances teamwork and facilitates expertise among team members. Using the robot enhanced the credibility of the other professions in the room as the provider was able to visualize and hear the interventions implemented by the participants in the room and it confirmed the e of the other team members. Overall, the experience allowed for and reinforced an appreciation of collaborative teamwork as students reported increased self-awareness and efficacy. Additionally, having students at similar clinical levels enhanced the activity as each discipline was able to bring forth their clinical expertise and add to the richness of the experience.

Data Integration

Once analysis of the quantitative and qualitative data was complete, the process of data integration began. The integrated results, found in **Table 2.3**, are organized by qualitative theme. Direct quotes are used to give insight into the participants’ quantitative survey responses, allowing for a more robust understanding of the student experience with simulation-based IPE.

Discussion

Lessons Learned

There were several lessons learned from the conduct of this feasibility, simulation-based IPE project. First, the orientation process to the simulation equipment should be more deliberate. Providing an instruction link to using the robot prior to the

Table 2.3. Joint display supporting mixed methods approach of student experience during IPE simulation:				
Theme 1: Better Understanding of Technology				
Instrument	**Response Format**	**Item Content**	**Sample Debriefing Question**	**Direct Quotes**
NLN – Fidelity/ Realism Domain (2 items)	Evaluative (Strongly disagree – strongly agree)	The scenario resembled a real-life situation, and real life factors, situations, and variables were built into the simulation.	Did you feel the robot added to the simulation? If so, how?	"It helped by advancing my understanding of advances in healthcare technology" "It was better than getting a phone call because I could see what was happening with my eyes and can visualize teamwork" "Yes, I liked it… helps to train with this for times when MD or specialist is not always on site" "Liked the robot and felt that if had more practice using it, I would master the learning curve and could embrace technology because this is the future"
Theme 2: Improved Communication Among Team Members				
SPICE- R2 Teamwork Domain (4 –items)	Evaluative (Strongly disagree – strongly agree)	Working with students from different disciplines enhances education and ability to work on an interprofessional team. And to establish collaborative relationships with one another, and understand other's roles	Would you recommend this experience to other students in your professions?	"Yes, because we had to rely on other members of the team to help us identify what was happening (due to technical difficulties) this made us feel vulnerable and uncomfortable because we had to ask for information and did not feel like to information we needed was readily accessible" "Yes, helped me to be able to have better communication with other disciplines"
SPICE- R2 Roles/ Responsibilities	Evaluative (Strongly disagree –	Evaluated using criteria that looks at role definition, training		"Liked it, helped me to work in teams with other professions and to understand their roles"

Domain (3 –items)	strongly agree)	requirements of others, and understanding of others roles.		"Appreciation of other disciplines" "Helped me to know the scope of other professions and how to use this knowledge for the patient's benefit"
SPICE- R2 Outcomes Domain (3-items)	Evaluative (Strongly disagree – strongly agree)	Assessed by measuring factors addressing patient centeredness of care, improved care delivery, and reduced cost of care when using an interprofessional team approach		"Yes, Yes, Yes, I will never underestimate the importance of teamwork" "Helped me identify areas of improvement for my practice"
Theme 3: Benefit of True to Life Experience				
NLN – Fidelity/ Realism Domain (2-item)	Evaluative (Strongly disagree – strongly agree)	The scenario resembled a real-life situation, and real life factors, situations, and variables were built into the simulation.	How will this experience impact your future healthcare practice?	"Appreciation of other disciplines" "Helped me identify areas of improvement for my practice" "It helped me to work as a team with other professional and prepared me for real world experiences" "Prepared me for real life… great practice in preparing for real life"
Theme 4: Reinforced Knowledge Level and Confidence				
SPICE- R2 Teamwork Domain (4 –items)	Evaluative (Strongly disagree – strongly agree)	Working with students from different disciplines enhances education and ability to work on an interprofessional team, and enhances collaborative relationships with one another, and	How will this experience impact your future healthcare practice?	"It helped me to be more comfortable and confident in working with other disciplines" "Because we all relied on one another, it helped us to realize what we know and I feel prepared to enter the workforce" "May help me to feel more comfortable in running a code in the future"

	understanding other's roles	"It helped me to be better prepared and confident in talking and working with a team of other disciplines "

activity, coupled with a longer, more in-depth on-site orientation to the equipment prior to the actual simulation scenario, would allow students to be more proficient at the mechanics of operating the equipment. Students and faculty alike were distracted by the challenges of operating or working with the robot (e.g., low speaker volume, difficulty zooming in on the patient and monitor, maneuvering the room) rather than solely focusing on the patient scenario at hand.

To refine future IPE experiences, the faculty will consider trialing a grand round simulation scenario, as the chaotic nature of a cardiac arrest simulation was inherently loud and less conducive to using the robot. Many of the nursing students wanted the medical student to be in the room in person with an ACLS scenario, and commented when learning to use the robot a calmer situation such as a simulated grand round might be more effective.

Additionally, there is additional technology that could address the technical challenges the students experienced with the robot that would improve sound and view of the room. Adding a blue-tooth speaker to the robot may improve the sound, and having a split-screen view of the room (patient and vital sign monitor) would be beneficial to the student using the robot. Furthermore, allowing for more practice time with the robot would also allow for the students to master the learning curve in regards to robotic capabilities.

In any simulation, to make it realistic, students need to do and not pretend. Therefore, students need real working equipment and supplies. For this project, critical equipment and supplies were available; however, the scenarios would have been enhanced if items were restocked between scenarios.

Finally, the technical challenges with the equipment ended up being a learning opportunity for the students. As a result, students had to work more collaboratively as a team to problem solve the issue and rely on one another's expertise. Allowing these technical challenges in the simulation did mimic real life scenarios in the hospital setting, as the rooms can be chaotic, equipment fails, and mistakes happen which forces teams to pull together and work collaboratively to optimize patient outcomes.

For an IPE program to be successful, several key elements are necessary, including funding, institutional support, good communication, and shared vision among the key stakeholders and interprofessional teams (Lawlis, Anson, & Greenfield, 2014). In terms of stakeholders, inter-disciplinary faculty must work together in a coordinated effort to support the simulation-based IPE program. Several other key factors such as flexibility in scheduling, motivated faculty to facilitate, and early involvement of stakeholders (faculty, local partners, and students) are required when employing and maintaining a simulation-based IPE program (Vyas, McCulloh, Dyer, Gregory, & Higbee, 2012). Other positive lessons learned reinforced the importance of maintaining strong partnerships within the university system and the community. For example, the initial recruitment goal was to have a total of 20 volunteers, but as a result of strong partnerships, our recruitment efforts exceeded our expectations as we had a total of 29 participants. Additionally, it was learned that even on a rural campus, it is possible to have a successful simulation-based IPE experience despite the technical challenges.

Implications for Interprofessional Healthcare Education and Future Research

IPE is an excellent tool used to promote teamwork and enhance interprofessional attitudes towards one another, and collaborative teamwork has been associated with

reduction in medical errors, with a potential to improve patient outcomes (Haizlip & Neumayr, 2016; Hausman, 2014). Schools using IPE with simulation can better prepare students to work in interprofessional teams delivering safer patient care (Baker et al., 2008; Headrick et al., 2012; Mohaupt, Van Soeren, Andrusyszyn, MacMillan, Devlin-Cop, & Reeves, 2012; Neville, Petro, Mitchell, & Brady, 2013; Shrader, McRae, King, & Kern, 2011). Improved teamwork and enhanced trust among team members were demonstrated in this simulation-based IPE project. When students worked together to problem solve a clinical issue, patient care and patient outcomes are improved which supports previous research. Several future implications for education were identified, including developing clinical scenarios designed to enhance students' soft skills, using simulation-based scenarios designed to use "remote in" technology, and designing IPE experiences tailored to similar educational levels.

As educators, it is important to reinforce soft skills such as communication clarity, active listening, and conflict resolution. By designing and implementing scenarios around the soft skills vital to effective and efficient interprofessional teams, simulation has the potential to be an effective technique in teaching the difficult art of communication, bridging the gap across silos of care (Baker et al., 2008; Balogun, Rose, Thomas, Owen, & Brasher, 2014; Marken, Zimmerman, Kennedy, Schremmer, & Smith, 2010; Shoemaker, Platko, Cleghorn, & Booth, 2014). One such scenario designed to enhance soft skills learning and reinforce collaborative teamwork could be a simulated grand round involving students from multiple disciplines discussing the clinical case from their professional perspective, as students must learn how to clearly communicate a clinical issue with the various disciplines so accurate treatment can be implemented in a timely

fashion. Better training focused on developing solid communication skills is vital to improving patient outcomes, as research has shown many medical errors are related to poor communication among team members (Haizlip & Neumayr, 2016; Hausman, 2014). Finally, IPE could be used in pairing a novice student with a senior-level student to promote mentorship; novice students could observe how simulation-based IPE should be conducted, maximizing student success in future IPE experiences.

Another novel use of simulation-based IPE could be the inclusion of family members into a scenario to mimic real life clinical scenarios, allowing the student to practice translating medical terminology into plain language that patients and families can understand. Simulation-based IPE could also be used to practice the delivery of bad news to patients and families, while promoting empathy and understanding. Future research should focus on the effect of simulation-based IPE on quality of patient-provider interactions.

Simulation involving “remote in” technology using telehealth machinery is also an important, as providers will continue to heavily rely on these technologies to provide quality care and access to the patients in rural communities. Allowing students to practice with this technology allows for mastery of skills needed to provide care to rurally located patients, and it allows for students to experience real-world situations they will likely encounter in the workforce upon graduation. Research should examine how best to incorporate these telehealth tools into different IPE scenarios to enhance rural health care delivery.

IPE is a critical component to include when educating healthcare professionals. To make the most of the experience, it is key to include students from the various

professions that are at the same level in their clinical experiences. Students that are at the same level can learn from one another, with one another, and about one another, enhancing the educational experience. When novice students from one discipline are paired with senior-level students from another, the novice students may not yet understand their role adequately enough to be able to participate meaningfully in the scenario.

Limitations

While demonstrating feasibility and acceptability, this project did have some limitations. The small sample size limits generalizability. Additionally, pre and post-surveys were conducted the day of the exercise; we were not able to evaluate retention of effect.

Conclusion

Complex healthcare now requires a collaborative and team approach to patient care. IPE trains students to work as part of a healthcare team. The IOM (2010) charged academic institutions to make a real obligation to incorporate IPE into the curriculum, and accreditation agencies identified IPE as essential form of education to achieving safe, quality patient-centered care (Decker et al., 2015). Human patient simulation has proven to be an effective tool for bridging the gap between classroom didactic material and its application in the clinical setting. Healthcare professionals must work as a collaborative team to ensure patient safety, provide quality healthcare, and share skills and knowledge appropriately (Decker et al., 2015). Through a hands-on approach using various learning modes simultaneously, IPE with a simulation-based experiential learning approach allows for the development and mastery of these competencies, which promotes collaborative

teamwork while protecting patients. Using “remote-in” technology in a simulation-based IPE activity is one way to foster IPE in a rural setting. This project confirmed it is feasible to offer simulation-based IPE in a rural setting and collaborative teamwork is enhanced using “remote in” technology during a simulation-based IPE activity.

REFERENCES

Agency for Healthcare Research and Quality. (2008) TeamSTEPPS: Team strategies & tools to enhance performance & patient safety instructor guide. Washington, DC: AHRQ Publications. Retrieved from https://www.ahrq.gov/teamstepps/index.html

Baker, C., Pulling, C., McGraw, R., Dagnone, J., Hopkins-Rosseel, D., & Medves, J. (2008). Simulation in interprofessional education for patient centered collaborative care. *Journal of Advanced Nursing*, 64(4), 372-379. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2648.2008.04798.x/full

Balogun, S. A., Rose, K., Thomas, S., Owen, J., & Brashers, V. (2014). Innovative interprofessional geriatric education for medical and nursing students: Focus on transitions in care. *QJM: An International Journal of Medicine, 108*(6), 465-471. doi: http://dx.doi.org/10.1093/qjmed/hcu226

Booth, T. L. & McMullen-Fix, K. (2012). Innovation center: Collaborative interprofessional simulation in a baccalaureate nursing education program. *Nursing Education Perspectives, 33*(2), 127-129. Retrieved from http://dx.doi.org/10.5480/1536-5026-33.2.127

Bureau of Labor Statistics. (2017). Occupational employment statistics. Retrieved from https://www.bls.gov/oes/current/oes291141.htm#nat

Center for Connected Health Policy. (2017). What is telehealth. Retrieved from http://www.cchpca.org/what-is-telehealth

Clarke, V. & Braun, V. (2013) Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The Psychologist*, 26(2), 120-123. Retrieved from

http://www.thepsychologist.org/uk/archive/archive_home.cfm?volumeID=26&editionID=222&article

Creswell, J. W. (2015). *A concise introduction to mixed methods research*. Thousand Oaks, Ca.: SAGE Publications.

Decker, S. I., Anderson, M., Boese, T., Epps, C., McCarthy, J., Motola, I., … & Scolaro, K. (June, 2015). Standards of best practice: Simulation standard VII: Simulation-enhanced interprofessional education. *Clinical Simulation in Nursing, 11*(6). 293-297. Retrieved from http://nursing.iupui.edu/development/conferences-institutes/pneg/friday-presentations/Breakout3F_AckermannINACSL_Standards%20presentation.pdf

Dominquez, D. G., Fike, D. S., MacLaughlin, E. J., and Zorek, J. A. (November 30, 2016). *Students perception of interprofessional education revised (SPICE-R2).* Retrieved from https://nexusipe.org/advancing/assessment-evaluation/students-perceptions-interprofessional-clinical-education-revised

Fetters, M. D., Curry, L., A., & Creswell, J. W. (2013, December). Achieving integration in mixed methods designs- Principles and practices. *Health Services Research,* 48(6Pt2), 2134-2156. Doi:10.1111/1475-6673.12117

Gallagher-Lepak, S., Scheibel, P., Gibson, C. (June, 2009). Integrating telehealth in nursing curricula: Can you hear me now? *Online Journal of Nursing Informatics*, 13 (2). Retrieved from http://ojni.org/13_2/GallagherLepak.pdf

Haizlip, J. & Neumayr, S. (2016). Room of errors. Retrieved from University of Virginia, ASPIRE Center website: https://ipe.virginia.edu/educationalactivities/clinicalprograms/roomoferrors/

Hausman, S. (June 2, 2014). Room of errors saves lives. *National Public Radio*. Podcast retrieved from: http://wvtf.org/post/room-errors-saves-lives#stream/0

Headrick, L. A., Barton, A. J., Ogrinc, G., Strang, C., Aboumatar, H. J. Aud, M. A., …Patterson, J. E. (2012). Results of an effort to integrate quality and safety into medical and nursing school curricula and foster joint learning. *Health Affairs*, *31*(12), 2669-2680. doi: 10.1377/hlthaff.2011.0121

Health Resources and Services Administration (March, 2015). Telehealth in rural America. [policy brief]. Retrieved from https://www.hrsa.gov/advisorycommittees/rural/publications/telehealthmarch2015.pdf

Hicks, F. D., Coke, L., Li, S. (June, 2009). *The effect of high-fidelity simulation on nursing students' knowledge and performance: A pilot study*. Retrieved from https://www.ncsbn.org/09_SimulationStudy_Vol40_web_with_cover.pdf

Institute of Medicine (2010). The future of nursing: Focus on education. Retrieved from http://iom.nationalacademies.org/~/media/Files/Report%20Files/2010/The-Future-of-Nursing/Nursing%20Education%202010%20Brief.pdf

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field methods*, *18*(1), 3-20.

Lawlis, T. R., Anson, J., & Greenfield, D. (2014). Barriers and enablers that influence sustainable interprofessional education: A literature review. *Journal of Interprofessional Care*, *28*(4), 305-310. Retrieved from http://www.tandfonline.com/doi/abs/10.3109/13561820.2014.895977?journalCode=ijic20

Liaw, S. K., Siau, C., Zhou, W. T., & Lau, T. C. (November, 2014). Interprofessional simulation-based education program: A promising approach for changing stereotypes and improving attitudes toward nurse-physician collaboration. *Applied Nursing Research* [serial online]. November 2014; *27*(4) 258-260. Retrieved from http://dx.doi.org/10.1016/j.apnr.2014.03.005

Marken, P. A., Zimmerman, C., Kennedy, C., Schremmer, R., & Smith, K. V. (2010). Human simulators and standardized patients to teach difficult conversations to interprofessional healthcare teams. *American Journal of Pharmaceutical Education, 74*(7), 120-130. Retrieved from http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pmc/articles/PMC2972514/

McGahie, W. C., Issenberg, S. B., Cohen, E. R., Barsuk, J. H., Wayne, D. B. (June, 2011). Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. *Academic Medicine*, 86(6), 706-711. doi: 10.1097/ACM.0b013e318217e119

Mohaupt, J., van Soeren, M., Andrusyszyn, M., A., MacMillan, K., Devlin-Cop, S., & Reeves, S. (2012). Understanding interprofessional relationships by the use of contact theory. *Journal of Interprofessional Care, 26*(5), 370-375. doi: 10.3109/13561820.2012.673512

National League for Nursing (2005). Simulation design scale – student version. Retrieved from http://www.nln.org/docs/default-source/professional-development-programs/nln-instrument_simulation-design-scale.pdf?sfvrsn=0

Neville, C. C., Petro, R., Mitchell, G. K., & Brady, S. (2013). Team decision making:

Design, implementation and evaluation of an interprofessional education activity for undergraduate health science students. *Journal of Interprofessional Care, 27*(6), 523-525. doi:10.3109/13561820.2013.784731

Palaganas, J. C., Epps, C., & Raemer, D. B. (2014). A history of simulation-enhanced interprofessional education. *Journal of Interprofessional Care, 28*(2) 110-115 6p. doi:10.3109/13561820.2013.869198.

Pippitt, K., Moloney-Johns, A., Jalilibahabadi, S. & Gren, L. H. (April, 2015). Collaboration versus competition: An interprofessional education experience. *Family Medicine, 47*(4). Retrieved from: http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pubmed/25853601

Rural Health Information Hub. (2017). Education and training of the rural healthcare workforce. Retrieved from https://www.ruralhealthinfo.org/topics/workforce-education-and-training

Shoemaker, M. J., Platko, C. M., Cleghorn, S. M., & Booth, A. (2014). Virtual patient care: An interprofessional education approach for physician assistant, physical therapy and occupational therapy students. *Journal of Interprofessional Care, 28*(4), 365-367. doi: 10.3109/13561820.2014.891978

Shrader, S., McRae, L., King, W. M., & Kern, D. (2011). A simulated interprofessional rounding experience in a clinical assessment course. *American Journal of Pharmaceutical Education, 75*(4), 61. Retrieved from http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pmc/articles/PMC3138354/

Smithburger, P. L., Kane-Gill, S. L., Kloet, M. A., Lohr, B., & Seybert, A. L. (2013).

Advancing interprofessional education through the use of high fidelity human patient simulators. *Pharmacy Practice, 11*(2), 61-65. Retrieved from http://eds.a.ebscohost.com.pallas2.tcl.sc.edu/ehost/pdfviewer/pdfviewer?sid=dcf58deb-5d28-4040-a94c-f5816ecbec0e%40sessionmgr4005&vid=3&hid=4211

Whelan, J. J., Spencer, J. F., & Dalton, L. (2008). Building rural healthcare teams through Interprofessional simulation-based education. [paper] 10th National Rural Health Conference]. Retrieved from https://www.ruralhealth.org.au/10thNRHC/10thnrhc.ruralhealth.org.au/papers/docs/Spencer_Judy_C4.pdf

Vyas, D., McCulloh, R., Dyer, C., Gregory, G., & Higbee, D. (2012). An interprofessional course using human patient simulation to teach patient safety and teamwork skills. *American Journal of Pharmaceutical Education, 76*(4), 71. Retrieved from http://doi.org/10.5688/ajpe76471

CHAPTER 3

CONCLUSION

The results of this project provided insight into best practice guidelines for implementing IPE simulation-based education into the curriculum in rural settings. Schools that incorporate IPE with simulation into the curriculum can better prepare students to work in interprofessional teams delivering safer patient care (Baker et al., 2008; Headrick et al., 2012; Mohaupt, Van Soeren, Andrusyszyn, MacMillan, Devlin-Cop, & Reeves, 2012; Neville, Petro, Mitchell, & Brady, 2013; Shrader, McRae, King, & Kern, 2011). Improved teamwork and enhanced trust among team members were demonstrated in this simulation-based IPE project. When students collaboratively problem solved a clinical issue, patient care and patient outcomes were improved which supports previous research. Several future implications for nursing practice/education, health policy, leadership, and directions for future research were identified including developing clinical scenarios designed to enhance students' soft skills, using simulation-based scenarios designed to use "remote in" technology, and designing IPE experiences tailored to similar educational levels.

Implications for Nursing Practice/Education

IPE is an excellent tool used to promote teamwork and enhance interprofessional attitudes towards one another, and collaborative teamwork has been associated with reduction in medical errors, with a potential to improve patient outcomes (Haizlip & Neumayr, 2016; Hausman, 2014). Schools using IPE with simulation can better prepare

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Another novel use of simulation-based IPE could be the inclusion of family members into a scenario to mimic real life clinical scenarios, allowing the student to practice translating medical terminology into plain language that patients and families can understand. Simulation-based IPE could also be used to practice the delivery of bad news to patients and families, while promoting empathy and understanding. Future research should focus on the effect of simulation-based IPE on quality of patient-provider interactions.

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IPE is a critical component to include when educating healthcare professionals, including nurses. To make the most of the experience, it is key to include students from the various professions that are at the same level in their clinical experiences. Students that are at the same level can learn from one another, with one another, and about one

another, enhancing the educational experience. When novice students from one discipline are paired with senior-level students from another, the novice students may not yet understand their role adequately enough to be able to participate meaningfully in the scenario.

Implications for Health Policy

The IOM has charged academic institutions to incorporate interprofessional education into the curriculum focused on developing and sustaining collaborative skills (IOM, 2010). Additionally, accreditation agencies recognize IPE as a vital form of education to achieve safe, quality patient-centered care (Decker et al., 2015). IPE *combined* with simulation-based experiential patient scenarios represents an innovative approach in enhancing learning, as hands-on practice allows students to develop and master core competencies, promotes interdisciplinary collaboration and communication skills, and protects patients. Health policy focusing on team collaboration aimed at reducing medical errors and enhancing patient safety will drive healthcare and subsequent healthcare education in the future.

Implications for Leadership

As previously stated, IPE is a critical component to include when educating healthcare professionals; leadership opportunities arise when groups of students work together. Pairing a novice student with a senior level student to observe how simulation-based IPE should be conducted helps to maximize novice student success in the future. When novice students observe senior students during a simulation, they have the opportunity to discern effective leadership strategies, glean understanding of how simulation works, and develop and understanding of how to communicate with other

disciplines. Pairing students together is a win-win for both as the senior student can teach and demonstrate effective leadership skills to the novice student, while the novice gains valuable insight and experience that will enhance their educational opportunities in the future and help make them a better clinician in practice.

Implications for Future Research

Healthcare is a team approach and in rural areas, the interdisciplinary team is not always physically present and must be brought in via technology. Future research in simulation could involve "remote in" technology using telehealth machinery as an important design element in the simulation. Providers continue to heavily rely on these available technologies in order to provide quality care and access to the patients located in rural communities. Allowing students to practice with this technology allows for mastery of skills needed to provide care to rurally located patients, and it allows for students to experience real-world situations they will likely encounter in the workforce upon graduation. Additionally, research using a simulated-based grand round scenario could also provide insight into communication strategies and collaborative teamwork skills.

Sustainability of the project

To make the most of the IPE experience, it is vital to include students from various professions that are at the same level in their clinical experiences. Students that are at the same level, can learn from one another, with one another, about one another, enhancing the educational experience. Having students at the same level in the clinical arena allows for each students to fully participate in the activity adding to the richness of the experience by fostering trust and collaborative teamwork among the team members.

USCL continues to partner with local agencies including the J. Marion Sims Foundation that has supported USCL for many years through educational grants. Grant money from J. Marion Sims Foundation was used to purchase needed equipment, including the Double Robotics robot, defibrillator and code cart, that was critical to the success of this project. With buy in from stakeholders at the CON, local agencies such as Mid-Carolinas AHEC, and other USC schools, the goal is to pilot simulation-based IPE with the USCL CON senior students and locally placed medical students recruited from AHEC. USCL senior nursing students as well as the faculty are excited, willing, and motivated to see what the future will bring to simulation-based IPE on a rural campus.

Conclusion

Complex healthcare now requires a collaborative and team approach to patient care. IPE trains students to work as part of a healthcare team. The IOM (2010) charged academic institutions to make a real obligation to incorporate IPE into the curriculum, and accreditation agencies identified IPE as essential form of education to achieving safe, quality patient-centered care (Decker et al., 2015). Human patient simulation has proven to be an effective tool for bridging the gap between classroom didactic material and its application in the clinical setting. Healthcare professionals must work as a collaborative team to ensure patient safety, provide quality healthcare, and share skills and knowledge appropriately (Decker et al., 2015). Through a hands-on approach using various learning modes simultaneously, IPE with a simulation-based experiential learning approach allows for the development and mastery of these competencies, which promotes collaborative teamwork while protecting patients when practicing. Thus, after careful consideration of the literature review, analysis of the research, and implementation of the feasibility

project, it was concluded that simulation-based IPE using remote-in technology could be successfully conducted at the USCL Simulation Lab using senior nursing students in their last semester, and students from a School of Medicine and a School of Pharmacy associated and recruited through Mid-Carolinas AHEC.

REFERENCES

Agency for Healthcare Research and Quality. (2008) TeamSTEPPS: Team strategies & tools to enhance performance & patient safety instructor guide. Washington, DC: AHRQ Publications. Retrieved from https://www.ahrq.gov/teamstepps/index.html

Baker, C., Pulling, C., McGraw, R., Dagnone, J., Hopkins-Rosseel, D., & Medves, J. (2008). Simulation in interprofessional education for patient centered collaborative care. *Journal of Advanced Nursing*, 64(4), 372-379. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2648.2008.04798.x/full

Balogun, S. A., Rose, K., Thomas, S., Owen, J., & Brashers, V. (2014). Innovative interprofessional geriatric education for medical and nursing students: Focus on transitions in care. *QJM: An International Journal of Medicine, 108*(6), 465-471. doi: http://dx.doi.org/10.1093/qjmed/hcu226

Bolesta, S. & Chmil, J. V. (2014). Interprofessional education among student health professionals using human patient simulation. *American Journal of Pharmaceutical Education, 78*(5), 94. Retrieved from http://doi.org/10.5688/ajpe78594

Booth, T. L. & McMullen-Fix, K. (2012). Innovation center: Collaborative interprofessional simulation in a baccalaureate nursing education program. *Nursing Education Perspectives, 33*(2), 127-129. doi: http://dx.doi.org/10.5480/1536-5026-33.2.127

Canadian Interprofessional Health Collaborative Practice (2017). [website]. Retrieved from http://www.cihc.ca/

Center for Connected Health Policy. (2017). What is telehealth. Retrieved from http://www.cchpca.org/what-is-telehealth

Dearholt, S. & Dang, D. (2012). *John Hopkins nursing evidence-based practice: Models and guidelines*. (2nd ed.). Retrieved from http://site.ebrary.com.pallas2.tcl.sc.edu/lib/southcarolina/reader.action?docID=10540866&ppg=56

Decker, S. I., Anderson, M., Boese, T., Epps, C., McCarthy, J., Motola, I., … & Scolaro, K. (June, 2015). Standards of best practice: Simulation standard VII: Simulation-enhanced interprofessional education. *Clinical Simulation in Nursing, 11*(6). 293-297. Retrieved from http://nursing.iupui.edu/development/conferences-institutes/pneg/friday-presentations/Breakout3F_AckermannINACSL_Standards%20presentation.pdf

Dominquez, D. G., Fike, D. S., MacLaughlin, E. J., and Zorek, J. A. (November 30, 2016). *Students perception of interprofessional education revised (SPICE-R2).* Retrieved from https://nexusipe.org/advancing/assessment-evaluation/students-perceptions-interprofessional-clinical-education-revised

Gallagher-Lepak, S., Scheibel, P., Gibson, C. (June, 2009). Integrating telehealth in nursing curricula: Can you hear me now? *Online Journal of Nursing Informatics*, 13 (2). Retrieved from http://ojni.org/13_2/GallagherLepak.pdf

Haizlip, J. & Neumayr, S. (2016). Room of errors. Retrieved from University of Virginia,

ASPIRE Center website: https://ipe.virginia.edu/educationalactivities/clinicalprograms/roomoferrors/

Hausman, S. (June 2, 2014). Room of errors saves lives. *National Public Radio*. Podcast retrieved from: http://wvtf.org/post/room-errors-saves-lives#stream/0

Headrick, L. A., Barton, A. J., Ogrinc, G., Strang, C., Aboumatar, H. J. Aud, M. A., …Patterson, J. E. (2012). Results of an effort to integrate quality and safety into medical and nursing school curricula and foster joint learning. *Health Affairs*, *31*(12), 2669-2680. doi: 10.1377/hlthaff.2011.0121

Health Resources and Services Administration (March, 2015). Telehealth in rural America. [policy brief]. Retrieved from https://www.hrsa.gov/advisorycommittees/rural/publications/telehealthmarch2015.pdf

Hicks, F. D., Coke, L., Li, S. (June, 2009). *The effect of high-fidelity simulation on nursing students' knowledge and performance: A pilot study*. Retrieved from https://www.ncsbn.org/09_SimulationStudy_Vol40_web_with_cover.pdf

Institute of Medicine (2010). The future of nursing: Focus on education. Retrieved from http://iom.nationalacademies.org/~/media/Files/Report%20Files/2010/The-Future-of-Nursing/Nursing%20Education%202010%20Brief.pdf

Interprofessional Education Collaborative (2017). Retrieved from https://ipecollaborative.org/

Lawlis, T. R., Anson, J., & Greenfield, D. (2014). Barriers and enablers that influence sustainable interprofessional education: A literature review. *Journal of Interprofessional Care*, *28*(4), 305-310. Retrieved from

http://www.tandfonline.com/doi/abs/10.3109/13561820.2014.895977?journalCode=ijic20

Le, Q., Spencer, J., & Whelan, J. (2008). Development of a tool to evaluate health science students' experience of an interprofessional education (IPE) programme. *Annals Academy of Medicine Singapore, 37*(12), 1027-1033. Retrieved from http://europepmc.org/abstract/MED/19159037

Lewis, R., Strachan, A., & Smith, M. M. (2012). Is high fidelity simulation the most effective method for the development of non-technical skills in nursing? A review of the current evidence. *The Open Nursing Journal, 6,* 82-89. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3415625/

Liaw, S. K., Siau, C., Zhou, W. T., & Lau, T. C. (November, 2014). Interprofessional simulation-based education program: A promising approach for changing stereotypes and improving attitudes toward nurse-physician collaboration. *Applied Nursing Research* [serial online]. November 2014; *27*(4) 258-260. Retrieved from http://dx.doi.org/10.1016/j.apnr.2014.03.005

Marken, P. A., Zimmerman, C., Kennedy, C., Schremmer, R., & Smith, K. V. (2010). Human simulators and standardized patients to teach difficult conversations to interprofessional healthcare teams. *American Journal of Pharmaceutical Education, 74*(7), 120-130. Retrieved from http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pmc/articles/PMC2972514/

McGahie, W. C., Issenberg, S. B., Cohen, E. R., Barsuk, J. H., Wayne, D. B. (June, 2011). Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative

review of the evidence. *Academic Medicine*, 86(6), 706-711. doi: 10.1097/ACM.0b013e318217e119

Melnyk, B.M. & Fineout-Overholt, E. (2015). *Evidence-based practice in nursing and healthcare. A guide to best practice*. (3rd ed.). Philadelphia, PA: Wolters Kluwer Lippincott Williams & Wilkins, pp. 24-39.

Miller, J. L., Rambeck, J. H., & Snyder, A. (2014). Improving emergency preparedness system readiness through simulation and interprofessional education. *Public Health Reports*, *129* (Suppl 4), 129-135. Retrieved from http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pmc/articles/PMC4187316/

Mohaupt, J., van Soeren, M., Andrusyszyn, M., A., MacMillan, K., Devlin-Cop, S., & Reeves, S. (2012). Understanding interprofessional relationships by the use of contact theory. *Journal of Interprofessional Care, 26*(5), 370-375. doi: 10.3109/13561820.2012.673512

National League for Nursing (2005). Simulation design scale – student version. Retrieved from http://www.nln.org/docs/default-source/professional-development-programs/nln-instrument_simulation-design-scale.pdf?sfvrsn=0

Neville, C. C., Petro, R., Mitchell, G. K., & Brady, S. (2013). Team decision making: Design, implementation and evaluation of an interprofessional education activity for undergraduate health science students. *Journal of Interprofessional Care, 27*(6), 523-525. doi:10.3109/13561820.2013.784731

Palaganas, J. C., Epps, C., & Raemer, D. B. (2014). A history of simulation-enhanced interprofessional education. *Journal of Interprofessional Care, 28*(2) 110-115 6p. doi:10.3109/13561820.2013.869198.

Pippitt, K., Moloney-Johns, A., Jalilibahabadi, S. & Gren, L. H. (April, 2015). Collaboration versus competition: An interprofessional education experience. *Family Medicine, 47*(4). Retrieved from: http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pubmed/25853601

Robins, L., Brock, D. M., Gallagher, T., Kartin, D., Lindhorst, T., Odegard, P. S., … Belza, B. (2008). Piloting team simulations to assess interprofessional care. *Journal of Interprofessional Care, 22*(3), 325-328. doi: 10.1080/13561820801886438

Shoemaker, M. J., Platko, C. M., Cleghorn, S. M., & Booth, A. (2014). Virtual patient care: An interprofessional education approach for physician assistant, physical therapy and occupational therapy students. *Journal of Interprofessional Care, 28*(4), 365-367. doi: 10.3109/13561820.2014.891978

Shrader, S., McRae, L., King, W. M., & Kern, D. (2011). A simulated interprofessional rounding experience in a clinical assessment course. *American Journal of Pharmaceutical Education, 75*(4), 61. Retrieved from http://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pmc/articles/PMC3138354/

Smithburger, P. L., Kane-Gill, S. L., Kloet, M. A., Lohr, B., & Seybert, A. L. (2013). Advancing interprofessional education through the use of high fidelity human patient simulators. *Pharmacy Practice, 11*(2), 61-65. Retrieved from http://eds.a.ebscohost.com.pallas2.tcl.sc.edu/ehost/pdfviewer/pdfviewer?sid=dcf58deb-5d28-4040-a94c-f5816ecbec0e%40sessionmgr4005&vid=3&hid=4211

University of Virginia Interprofessional Education (2017). The Center for ASPIRE. [website]. Retrieved from https://ipe.virginia.edu/

Walters, S. J. Robertson-Malt, S. & Stern, C. (2015). The measurement of collaboration within healthcare settings: a systematic review protocol of measurement properties of instruments. *JBI Database of Systematic Reviews & Implementation Reports,13*(7):24-43. [PM:26455844]. Retrieved from http://ovidsp.tx.ovid.com.pallas2.tcl.sc.edu/sp-3.18.0b/ovidweb.cgi#

Wang, R., Shi, N, Bai, J., Zheng, Y, & Zhao, Y. (2015). Implementation and evaluation of an interprofessional simulation-based education program for undergraduate nursing students in operating room nursing education: A randomized control trail. *BMC Medical Education*, *15*. 115. Retrieved from http://doi.org/10.1186/s12909-015-0400-8

Watters, C., Reedy, G., Ross, A., Morgan, N. J., Handslip, R., & Jaye P. (January, 2015). Does interprofessional simulation increase self-efficacy: A comparative study? *BMJ Open*, *5*(1). Retrieved from http://bmjopen.bmj.com/content/5/1/e005472.full

Whelan, J. J., Spencer, J. F., & Dalton, L. (2008a). Building rural healthcare teams through Interprofessional simulation-based education. [paper] 10th National Rural Health Conference]. Retrieved from https://www.ruralhealth.org.au/10thNRHC/10thnrhc.ruralhealth.org.au/papers/docs/Spencer_Judy_C4.pdf

Whelan, J. J., Spencer, J. F., & Rooney, K. (2008). A 'RIPPER' project: Advancing rural interprofessional health education at the University of Tasmania. *Rural and Remote Health, 8*(3), 1-11. Retrieved from http://eds.b.ebscohost.com.pallas2.tcl.sc.edu/ehost/detail/detail?vid=9&sid=814ac

b35-ed66-4af5-b5f8-02b6505d96ce%40sessionmgr113&hid=120&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=105698710&db=ccm

World Health Organization. (2010). Framework for action on interprofessional education & collaborative practice. Geneva, Switzerland: World Health Organization

Vyas, D., McCulloh, R., Dyer, C., Gregory, G., & Higbee, D. (2012). An interprofessional course using human patient simulation to teach patient safety and teamwork skills. *American Journal of Pharmaceutical Education, 76*(4), 71. Retrieved from http://doi.org/10.5688/ajpe76471

APPENDIX A – EVIDENCE TABLE

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
Wang et al. (2015) Implementation and evaluation of an interprofessional simulation-based education program for undergraduate nursing students in operating room nursing education: a randomized controlled trail **Level I – C** **RCT** Pre-and post- survey	55 females (3rd) year nursing students and 46 (4th) year medical students were randomly assigned to IPE (N=28) or traditional group (N=27). In the IPSE group 1-2 nursing and 3-4 medical students were arranged in 1 group and were asked to perform surgical procedures on animals as a team. In the traditional (control) group only nursing students were asked to practice surgical skills	Validity: (potential threats include setting selection, patient selection, characteristics of randomized patients, protocol differences, etc.) Small sample size nursing students (n=55); but it is in sample range for IPSE studies. Observations were also done immediately after the simulation. Due to small sample size, quality rating is poor (C) Reliability: (refers to repeatability of the test)	Students in the IPE group with simulation showed statistically significant responses to four of nineteen questions on the RIPLS, reflecting a more positive attitude toward IPE (teamwork, communication, and clinical knowledge) as shown below: Cronbach alpha reported as: Content validity was (0.91) RIPLS (0.92)	Integrated course with IPE and simulation provided a positive impact toward learning. Further longitudinal studies are needed to see if IPSE can translate into enhanced workplace improvements

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
55 students (nursing and medical)	under the instructor's supervision. Students were assigned Pre-and post-surveys were done using RIPLS scale 3 simulated scenarios lasting three hours over 2 weeks (each student participated in 2 scenarios)	The English version RIPLS tool was found reliable and valid. Content validity was 0.91 Could have possible detection bias as one group was nursing and medical students and one group was nursing only lead by an instructor leading to better prepared group lead by instructor Randomization minimizes threats to internal validity. However, blinding or masking of the subjects and providers was not done due to logistics of the study. RIPLS (0.92) since no Chinese version was	Teamwork and collaboration (0.86) Professional identity (0.80) Roles and responsibility (0.71)	

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		available it was translated into Chinese, with results translated back to English. Both English translations were compared to distinguish for changes in meaning. 5 experts confirmed the validity of the Chinese version to ensure cultural competence Cronbach alpha reported as: Content validity of questionnaire was excellent (0.88) Reliability was (0.86)		
Vyas et al. (2012) An interprofessional course using human patient simulation to	Pre/post Pilot Study compared (Pre-licensure group) of 208 students (pharmacy, medical and nursing)	Internal Validity: (Threats include maturation, testing, instrumentation, history, and selection) Learners	Score on 8 of 30 items improved over pre-simulation scores Score on 3 of 10 items on team building also	Simulation provided an opportunity to recognize and react to patient safety issues and to enhance their

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
teach patient safety and teamwork skills **Level II - A** Quasi-experimental, non-randomized	total in 2009 when simulation added to a group prior to that in 2007-2008 (no simulation) 11% pharmacy, 46% medical, and 26% nursing students Each group of 10-12 students (all disciplines) received 5 patient cases and conducted their role in a 10-minute time frame to determine the best course of action in providing safe and effective care. Students' completed30 item Likert scale on KSA regarding teamwork and QI. Completed a 10-item team building and interprofessional	had varied levels of clinical experience. Increased apprehension if students had never had simulation experience (no orientation) Confusion about roles and responsibilities (could have been clearer) Analysis was group data only and not matched to de-identified individuals Non-randomization poses threat to internal validity through bias. Reliability: Likert scale and survey proved reliable as a testing tool	improved after participating in a simulation exercise 90% said simulation increased their understanding of professional roles and the importance of interprofessional education Significant positives on KSA Training did not dilute their own training ($p<0.001$) Competent professionals don't make errors leading to harm ($p<0.001$) Staff should be reprimanded when an error occurs ($p<0.001$)	interprofessional collaboration. PDSA cycles are integral to developing simulations Involving all stakeholders is key to well-rounded experience for students in simulations Early involvement of CSL staff is critical and adequate numbers of faculty and staff to run simulations is needed Flexibility is a must in coordinating all the discipline schedules

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
	communication survey and general course evaluation		Student's felt increased comfort when disclosing an error ($p<0.002$)	
Watters et al. (2015) Does interprofessional simulation increase self-efficacy: a comparative study **Level II -A** Quasi-experimental, non-randomized	Quasi-experimental, non-randomized (Post-licensure group/ in early years post graduate education) 156 doctors and 115 nurses and midwives participated in a 1-day simulation course incorporating five clinical and one communication scenario assigned to IP or UP groups based on demand for course Mixed methods approach using pre-and post-course questionnaires	Validity: Nonrandomized student group poses threat to validity. Time limitations did not allow for measuring nurses in-depth as it did for physicians Reliability: Evaluation tool developed by a learning scientist with expertise in education research for this study proved reliable (see results of the study) but has yet to be validated. The instrument was felt to have face validity and high content validity (designed by experts and proven robust over	Qualitative analysis showed improvements in communication/teamwork and leadership through thematic analysis Confidence ratings improved overall for both doctors and nurse ($p<0.001$) from (N=115, nurses with 63% pre) compared to post (N= 57 with 77% post) Improved nurse (N=115, $p<0.001$)) outcomes observed for uniprofessional (12%, N=64)) versus	Simulation training enhances self-efficacy and leads to increases in perceived ability to communicate/work as a team and leadership/management of clinical situations

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		thousands of simulations) but concurrent and predictive validity is not proven Retention rate was 70% for nurses 30% for doctor post measurement rate which can mean attrition bias The doctors second comparison was post course response only and not compared to a pre-intervention Challenges in running multiple groups over time	interprofessional (20%, n=66) Doctors with interprofessional training was significantly associated with better outcomes for communication/teamwork (n=156; $p<0.05$)	
Headrick et al. (2012) Results of an effort to integrate quality and safety into medical and nursing school	2009-2010 - 6 University sites created new educational experiences that involved 1374 student encounters overall	Validity: Non-randomization poses threat to internal validity through bias; student selection was	Findings were collected via monthly reports from the sites, site visits, and final site reports.	Results showed that in clinical and simulation setting, they could evaluate changes in student behavior and organizational practice.

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
curricular and foster joint learning **Level II - A** Quasi-experimental Pilot study generating insights/opinion 1374 students (medical and nursing) from 6 universities over a 1 year time frame (2009-2010)	(classroom, clinical and simulation activities) 51% were nursing and 48% medical and remainder 1% were pharmacy and physical therapy students. Each school was assisted and supported by expertly trained coaches from the Retooling for Quality and Safety Initiative of the Josiah Macy Jr. Foundation and the Institute for Healthcare Improvement	based on clinical course requirements Lack of available critical mass – hard to find clinical based faculty members who were ready to teach about improvement of care Each site created their own pilot study, but all included IP teams of students Reliability: Able to measure the student's reactions to the learning but unable to measure changes in student's behavior, changes in organizational practice, or benefits to patients (expect in simulation or clinical activities) - this was because there was	The repeat of test approach helped faculty members use their evaluation results to improve the educational experience, once established, set interventions were implemented.	This study found that schools using IPE with simulation can better prepare students to work in interprofessional teams that deliver safer care. Also, found that schools that participated in the Retooling for Quality and Safety initiative made major progress toward the integrations of healthcare improvement and safety into their curricula. This this approach would be beneficial to other schools

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		no available tool to evaluate the education innovations (interventions) With each interaction, faculty used a repeated tests of change approach adjusting the experience based on lessons learned which threatens reliability		
Shrader et al. (2011) A simulated interprofessional rounding experience in a clinical assessment course **Level II - A** Experimental nonrandomized (pilot study)	114 Students (medical, pharmacy, and physician assistant) completed a pre-and post-survey to assess interprofessional attitudes and satisfaction before and after participation in an IPE simulation experience. Students were divided into 22 groups with 5	Validity: Non-randomization poses threat to internal validity through bias. Data collection was attitudinal and self-reported (87-91% pre-and post-response rate) Groups were imbalanced (3 pharmacy and 2 non-pharmacy	Overall, students reported the experience improved their attitudes regarding teamwork and increased their satisfaction with simulation with mean scores of 65-75% for each experience for pharmacy students but not the other disciplines.	Incorporating a simulated IPE experience improved student attitudes regarding teamwork and increased student satisfaction. Other schools should consider implementation of IPE with simulations

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
114 Students (medical, pharmacy, and physician assistant)	students (3 from pharmacy and 1 from each of the other disciplines) Each team participated in one 75-minute simulation using anonymous, voluntary survey instruments and clinical performance scores	students) may create bias Also, there was no control group to compare to, and medical and physician assistant student's data were not separated for data collection purposes due to different numbers participating Reliability: The 5 point Likert scale survey used was developed by the interprofessional institute and is widely used on MUSC campus.	Pre-and post-survey results were analyzed using Wilcoxon rank sum tests stratified by student discipline. Significant improvement in confidence after simulated activity	
Liaw et al. (2014) Interprofessional simulation-based education program: A promising approach for changing stereotypes and	Prospective, quasi-experimental pre-and post-test design study. Students were divided into 10 groups (6-7 nursing and 2-3 medical students per group).	Validity: Evidence was limited to pre-and post-test design Non-randomization as program was required for nursing students and optional for medical	SSRQ scores: Both groups rated the other group significantly higher ($p<0.001$) for perception of the other health profession after simulation than before.	At the pre-licensure level has a great potential for impact on collaborative patient centered care

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
improving attitudes toward nurse-physician collaboration **Level II - A** Prospective, quasi-experimental pre-and post-test design study 102 students (medical and nursing) participated with 23 (100%) medical and 73 (92.4%) nursing completed the questionnaire	Each group completed two 15 minute simulations A 9-item SSRQ with a 5 point Likert scale was used to measure student's perception of one another health profession. A 14-item JSATPNC with a 4-point scale was used to measure collaboration Pre-and post-analysis of were completed using a paired T test.	students which could affect the generalizability of the findings Non-randomization poses threat to internal validity through bias Reliability: 9-item SSRQ with 5 point Likert scale was evaluated in a previous study for content validity and test-retest reliability. Content validity was established by a panel of academics, health and social care professional and pre-registration students. Reported high internal consistency with Cronbach alpha of 0.76 to 0.88	JSATPNC scores: Both groups demonstrated significant improvements ($p<0.001$) in scores for attitudes toward collaboration between nurse-physician after simulation	

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		The 14-item JSATPNC with 4 point Likert scale has a Cronbach alpha of 0.85 to 0.87 high internal consistency for this study		
Mohaupt et al. (2012) Understanding interprofessional relationships using contact theory **Level II - A** Quasi-experimental design pre-and post-test 84 students (nursing, pharmacy tech, OT assistant, PT assistant, and paramedic)	Each student was randomly assigned to a small IPE group consisting of 1 student from each discipline. Each group participated in 3 scenarios lasting 90 minutes each over the course of 1 day.	Validity: Circumstances did not allow for control groups so there was no comparison group Voluntary participation and those more anxious to learn about IPE volunteered which could influence bias as those more anxious to learn about IPE volunteer Non-randomization poses threat to internal validity through bias 50% of the students were from nursing Reliability: The IEPS measurement scale has a	Statistically significant increases in positive attitudes in three of four subscales were found: competency and autonomy, perceived need for collaboration and actual collaboration. ANOVA revealed significant effect for time for competency and autonomy scales within groups (p=0.004) but no difference between professions (p=0.885), for "perceived need for collaboration"	Planning initiatives that promote an atmosphere conducive to intergroup contact are important in IPE education and can foster improved collaboration among students. Targeting student in their final semesters also promotes equality

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		Cronbach's alpha reliability value of 0.87 which is high and has been widely used.	(P=0.026) within group and (p=0.753) between groups, for "perception of actual collaboration" (p=0.004) for within and (p=0.193) for between groups.	
Whelan et al. (2008) A "RIPPER" project: advancing rural interprofessional health education at the university of Tasmania **Level II - B** Pilot study Pre-and post-Quasi-experimental design 60 students (medicine, nursing, and pharmacy)	The RIPPER program focused on a multi-station learning circuit using IPE scenarios where students worked in teams. Students were evaluated using 2 questionnaires before and after the simulation. 60 students volunteered over 2 weekends in 2006 and 2007 Quantitative data collected on a 13-item questionnaire	Validity: Non-randomization poses threat to internal validity through bias Reliability: 13-item questionnaire using 5 point Likert scale and 8 –item qualitative questions were asked. No information about the validity or reliability of the instrument tools was mentioned.	98 and 96 pre-and post-response rate. Multiple categorizations using chi-squared tests where p 0.05) were noted especially under collaboration and understanding roles and responsibilities. 70% of students identified interactive and authentic case-based learning as a positive aspect 80% of students noted themes of positive mentoring guidance and	The RIPPER is an effective model for IPE and practice and resulted in an increased awareness and importance of collaboration among team members. It also mentioned that sustainability of the project is difficult as resources, time constraints, and commitment to the program are ongoing issues to combat

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
	Qualitative data collected on an 8-item questionnaire		support as crucial to learning	
Le et al. (2008) Development of a tool to evaluate health science students' experience of an interprofessional education (IPE) program **Level II - C** Pre-and Post-quasi experimental design	Pre-and Post-quasi experimental design studying 29 students (pharmacy, nursing, medicine) RIPPER program is a health education pilot program using interprofessional case based scenarios using simulation RIPPER used pre/post quasi-experimental design to evaluate students understanding and experience of interprofessional practice conducted during a weekend retreat	Validity was tested using experts in the field and construct using exploratory factor analysis (KMO values >0.5 are acceptable) and pre-questionnaire (KMO = 0.699) and post-questionnaire (KMO = 0.453). The post –questionnaire leads one to rethink the variables to include in the data or collect more data. Weakness: small sample size (n=29) and non-randomization poses threat to internal validity through bias	Factor analysis of the 12 statements measured identified 3 main factors including appreciation of professional roles, improved practice based on teamwork, and importance of working together to enhance clinical practice. Factor analysis showed that 2 factors explained 67% of the total variance. All 3 factors were loaded and used as the 3rd factor had emerged on the pre-questionnaire data and was considered a key reason for doing IPE	Evidence supports this tool to adequately measure student's attitudes and identified 3 main factors including appreciation of professional roles, improved practice based on teamwork, and importance of working together to enhance clinical practice. All were enhanced with simulation

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		Reliability of instrument was tested using Cronbach alpha and values above 0.6 were considered acceptable. Cronbach alpha pre (0.903) and post questionnaire (0.928) = satisfactory reliability		
Smithburger et al. (2013) Advancing interprofessional education using high fidelity human patient simulation **Level II - C** Quasi-experimental pilot study, feasibility study nonrandomized	Students (pharmacy, nursing, physician assistant, medical, and social work students) were included if they volunteered for feasibility study Once weekly for 4-week time periods, teams of students worked together using simulation to complete complex scenarios. Four simulations lasting for three hour sessions	Validity: Non-randomized group selection and possible confounding factors that could impact CATS assessment scores may have occurred as improvements in scores may have increased because of factors that were unable to be controlled for by investigators such as students became more comfortable with one	The CATS scores improved from HFS sessions 1 to 2 (p=0.01), 2 to 3 ((p=0.035) and overall from 1 to 4 (P=0.001). Inter-rater reliability between evaluators was high (0.085, 95% CI 0.71, 0.99). Students perceived HFS improved: communication ability, confidence in patient	The feasibility project proved that successful implementation of this design can improve teamwork and communication between the cohort of IP students

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
	occurred weekly over a four-week period. Communication was evaluated using the CATS assessment by 2 independent evaluators external to the project.	another because of working together previously in teams. Small number of students participated but feel this IPE teaching method can be applied to larger scale IP studies Generalizability maybe limited as this was conducted at one university with all health sciences schools in close proximity Reliability CATS is a proven tool with reliability	care, stimulated interest in IP work	
Lewis et al. (2012) Is high fidelity simulation the most effective method for the development of non-technical skills in	Databases: *Web of Science, Ebsco host (CINAHL Plus, ERIC, Embase, Medline), Cochrane Library, SCOPUS, Science*	Validity of the study: All studies agreed that simulation has benefits, but each study looked at benefits slightly differently. In other	Simulation is positively associated with significantly improved communication skills which improve team performance and	Applicability: HFS is proven to provide students with a learning environment in which skills can be developed, mistakes

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
nursing? A review of the current evidence **Level III - B Systematic Review of Literature between 2000-2011** medical and nursing students	*Direct, ProQuest and ProQuest Dissertations and Theses Database)* between 2000-2011. Only included were quantitative pre- and post-test studies, quasi-experimental and single-test studies with 16 articles used for review	words, each study analyzed and presented the data differently so it was hard to draw conclusions based on the data. The robustness of the studies maybe questions as there was no uniform measure for robustness. Inclusion criteria was established (only included were quantitative pre- and post-test studies, quasi-experimental and single-test studies) Exclusion criteria (all qualitative and descriptive papers)	management in crisis situations. This review found that some studies found significant differences between the impact of simulation and other educational methods and some did not. One reason was different methods in measuring produced varied results. They also found that maybe researchers are not asking the right questions or looking at things in the wrong way.	can be made and learned from, and patient safety is not jeopardized. The team agreed that simulation has benefits, but each study looked at benefits slightly differently. In other words, each study analyzed and presented the data differently so it was hard to draw conclusions based on the data.

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		The inclusion and exclusion criteria in this study help to minimize threats to validity because they include only experimental studies 16 articles used for review with 3 RCTS, & pre-and post/test experiments (quasi-experiments) and 6 other studies using single intervention (not considered as robust). Because of the array of types of studies included in the review, the study lacked uniformity which lowers he quality rating to good (B)		

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		Sample sizes tended to be small <100 in most studies. Sample size is compensated by richness of the data and use of mixed methods approach		
Lawlis et al. (2014) Barriers and enablers that influence sustainable interprofessional education: a literature review **Level III - B** Systematic review of literature between 2010-2012	Systematic Review if the literature Searches conducted across 8 Databases: Medline, Medline-In Process, *CINAHL, PyschINFO, Embase, Cochrane Library, Social Work Abstracts, and ProQuest Sociological Abstracts* between 4/2010-12/2012 using 21 search terms revealed 1570 articles which was	When the ROL was conducted, the systematic ROL was not the intent; thus, some elements/details may have been missed or overlooked The inclusion and exclusions criteria were set initially and articles were analyzed for barriers and enablers. The author did not identify the types of research included in the 40 articles (as a review	Concluded there are five key "fundamental elements" across the three stakeholders (Government funding, Institutional (HEI funding and support for the programs), and individual (communication and shared visions)	Concluded there are five key "fundamental elements" across the three stakeholders (Government funding, Institutional (HEI funding and support for the programs), and individual (communication and shared visions)). For programs to be successful in implementing and sustaining IPE, they

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
	refined to 40 articles for analysis. Additionally, 10 key international and Australian IPE organizational websites were searched	of the literature was not the initial intent). Therefore, validity may be compromised; therefore, the quality rating is only good (B)		must have more of the key elements
Miller et al. (2014) Improving emergency preparedness system readiness through simulation an interprofessional education **Level III – B** Non-experimental Longitudinal Cohort study 312 students (9 cohorts) between Oct 2009 – Feb 2012)	Collected both quantitative and qualitative data about individual and team knowledge, skills and attitudes. Measured immediately after simulation and at 6 -12 months later 312 students enrolled in 9 workshops during a 24-month period indicated the curriculum to be effective Multiple strategies (multiple-choice questions, performance	Validity: Flexibility required for the intervention created inconsistency in the intervention Participants were recruited in multiple ways, participant numbers varied from 26-55, and student representation changed with each workshop. Non-randomization poses threat to internal validity through bias. Also, possible maturation of students	On knowledge items alone students demonstrated 31.9% improvement over pretest scores. When measured post intervention there was decay in scores (with the biggest decay in students with the longest lag time between measurements). No student returned to pre-intervention scores though. With repeated simulations (4th time	312 students enrolled in 9 workshops during a 24-month period indicated the curriculum to be effective and efficient in improving skills. D101 (course studied) can address several needs in emergency preparedness training – and using simulation can address all four ION research priorities meeting PHEP and IPEC competencies.

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
	checklists, and pre-and post-surveys) were used to assess knowledge, skill, attitudinal, and behavior outcomes throughout the training and at 6 and 12 months after completion. Each student was trained for a limit of 10 hours (2 introductory online training and 8 hours of face to face workshops and simulation.	with repeated simulations (4th time around, different scenario, scores improved due to repetition in anchoring behaviors) Wide range of performances created large CI which calls into question the precision (not accuracy) of particular measurements This created challenges for comparability across cohorts. Each group of student was interprofessional with at least 3 professions represented. Reliability: Trained content experts rated the participants using tools that had been field	around, different scenario, scores improved due to repetition in anchoring behaviors). In all 79% indicated improved confidence in the following areas: Crisis communication (91.7%); situational awareness (85.7%); safe practice (85.2%); triage (85.2%); and crisis leadership (79.2%).	

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		tested in a pilot workshop		
Bolesta and Chmil (2014) Interprofessional education among student health professionals using human patient simulation **Level III - B** Non-experimental Pre-and post-pilot cohort study 55 students analyzed (started with 121 but due to attrition and failure to complete all surveys only 55 were used)	Pre-and post-study with 55 students (Junior nursing students and 3rd year pharmacy students) analyzed (started with 121 but due to attrition and failure to complete all surveys only 55 were used) CSL was used using simulation with students working in groups of 2-3 students from both disciplines working together to gather needed data to diagnose and treat the patient in a 20-minute time frame	Validity: Unable to directly assess IPE experience on student learning which would be a key factor in determining future use of IPE in curricular No prep was given to students so help decrease potential bias Low participation of nursing students so extrapolation of the data to them is limited (48 pharmacy and 7 nursing students) and limits validity. Reliability: RIPLS (19-point item instrument using a 5 point Likert scale) is a proven and reliable tool	Scores from the RIPLS (19-point item instrument using a 5 point Likert scale) instrument and additional survey instrument items showed students gained an appreciation for IPE and that communication improved because of the IPE	In summary student felt more positive about the other professional and felt they became better team members as they understood one another's roles better after simulation.

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
Booth and McMullen – Fix (2012) Collaboration interprofessional simulation in a baccalaureate nursing education program **Level III - B** Non-experimental Case study/cohort (nursing and medical students) of the nursing school experience to implement IPE	Students in pairs (2 nursing students) rounded on students and the scenario required the students to call the physician (medical students). Each scenario lasted 30 minutes and students were evaluated on the SDS (20- item evaluation tool using a 5-point scale)	Validity: Not random assignment, students chose their preferred group and time, which increases threat to validity. Reliability: Evaluation tool selected was NLN Simulation Design Scale – which has proven reliability and validity… however in-depth statistical analysis was not performed.	91 % of the students reported objectives to be understood. 98% said it was realistic and 96% said they could problem solve better.	Overall, faculty found this teaching strategy (IPE simulation) enhanced student awareness of maintaining patient safety, and improved problem solving of when to notify physician. Also, communication was improved within IPE teams.
Neville et al. (2013) Team decision making: design, implementation, and evaluation of an interprofessional education activity for undergraduate health science students	Cross-sectional study between April –October 2011 of 94 enrolled with a final sample (n=61) students using pre-and post-survey (64.8% completion)	Validity: There was a 70% completion rate of the post survey. Some students were unable to complete all parts due to scheduling issues Dropout rates limit validity and non-	RIPLS – results were significant ($p<.001$) Showed a positive perception of their own role and the role of the team members in all except for 2 items IEPS – results showed students had	Overall students demonstrated positive attitudes towards IPE which allows students to work in teams providing better patient outcomes. The experience demonstrated the

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
Level III – B Non-experimental Cross-sectional cohort study 94 Students (nursing, medicine, and midwifery)		randomization limits validity as well Reliability: All evaluation tools are proven tools in the industry and are peer reviewed and tests for validity and reliability.	professionally oriented perceptions related to the affective domain GRPQ and NRPQ (generic and nurse role perception questionnaire) – showed a positive role perception of their own role and that of the other professions. Some fluctuations were seen for each profession All evaluation tools are proven tools in the industry and are peer reviewed and tests for validity and reliability.	importance of being able to communicate and practice as a team.
Haizlip and Neumayr (2016) Room of Errors **Level III - B** **Non-experimental** **Case study**	Case Study with a simulated ICU "Room of Errors" where participants were asked to work alone and then compare findings with	Validity: Post ad hoc analysis with professional opinion only Threats to validity and reliability as non-	Found students alone could identify errors, but when they came together as a group, almost twice as many	IPE and teamwork can enhance patient safety when others speak up and collaborate

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
Students from nursing, pharmacy, medicine, and therapy services	group to see how many errors were identified Completed pre-and post-questionnaire regarding roles and empowerment	randomization poses threat to internal validity through bias.	errors were identified collectively Each individual identifies about 30 problems, but collectively they spot 54 issues that could put their patient at risk.	
Baker et al. (2008) Simulation in interprofessional education for patient-centered collaborative care **Level III- B** Non-experimental action research pilot study using mixed methods both qualitative and quantitative methods Students (nursing, medicine, and residents)	Action research pilot study with post pilot survey of students after having IPE and simulation-based learning activities was conducted in 2005-2007 using a questionnaire based on the interdisciplinary education perception scale. Mixed methods were used.	Validity: Voluntary participants, non-randomization poses threat to internal validity through bias. Reliability: The IEPS scale has proven/published reliability and validity Factor analysis reveals accurate measurement with a Cronbach alpha for reliability of 0.87 Descriptive statistics were used to analyze the Likert-type rating scale	Found simulation provided IPE experiences that students felt relevant for their future Attitudinal scores were positive. 86.3% (medical students) and 90.3% (nursing) students agreed it was beneficial to participate in the IPE sessions as it increased their perception of the others role	IPE with simulation is a promising approach to preparing students for collaborative healthcare delivery which in turn is bridging gaps across silos of care.

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
	1st Pilot between 2005-2006 and 2nd Pilot between 2006-2007	and thematic analysis was carried out		
Balogun et al. (2014) Innovative interprofessional geriatric education for medical and nursing students: focus on transitions in care **Level III - B** Single descriptive qualitative case study UVA 254 students (medical and nursing)	254 students were enrolled in 90-minute interactive case-based workshops with simulation over a year Post workshop survey data was analyzed using descriptive and nonparametric testing	Validity: large sample size, Not a comparison Descriptive and nonparametric statistics only to determine validity Reliability: Qualitative in nature allows for multiple interpretations of reality	90% of students were able to describe necessary communication for working in IPE teams. Four of five students' reports enhanced appreciation for working in teams. 75% were able to identify legal, financial, and social implications in transition of care Nursing rated the workshop more valuable than medical students	Students improved communication/collaboration and teamwork when exposed to IPE
Shoemaker et al. (2014) Virtual patient care: an interprofessional education approach	Each of the 24 groups were asked to submit a written submission of reflective questions to a	Validity: Retrospective analysis of an assignment not designed or intended for research purposes.	Student responses to reflective questions revealed three themes: Benefits to collaborative care; role clarification;	Three themes revealed: Benefits to collaborative care; role clarification; and increased comfort and

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
for physician assistant, physical therapy and occupational therapy students **Level III - B** Non-experimental Retrospective qualitative case report 100 students (physician assistant, OT and PT students)	virtual patient base- IPE experience	Non-randomization poses threat to internal validity through bias, and case report of a single student cohort at a single institution so maybe difficult to generalize findings. Subject to investigator bias; although the same themes were independently derived from 2 authors	and increased comfort and confidence in care after simulation	confidence in care after simulation. Programs should offer other case-based IPE activities into their curriculum as well
Robins et al. (2008) Piloting team simulations to assess interprofessional skills **Level III - C** Non-experimental Pilot cohort study using 15 students (nursing, pharmacy, and medical students)	Pilot tested 2 standardized IP team simulations	Validity: Small sample size, Students volunteered, so non-randomization poses threat to internal validity through bias. Evaluation instrument was drafted from the literature Interventions were deliver by 2 sets of	Student's performance such as advocating for their position, addressing blaming behavior, speaking up against authority and taking responsibility were highly variable. This may indicate students need more practice in these areas.	Team based simulation appears promising as a means of program evaluation and provides a platform where students can practice and receive feedback about their interprofessional teamwork skills

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
		players (faculty and actors, but used standardized scripts to follow Reliability: No actual data was given for the tool used and faculty scored the evaluation instrument at the time of simulation and during video review which threatens reliability	Students did report increase in ability to communicate effectively within teams.	
Marken et al. (2010) Human simulators and standardized patients to teach difficult conversations to interprofessional healthcare teams **Level III - C** Non-experimental Pilot Demonstration study with mixed methods approach	Demonstration study held over 2 evening (4 hour sessions each) held 3 weeks apart in September and October 2008 in a university CSL Pre/post qualitative questionnaire using those 12 students performed in interdisciplinary teams	Validity: Small sample, volunteer, and were awarded gift card or clinical hours for participation Non-randomization poses threat to internal validity through bias. Reliability: Conscious Competency model was selected from the literature to show if	Students gained confidence in dealing with difficult patients. Each student was asked to write 3 statements that they believe about difficult conversations at the end of the 2nd session. 75% could do this correctly. A faculty member compared the accuracy of the	Simulation is an effective technique to teach interprofessional teams on how to engage in difficult conversations with patients and families. Results were positive and students demonstrated both knowledge and skill enhancement using the

Brief Reference, Type of study, Quality rating	Methods	Threats to validity/ reliability	Findings	Conclusions
12 volunteers (pharmacy, nursing, medical students)	using simulation of difficult conversations	students gained awareness. Assessment tools that were used proved reliable and valid in literature The rubric that was used for the debriefing was not reported in this study as it had not been validated and interrater reliability was not completed before this session. Content experts were utilized to design the content and simulations	statements to content delivered. Rubrics for simulation performance session and student satisfaction were also completed For all items the student moved at least one stage higher in the matrix and significant changes were noted in only questions 1-5 and 9 based on Wilcoxon signed rank test	assessment tool and they were satisfied with the program

Note: Evidence ratings (Level I-VI) for the literature are based on Dearholt & Dang (2012) book, *John Hopkins Nursing Evidence-Based Practice: Model and Guidelines*

APPENDIX B – LEVELS AND QUALITY OF EVIDENCE

Evidence Levels	Quality Guides
Level I Experimental study, randomized control trial (RCT), Systematic review if RCTs with or without meta-analysis	**A – High Quality:** Material officially sponsored by a professional, public, private organization, or government agency; documentation of a systematic review of literature search strategy; consistent results with sufficient number of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies and definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years **B – Good Quality:** Material officially sponsored by a professional, public, private organization, or government agency; reasonably thorough and appropriate systematic literature search strategy; reasonably consistent results with sufficient number of well-designed studies; evaluation of strengths and limitations of included studies with fairly definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years **C – Low Quality:** Material not sponsored by an official organization or agency; undefined, poorly defined, or limited literature search strategy; no
Level II Quasi-experimental study, Systematic review if a combination of RCTs and quasi-experimental, or quasi-experimental studies only, with or without meta-analysis	
Level III Non-experimental study Systematic review if a combination of RCTs, quasi-experimental and non-experimental study only, with or without meta-analysis Qualitative study or systematic review with or without meta-synthesis	
Level IV	

Evidence Levels	Quality Guides
Opinion of respected authorities and/or nationally recognized expert committee's/consensus panels based on scientific evidence Includes: • Clinical practice guidelines • Consensus panels	evaluation of strengths and limitations of included studies; insufficient evidence with inconsistent results, conclusions cannot be drawn, not revised within the last 5 years

Note: Evidence ratings (Level I-IV) and quality ratings (A-C) for the literature are based on Dearholt & Dang (2012) book, *John Hopkins Nursing Evidence-Based Practice: Model and Guidelines.*

APPENDIX C – SPICE-R2 INSTRUMENT

Dear Student: In this survey you are being asked about your attitudes toward interprofessional teams and the team approach to care. By ***interprofessional team***, we mean two or more health professionals (e.g., nurse, occupational therapist, pharmacist, physical therapist, physician, social worker, veterinarian, etc.) who work together to plan, coordinate, and/or deliver care to patients/clients.

PLEASE NOTE: The following scale progresses from "Strongly Disagree (1)" to "Strongly Agree (5)"

INSTRUCTIONS: **Please be candid as you indicate the extent of your disagreement/agreement with each of the following statements related to interprofessional teams and the team approach to care.**		***Strongly Disagree (1)***	***Disagree (2)***	***Neutral (3)***	***Agree (4)***	***Strongly Agree (5)***
1.	Working with students from different disciplines enhances my education	1	2	3	4	5
2.	My role within an interprofessional team is clearly defined	1	2	3	4	5
3.	Patient/client satisfaction is improved when care is delivered by an interprofessional team	1	2	3	4	5
4.	Participating in educational experiences with students from different disciplines enhances my ability to work on an interprofessional team	1	2	3	4	5
5.	I have an understanding of the courses taken by, and training requirements of, other health professionals	1	2	3	4	5
6.	Healthcare costs are reduced when patients/clients are treated by an interprofessional team	1	2	3	4	5

7.	Health professional students from different disciplines should be educated to establish collaborative relationships with one another	1	2	3	4	5
8.	I understand the roles of other health professionals within an interprofessional team	1	2	3	4	5
9.	Patient/client-centeredness increases when care is delivered by an interprofessional team	1	2	3	4	5
10.	During their education, health professional students should be involved in teamwork with students from different disciplines in order to understand their respective roles	1	2	3	4	5

APPENDIX D – SIMULATION DESIGN SCALE (STUDENT VERSION)

In order to measure if the best simulation design elements were implemented in your simulation, please complete the survey below as you perceive it. There is no right or wrong answers, only your perceived amount of agreement or disagreement. Please use the following code to answer the questions.

Use the following rating system when assessing the simulation design elements: 1- Strongly disagree with the statement 2- Disagree with the statement 3- Undecided – you neither agree or disagree with the statement 4- Agree with the statement 5- Strongly agree with the statement NA – Not applicable; the statement does not pertain to the simulation activity performed	Rate each item based upon how important that item is **to you** 1- Not important 2- Somewhat Important 3- Neutral 4- Important 5- Very Important

Item	1	2	3	4	5	NA	1	2	3	4	5
Objectives and Information											
1. There was enough information provided at the beginning of the simulation to provide direction and encouragement.											
2. I clearly understood the purpose and objectives of the simulation.											
3. The simulation provided enough information in a clear matter for me to problem-solve the situation.											
4. There was enough information provided to me during the simulation.											
5. The cues were appropriate and geared to promote my understanding.											
Support											
6. Support was offered in a timely manner.											
7. My need for help was recognized.											

8. I felt supported by the faculty's assistance during the simulation.											
9. I was supported in the learning process.											
Problem Solving											
10. Independent problem-solving was facilitated.											
11. I was encouraged to explore all possibilities of the simulation.											
12. The simulation was designed for my specific level of knowledge and skills.											
13. The simulation allowed me the opportunity to prioritize assessments and care											
14. The simulation provided me an opportunity to goal set for my patient.											
Feedback/Guided Reflection											
15. Feedback provided was constructive.											
16. Feedback was provided in a timely manner.											
17. The simulation allowed me to analyze my own behavior and actions.											
18. There was an opportunity after the simulation to obtain guidance/feedback from the faculty in order to build knowledge to another level.											
Fidelity (Realism)											
19. The scenario resembled a real-life situation.											
20. Real life factors, situations, and variables were built into the simulation scenario											

National League for Nursing (2005)

APPENDIX E -DISSEMINATION

This project is in the process of being disseminated for publication to an interprofessional journal, and an abstract of the presentation has been submitted to two professional meetings for podium presentation. One abstract has been approved and one is under review currently.

Article Submission – submitted

An article entitled "Simulation-based Interprofessional Education in a Rural Setting" has been submitted for review to *The Journal of Interprofessional Care* for review.

Scott, A. D., Estrada, R. D., Catledge, C. B., & Mitchell, S. (2017). Simulation-based interprofessional education in a rural setting. Submitted to *The Journal of Interprofessional Care.*

Abstract submission – under review

An abstract titled, Simulation-Based IPE in a Rural Setting Using Remote-in Technology has been submitted in the innovation project category to the 18th International Meeting on Simulation in Healthcare (IMSH 2018) conference to be held January 13-17, 2018 in Los Angeles, California.

Scott, A. D., Estrada, R. D., (2017). Simulation-based interprofessional education in a rural setting. Submitted to the 18th International Meeting on Simulation in Healthcare (IMSH 2018) conference to be held January 13-17, 2018 in Los Angeles, California. Podium presentation

Abstract submission – accepted

An abstract titled, Simulation-Based IPE in a Rural Setting Using Remote-in Technology has been accepted to the University of South Carolina Lancaster Faculty Colloquium Series to be presented in September 27, 2018 in Lancaster, South Carolina.

Scott, A. D., Estrada, R. D., (2017). Simulation-based interprofessional education in a

rural setting. Submitted to the University of South Carolina Lancaster Faculty Colloquium Series to be presented in September 27, 2018 in Lancaster, South Carolina. Podium presentation.

Simulation-Based IPE in a Rural Setting Using Remote-in Technology

Abstract

Project Objective

Healthcare students benefit from inter-disciplinary learning opportunities, including the practice of communication and collaborative strategies essential for real-world patient care.[1] Faculty are increasingly using simulation-based inter-professional education (IPE) experiences to enhance inter-disciplinary practice. As students of rurally-located educational programs have specific barriers to IPE participation, an innovative solution may be the use of telehealth tools.[2] Telehealth is remote healthcare provision to patients at distant sites using technology-based tools.[3] A simulation-based IPE experience using these tools not only provides students the opportunity to work with the technology, but addresses issues inherent in providing IPE experiences to rurally-located students. The purpose of this project was to examine the feasibility and acceptability of a simulation-based IPE experience for pre-licensure nursing, pharmacy, and medical students on a rurally-located campus.

Methods

Using a mixed-methods, explanatory sequential approach,[4] this project: 1) examined the feasibility of implementing a simulation-based IPE experience using telehealth tools; and 2) evaluated student perceptions of inter-professional teamwork, roles and responsibilities, and patient outcomes for collaborative practice, both pre- and post-scenario. Twenty-nine participants included fourth year nursing (n=16), third year medical (n=8), and fourth year pharmacy (n=5) students. The students first completed a questionnaire regarding knowledge of and attitudes toward IPE, and were then randomly assigned to one of five IPE groups consisting of 5-7 students. Each group completed an advanced cardiac simulation scenario in which the nursing and pharmacy students were in the simulation lab, and the medical students “remoted in” using a telehealth robot. The scenario concluded with a video-recorded debriefing session; subsequently, the students completed post-surveys.

Results

Quantitative data were analyzed using SPSS. Results revealed 94% agreed/strongly agreed the IPE experience resembled a real-life situation. 100% of nursing/medical students and 80% of the pharmacy students indicated they would recommend this experience to their peers. Significant positive changes in attitudes towards using an inter-professional team approach were noted for pharmacy students, especially in regards to patient outcomes, reduced costs, and improved patient-centered care.
Qualitative data were transcribed and analyzed using thematic analysis. Four themes emerged: 1) better understanding of technology; 2) improved communication among team members; 3) benefit of true to life experience; and 4) increased knowledge level and confidence. Participant suggestions for improvement included: 1) improve the simulation/telehealth equipment orientation; 2) consider a grand round-type simulation; and 3) address technical challenges with the robot, e.g., volume control.

Conclusion

Complex healthcare now requires a collaborative and team approach to patient care. A simulation-based IPE approach using “remote in” technology allows for the development and mastery of these competencies. Although limited by a small sample size, this project confirmed it is feasible and acceptable to offer simulation-based IPE in a rural setting facilitated by the use of telehealth tools, and collaborative teamwork is enhanced by using “remote in” technology during a simulation-based IPE activity. Future work will incorporate student suggestions to improve the experience, as well as integrate students from other healthcare disciplines, such as physician assistant students.

REFERENCES

1. Smithburger, P. L., Kane-Gill, S. L., Kloet, M. A., Lohr, B., & Seybert, A. L. (2013). Advancing interprofessional education through the use of high fidelity human patient simulators. *Pharmacy Practice, 11*(2), 61-65. Retrieved from http://eds.a.ebscohost.com.pallas2.tcl.sc.edu/ehost/pdfviewer/pdfviewer?sid=dcf58deb-5d28-4040-a94c-f5816ecbec0e%40sessionmgr4005&vid=3&hid=4211
2. Whelan, J. J., Spencer, J. F., & Dalton, L. (2008). Building rural healthcare teams through interprofessional simulation-based education. [paper] 10th National Rural Health Conference]. Retrieved from https://www.ruralhealth.org.au/10thNRHC/10thnrhc.ruralhealth.org.au/papers/docs/Spencer_Judy_C4.pdf
3. Center for Connected Health Policy. (2017). *What is telehealth*. Retrieved from http://www.cchpca.org/what-is-telehealth
4. Fetters, M. D., Curry, L., A., & Creswell, J. W. (2013, December). Achieving integration in mixed methods designs- Principles and practices. *Health Services Research*, 48(6Pt2), 2134-2156. Doi:10.1111/1475-6673.12117