# INTERPROFESSIONAL TEAM TRAINING USING SIMULATION:

# A COMPARISON OF TWO DIFFERENT TIME DELIVERIES

A Dissertation

Presented to

The Graduate Faculty of The University of Akron

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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December 2016

INTERPROFESSIONAL TEAM TRAINING USING SIMULATION:

A COMPARISON OF TWO DIFFERENT TIME DELIVERIES

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Dissertation

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ABSTRACT

Teamwork and collaboration among healthcare professionals has been identified by the Institute of Medicine and Agency for Healthcare Research and Quality as a national priority that can be used to improve quality and safety in healthcare (AHRQ, 2000, IOM, 1999). Care that is delivered in collaborative teams has been associated with better patient outcomes including decreased medical error (Morey, et al., 2002), and decreased adverse patient outcomes (Mann, et al., 2006). Educating the next generation of health care providers to function in collaborative teams is an important step in achieving the goal of lower medical error for patients in all settings. Team skills are not inherent but must be learned, and well-designed interprofessional team training can provide an effective way to educate healthcare students for the ultimate goal of providing patient-centered care as part of interprofessional collaborative practice (IPCP).

Best practices in team training have not been determined in the research, therefore this study was designed to explore the effect of different interprofessional education (IPE) models for development of learners' teamwork attitudes and skills that are part of overall teamwork competency. Two team training models with different time deliveries were provided to nineteen interprofessional teams made up of undergraduate nursing, medicine, and respiratory therapy students, culminating in an interprofessional cardiac arrest simulation. One model was delivered over one immersive session of four hours, the other was delivered over several weeks in small increments. Results of team attitude and teamwork skills revealed some differences related to training models. Using a liberal level of significance of $p < .10$ to account for small sample size, immersive one-day training was associated with higher team skills when compared to extended time delivery ($p = .077$, $d = .09$). Team attitude was equally positively affected by both models of team training from pre- to post-simulation measures ($p = .001$) with a moderate effect size (partial $\eta^2 = .40$). Multiple regression analysis to determine prediction of teamwork skills revealed pre-simulation variables of team anxiety, and team feelings of preparation were statistically significant ($p = 0.092$), but pre-simulation attitude was not a significant predictor of team skills. A multiple regression to determine teamwork attitude predictors revealed pre-existing teamwork attitude to be the strongest relationship ($p < .001$). Results can be used by healthcare educators to inform their decisions for use of time and other resources for designing and implementing education for the purpose of increasing teamwork skills and attitudes.

# DEDICATION

I would like to dedicate this dissertation to my God and my family who have supported me without exception as I traveled along this doctoral degree journey.  To my husband who never puts anyone ahead of himself, and who I never could have made it to the end without his love, help, and emotional support.  To my children who put up with my endless hours of work, and were always there to make me smile when I needed it most. And to my parents who always thought I could do anything I wanted to do.  Thank you for supporting and encouraging me to believe in myself.  I am the person I have become because of your example of loving without condition, hard work, dedication, and perseverance.  Lastly, I give glory to God for putting for the many gifts He has given me to get to this point.

ACKNOWLEDGEMENTS

I would like to acknowledge the help I received from my dedicated committee members for their ongoing guidance and support over the years. I offer my deepest gratitude to Dr. Susan N. Kushner Benson who gave unwavering support and mentorship as I learned how to become a researcher. I would also like to thank the wonderful role models who offered collegial guidance and support over the years and who encouraged me to pursue my doctoral degree: Dr. Kathy Ross-Alaolmolki, Dr. Elaine Fisher, Mrs. Cheryl Buchanan, and Mrs. Martha Conrad. You believed in me before I believed in me. Thank you!

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# CHAPTER I

# INTRODUCTION

The Institute of Medicine (IOM) published *To Err is Human* over a decade ago which revealed the astounding numbers of medical errors that occur in American hospitals, and identified the need for better communication, teamwork, and collaboration among healthcare workers as key strategies for decreasing errors (Kohn, Corrigan, & Donaldson, 2000). This landmark document led licensing and accrediting bodies in healthcare education (National League for Nursing, National Council of State Boards of Nursing, Accreditation Council of Graduate Medical Education) and healthcare facilities (The Joint Commission) to identify teamwork and collaboration as a national priority that can be used to improve quality and safety in healthcare (Agency for Healthcare Research and Quality, 2000). Care that is delivered in collaborative teams has been associated with better patient outcomes; studies have shown that team training can decrease medical error (Morey et al., 2002), decrease ICU length of stay (Pronovost, Berenholtz, & Dorman, 2003), decrease complications (Sexton, 2006) and decrease adverse patient outcomes (Mann et al., 2006). Educating the next generation of health care providers to function in collaborative teams is an important step in achieving the goal of lower medical error for patients in all settings.

## Interprofessional Education for Team Training

Interprofessional education (IPE) is where two or more professions come together to learn from, about, and with one another (World Health Organization, 2010). Healthcare education that "occurs in silos," that which does not cross professional lines, is being called out by leaders in healthcare and education as a practice that needs to be changed, sparking an increase in IPE curriculum design and research (Institute of Medicine, 2010). Well-designed IPE, following best practices derived from education research and scholarship, can provide an effective way to train groups of healthcare students where overlapping learning objectives exist, such as with teamwork, communication, or values and ethics to name a few. The ultimate goal of IPE is to develop individuals who can work collaboratively together for the purpose of providing patient-centered care; this is called interprofessional collaborative practice (IPCP), the gold standard of high quality healthcare.

Preparing the next generation of healthcare students for interprofessional collaborative practice should be part of every academic program in all health disciplines (Interprofessional Education Collaborative Expert Panel., 2011). Team training is a fundamental way to teach students the concepts and practices of teamwork that can lead to the achievement of IPCP; team skills are not inherent but must be learned (TeamSTEPPS National Implementation Plan, 2014). Team training through IPE can cultivate knowledge, skills and attitudes (KSAs) that make up team competencies, and also serve to teach students about the different roles and responsibilities of each discipline, another gap in healthcare education, and an integral part of IPCP (Interprofessional Education Collaborative Expert Panel, 2011; TeamSTEPPS National

Implementation Plan, 2014). When team training incorporates the various disciplines of students that will be expected to collaborate in future practice, the experience becomes more meaningful as a realistic application. Team training with IPE that uses the active learning of simulation, adds additional realism that can help learners to recognize the transferability of education into practice (TeamSTEPPS National Implementation Plan, 2014).

**Barriers for Implementing Interprofessional Education**

Even though educators may recognize the value and benefit of interprofessional education, it can be very difficult to create opportunities in an already crowded and established curriculum. To make such a change takes buy-in from faculty and administrators, and faculty champions to act as transformational leaders who display commitment, persistence, and creativity. There are a number of barriers that must be overcome to introduce, and then integrate IPE into health profession curriculum, and Reeves, Palaganas and Zierler (2015) summarized these in a review of literature, citing logistics as the most common along with others in the following sections.

**Logistical barrier of IPE.** Logistical issues in interprofessional education can be related to large numbers of students, competing schedules of coursework, different timing of didactic content and learning objectives, and varying levels of expertise among undergraduate and graduate programs. Another layer of complexity arises from the division of coursework into classroom, lab, and clinical practice components spanning different days of the week. Additionally, rules associated with state boards of nursing may prevent programs from simply exchanging clinical hours with simulated learning experiences (Ohio Board of Nursing, 2015).

The logistics of implementing interprofessional education can be very complex, but a starting point that precludes IPE, is identifying shared learning objectives among students from different professions. Once an opportunity for shared learning is identified, the next issues become seeking collaboration among faculty from respective programs, and determining effective pedagogical strategies to implement a learning program to meet the learning objectives. If simulation is part of the plan, finding a compatible block of time becomes the next major hurdle, leading to arrangements for accommodating the number of students with available resources. In my experience planning and implementing IPE, organized logistics makes for higher student satisfaction and learning.

**Cost barrier of IPE.** Overcoming logistical issues is not the only obstacle for implementing IPE, but cost, availability of appropriate equipment and facilities, design and approval of formal academic courses, and educator and/or administrator buy-in are all additional factors (Reeves, Palaganas, & Zierler, 2015). The issue of cost can be a significant barrier with one event potentially priced at thousands of dollars when high-fidelity simulation is used. Although simulation centers are becoming more common in schools of nursing and medicine, the increased number of students in an IPE simulation event may require larger and/or costly facilities. Securing funds for these facilities has become more difficult to obtain in current times of decreased state and federal dollars directed to academic institutions. Evidence of effective IPE strategies, ground in quality research, is imperative for securing ongoing financial support from administrators and grant funding.

One way of overcoming the barrier of cost is to use evidence from previously implemented IPE as a source of data collection to evaluate effectiveness. This can be accomplished by utilizing video-recorded simulations that were conducted with interprofessional participants. This type of research is considered ex post facto, and is the basis for the research conducted in this dissertation study.

### Ex Post Facto Research Using Interprofessional Simulation Recordings

Because of the significant logistical effort and financial cost accompanying the implementation of simulation-based IPE, the opportunity to evaluate outcomes through data collection during these events should not be missed. It is for this reason that I chose to access archived video-recorded IPE simulations as a rich source of evidence of student learning outcomes that had remained an untapped resource of data. These recordings provided valuable information regarding student learning, and was a practical, cost-effective way to conduct quality research. A description of the study is provided in the following section.

## Ex Post Facto Study: A Comparison of Team Training Methods

For this dissertation research, I accessed previously video-recorded, archived simulations obtained during three interprofessional education events. The IPE was designed by me with a team of other educators, in a separate IRB-approved research study that spanned the 2014-2015 academic year. We implemented two different team-training education designs, followed by interprofessional simulations. One training method was carried out in one day (immersive), and one that was distributed over several weeks (time-distributed). Learning objectives at that time were focused on teamwork attitude competencies for students from my own critical care nursing course, joined by students from medicine, and respiratory therapy. Demographic survey data were collected at the time of the events, as well as teamwork attitude surveys collected before and after the simulations. The video-recorded simulations were not used in any research prior to this dissertation, and was the focus of this study in combination with demographic and team attitude survey data. This design allowed inclusion of knowledge, skills and attitudes assessment which captures the complexity of teamwork competency more fully. The video simulations allowed an evaluation of observable behaviors representing teamwork skills, while knowledge and attitude levels were assessed by self-reported survey items. Previous studies have looked at outcomes of either teamwork attitude or teamwork skills, but a gap exists for studies that evaluate all components of team competency. Also missing in the literature is a comparison of different time-deliveries of team-training methods which this study can provide evidence.

## Individual Factors that Can Influence Team Competency

The achievement of team competency, knowledge, skills and attitudes of teamwork, can be influenced by various individual factors including feelings of preparation (confidence in pre-requisite knowledge) and anxiety. These factors were considered in this study to determine the extent of the impact on the learning outcomes of teamwork attitude and skills. These variables were chosen based on a review of the literature, and because there is opportunity to influence these pre-simulation states by the educator (as opposed to gender or age), should either be determined a predictive factor in team attitude or skill. A brief explanation of these variables will be discussed here, and further explored in Chapter II.

**Teamwork and feelings of preparation.** Competency is multi-faceted, and consists of knowledge, skills and attitudes (Decker, Utterback, Thomas, Mitchell, &

Sportsman, 2011; Interprofessional Education Collaborative Expert Panel, 2011). Educators agree that knowledge acquisition precedes the higher level of knowledge application demonstrated as a skill (Anderson, Krathwohl, & Bloom, 2001). Researchers and educators often measure knowledge as a separate entity through objective testing, but self-report of knowledge is another research alternative. A learner's self-report of "feelings of preparation" as was chosen for this study, captures more than rote knowledge because it includes nuances of one's trust or confidence in the knowledge. A learner may possess knowledge, but may not "feel prepared" for an experience that requires application of the knowledge, such as a team skill demonstration. Conversely, a learner may "feel prepared" but have a low level of actual knowledge. I chose to assess feelings of preparation of the learners in the initial data collection to capture these additional nuances. I have used the student's self-report of feelings of preparation as a component of teamwork competency, along with reported attitudes and observed skills.

**Teamwork and anxiety.** Anxiety can be a barrier to education, acting as a distraction that limits attention to new or higher learning. A certain level of anxiety may act as a positive influence, raising the attention level of the individual, and indicate that the learner is invested in the experience, but too much anxiety is not conducive to learning. I chose to assess the participants' level of anxiety to evaluate the effect it has on achievement of teamwork skills and attitudes, the learning outcomes of team training.

## The Importance of this Study to Healthcare Educators

Early adopters have reported models of simulation-based interprofessional education that were designed as one-day events (immersive) and others that occurred over several weeks (time-distributed). Theoretical basis for time-distributed education design is supported by Benner (1984) in the Novice to Expert theory, and Kozlowski and Bell's (2003) Distributed Learning Design model, each of which describe the value of building knowledge and skills over time. Formal education is also built on the theory that repetition over time allows students to retain and build on new knowledge. From an interprofessional education perspective, students have criticized programs that they considered too short, implying support for longer or repeated designs (Hammick, Freeth, Koppel, Reeves, & Barr, 2007).

Logistical and other barriers can be greater with the time-distributed delivery related to scheduling issues and cost associated with multiple blocks of time. Some IPE involves creation of a formal academic course which brings another set of requirements and steps leading to approval. By contrast, planning for a one-day immersive design requires less logistical and cost issues for scheduling between educators, students, and facilities. By comparing student outcomes associated with these different models of IPE delivery, educators can make informed decisions regarding the use of such resources weighed against the projected benefits.

Understanding predictive variables that can influence teamwork attitude and skills is also valuable to healthcare educators. By identifying whether pre-simulation feelings of preparation, attitude, or anxiety have an impact on teamwork skills or teamwork attitude, educators can implement strategies to improve these pre-simulation states by augmenting students' attitudes, knowledge and confidence, and assuaging their anxiety leading up to simulation interprofessional education.

## Purpose of the Study and Research Questions

The purpose of this study was to determine if there is an optimal training method to prepare students for interprofessional simulation, between two methods delivered over different time periods, for developing team competencies consisting of teamwork attitude, skills, and knowledge. I compared the effects of two team-training models, one that occurred in a single day event (immersive team training), with one that spanned several weeks (time-distributed team training) on student learning outcomes of teamwork attitude and skills. In this study, I addressed three components of teamwork competency; teamwork attitude assessed with the TeamSTEPPS®-Teamwork Attitude Questionnaire (TAQ), teamwork skills assessed with the TeamSTEPPS® Team Performance Observation Tool (TPOT), and feeling of preparation and anxiety using a researcher-designed survey items. The TAQ and TPOT were designed to align with the TeamSTEPPS team-training curriculum that was the education framework used in this study, and were recommended for evaluating TeamSTEPPS team training (TeamSTEPPS Instructor Guide 2.0, 2014). Each of these tools and the curriculum are described in Chapter II. Teamwork knowledge and anxiety were assessed through a self-report by participants asked to rate their feelings of preparation, and level of anxiety related to interprofessional education prior to participation in interprofessional simulations.

Four research questions are the foundation of this study:

1. What is the optimal training method to prepare professionals to benefit from participation in an interprofessional simulation for performing teamwork skills?

2. Does teamwork attitude change following interprofessional team training and simulation while controlling for team training method?

3. Which predictor team variables, pre-training teamwork attitude, feelings of preparation, or level of anxiety are most predictive of simulation teamwork skills?

4. Which predictor team variables, pre-training teamwork attitude, feelings of preparation, or level of anxiety are most predictive of post-simulation teamwork attitude?

## Definition of Terms

The independent and dependent variables and other terms have been defined in theory and in operational terms as they were used in this study. The definitions provided here are to confirm the meaning of these terms as they apply to my research, and are listed in alphabetical order.

1. Debriefing: A reflective exercise that follows the active learning phase of a simulation often led by a facilitator.

2. Fidelity: Associated with the level of immersion in reality that can be created by the environment, the manikin, and the psychological atmosphere of the simulation experience. May also include the social context, and sense of psychological safety (Meakim et al., 2013).

3. High fidelity simulation: Highly realistic, may include interactive manikins, standardized patient actors, or virtual reality technology. High fidelity manikins are interactive and programmable to mimic human-like responses.

4. Immersive team training: Team training that is delivered in an intensive short-term timeframe that utilizes a variety of engaging teaching methods spanning several hours of one day. For this study, immersive team training will be operationally defined as team training consisting of didactic delivered as a 45-minute online recording, 2 hours

of face to face class with a combination of didactic lecture, small group discussion using problem-based case studies, culminating in a 2-hour of simulation experience.

5. Interprofessional collaborative practice (IPCP): When interprofessional health workers come together with patients, families, caregivers and communities to deliver high quality care (World Health Organization, 2010).

6. Interprofessional education (IPE): Where two or more disciplines come together to learn from, with, and about one another facilitate collaboration and achieve health goals (World Health Organization, 2010).

7. Simulation: An educational process where learning experiences are simulated to imitate the working environment (Jeffries, 2007).

8. TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety): Team training curriculum designed to educate health professionals to work in interprofessional teams to achieve health related patient, community or environmental goals.

9. Teamwork: The synergistic effect of a group working together with more success than individuals can achieve separately (Marks, Mathieu, & Zaccaro, 2001)

10. Teamwork attitude**:** Teamwork attitudes are affective feelings toward others on a particular team. Teamwork attitude will be operationally defined as attitude toward five subcomponents of teamwork: team structure, leadership, situation monitoring, mutual support and communication.

11. Teamwork competency skills: Competency consists of knowledge, skills, and clinical judgment in the context of a healthcare situation (NCSBN, 2005). Teamwork competency skills consist of the application of knowledge through actions that represent

team-based actions.  For this study, the operational definition of teamwork competency skills will be the collective observed teamwork behaviors of team members engaged in a clinically simulated experience.

12.  Time distributed team training: Team training that is delivered gradually in small increments over an extended timeframe.  For this study, the operational definition will be team training that is delivered over seven weeks consisting of three online modules of content delivery, each followed by a reflection exercise, or small online group discussions using problem-based case studies, culminating in a 2-hour simulation experience.

# CHAPTER II

## REVIEW OF THE LITERATURE

This chapter provides a summary of literature as it applies to the topics in this research study, specifically the development of interprofessional teamwork and collaborative practice competencies in healthcare professionals using simulation-based interprofessional education. There will be three major topics explored in this review: interprofessional education (IPE), the pedagogy of simulation, and teamwork and collaborative practice competency. In the first section, I discuss a model and the theoretical underpinnings that inform best practices in IPE, followed by individual core competencies that provide operational language to the components of IPE, and end with a review of IPE research. In the second section focused on the pedagogy of simulation, I explain the theoretical underpinnings of simulation, followed by discussion of a simulation model, and standards of simulation education design, ending with a review of simulation research. The third section focuses on teamwork and collaborative practice competency, beginning with a short summary of team theory that was used to develop team training programs, followed by a discussion of team training curriculum and sub-competencies, evaluation tools, and ending with a review of teamwork research. Along the way, I describe how this research study was guided by the evidence presented in this chapter, and how it can contribute meaningfully to the current body of evidence.

## Interprofessional Education

As described in Chapter I, definition of terms, interprofessional education has been defined by experts in healthcare and education around the world as "The process by which students or professionals from two or more different healthcare backgrounds learn about, from, and with each other to enable effective collaboration and improve health outcomes" (Interprofessional Education Collaborative Expert Panel., 2011, p. 2 ). To fully understand IPE it is necessary to break it down into the smaller components that make up the important variables as recognized in the literature. This section includes The Interprofessional Learning Continuum model (IPLC), followed by an overview of the Interprofessional Education Collaborative (IPEC) Core Competencies that are made up of individual knowledge, skill and attitude statements, and finish with a summary of IPE research.

### Interprofessional Learning Continuum (IPLC) model

The Interprofessional Learning Continuum model (Institute of Medicine, 2015) offers a global snapshot of designing effective IPE. This model depicts learning in interprofessional groups as increasing over time, allowing participants to begin with foundational education as students, progressing to continued professional development and practice. This model aligns with Benner's (1984) learning theory, From Novice to Expert often used in nursing education. This model parallels a time-distributed approach to interprofessional learning, one that occurs over time, progressing in complexity and based on prior experiences (Figure 1).

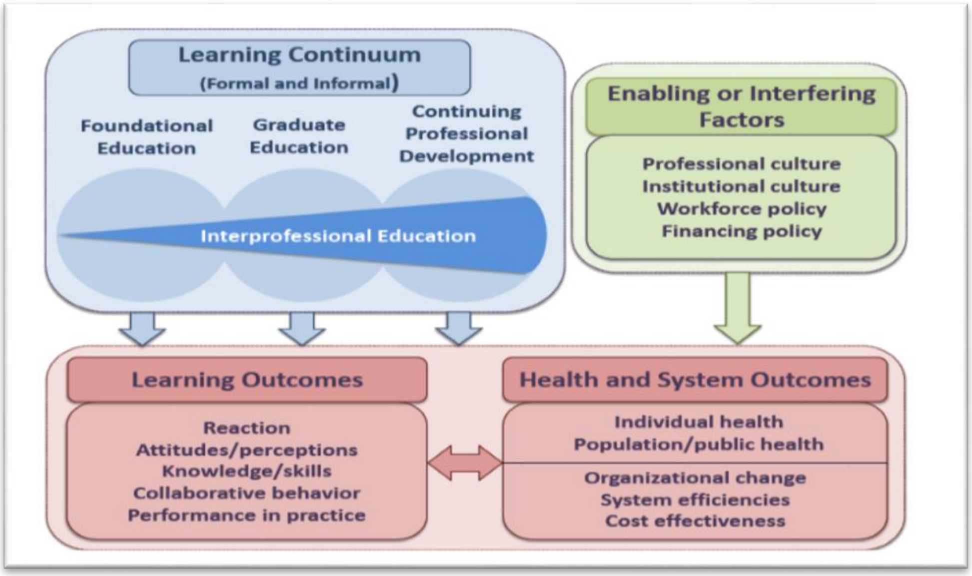


*Figure 1*: Interprofessional Learning Continuum (IPLC) model

A portion of the model recognizes the role of enabling or interfering factors for interprofessional learning that includes culture and policies. Professional culture relates directly to Allport's (1954) Social Identity theory that recognizes stereotype attitudes and perceptions of in-group and out-group barriers which can affect how different disciplines interact when brought together. Allport believes that over time, individuals become socialized into a group identity associated with their own profession, and a mental formation of an in-group occurs. Members of the in-group become less likely to accept those outside of their group known as the out-group (other professionals) (Allport, 1954). Healthcare teams have natural hierarchies in practice that typically place the physician in the position of authority.

Stereotype attitudes among healthcare team members, especially regarding perceived authority figures, are common and can influence attitudes toward teamwork in general if there are negative feelings toward the authority figure (Stewart, Kennedy, &

Cuene-Grandidier, 2010). When planning IPE, it is imperative to recognize the potential for negative professional culture attitudes and stereotyping that may impact outcomes, and to embed ways to minimize its effect. The other enabling or interfering factors are institutional culture, workforce policy, and financial policy that pertain more to the workplace setting rather than educational, and do not apply to this study.

Potential outcomes of interprofessional learning are represented in the model, and act as a guide for planning IPE to target participant measures of reaction, attitudes/perceptions, knowledge/skills, collaborative behavior, and performance in practice. By using the model to plan research, outcome categories can be consistently used to create common threads. Health and system outcomes in the model include an expanding continuum of individual health, population/public health, organizational change, system efficiencies, and cost effectiveness (Institute of Medicine, 2015).

Components of the IPLC model were used to plan and guide this study. Undergraduate healthcare students were selected, which is at the foundational level of the learning continuum. I recognized potential enabling and interfering factors of professional culture, and embedded ways to assess attitude and encourage positive attitudes among participants with scheduled social time and educator role-modeling of collaboration. Lastly, I chose learning outcomes of teamwork attitude and team skills represented in the model. More details regarding the study design are provided in Chapter III.

**Interprofessional Education Competencies**

Building on the definition of IPE, standards and competencies have been identified by coalitions of experts making up the World Health Organization (WHO), and the Interprofessional Education Collaborative (IPEC), and are discussed and related to the learning outcomes chosen for this study.  The IPEC Expert Panel (2011) identified four core competency domains for interprofessional collaborative practice: Values and Ethics (VE) for IP practice, Roles and Responsibilities (RR), Interprofessional Communication (CC) and Teams and Teamwork (TT).  I have summarized each of these four domains and identified the targeted competencies for this study.  A greater focus is placed on the Teams and Teamwork domain which encompasses components of the other three domains, and is most applicable to this study.

**Values and ethics.** The constructs of values and ethics (VE) are common themes across all healthcare professionals (HCP) in education and practice.  The IPEC group has broken down this domain into 10 specific, measurable knowledge, skill and attitude (KSA) statements (Table 1).

Table 1.  Specific values and ethics domain competency statements

| Item | Competency Statement |
|---|---|
| *VE1 | Place the interests of patients and populations at the center of interprofessional health care delivery. |
| VE2 | Respect the dignity and privacy of patients while maintaining confidentiality in the delivery of team-based care. |
| VE3 | Embrace the cultural diversity and individual differences that characterize patients, populations, and the health care team. |
| *VE4 | Respect the unique cultures, values, roles/responsibilities, and expertise of other health professions. |
| *VE5 | Work in cooperation with those who receive care, those who provide care, and others who contribute to or support the delivery of prevention and health services. |

Table 1. Specific values and ethics domain competency statements (Cont'd.)

| | |
|---|---|
| *VE6 | Develop a trusting relationship with patients, families, and other team members (CIHC, 2010). |
| *VE7 | Demonstrate high standards of ethical conduct and quality of care in one's contributions to team-based care. |
| VE8 | Manage ethical dilemmas specific to interprofessional patient/population centered care situations. |
| VE9 | Act with honesty and integrity in relationships with patients, families, and other team members. |
| *VE10 | Maintain competence in one's own profession appropriate to scope of practice. |

*Indicates targeted learning outcomes for this study.

Even though it is a separate domain, value and ethics is a thread that undergirds the other three domains as later noted. The major themes and concepts of this domain include respect for others including cultural differences, right to privacy, professionalism, and individual competency (IPEC Expert Panel, 2011). The major theme from this domain that applies to this study is professionalism. Individual professionalism is guided by the identity of the discipline, reinforced by regulating bodies that define the scope of practice of a profession (American Association of Colleges of Nursing, 2008). Interprofessional professionalism differs in a way that it applies to a group of HCP with a focus on service to individuals, groups or communities for a goal of optimum health, rather than individual professionalism that is self-serving to one's own profession (IPEC Expert Panel, 2011).

In this study, individuals were brought together and expected to display individual professionalism, as well as interprofessional professionalism that encompasses interactive attributes of altruism, mutual respect, trust, communication, and accountability in relationships with other team members.  Mutual respect and trust are foundational to collaboration as a two-way attitude meant to be reciprocated between individuals working toward a common goal (IPEC Expert Panel, 2011).  As study participants engage in team simulations, these behaviors and attitudes will be tested and measured.

**Roles and responsibilities.** The second IPEC Core Competency domain is roles and responsibilities (RR) which is using one's own role, and those of others, to effectively address a healthcare problem.  The essence of this domain is knowing, understanding and utilizing the scope of one's own professional role and those of all team members in an effort to collaboratively achieve healthcare that is efficient, equitable, effective, safe, and timely.  There are nine competency statements (Table 2) that incorporate knowing and communicating the role of self and others for addressing a health issue (IPEC Expert Panel, 2011).

Table 2.  Specific roles and responsibilities domain competency statements

| Item | Competency Statement |
|---|---|
| *RR1 | Communicate one's roles and responsibilities clearly to patients, families, and other professionals. |
| RR2 | Recognize one's limitations in skills, knowledge, and abilities. |
| *RR3 | Engage diverse healthcare professionals who complement one's own professional expertise, as well as associated resources, to develop strategies to meet specific patient care needs. |
| RR4 | Explain the roles and responsibilities of other care providers and how the team works together to provide care. |
| *RR5 | Use the full scope of knowledge, skills, and abilities of available health professionals and healthcare workers to provide care that is safe, timely, efficient, effective, and equitable. |

Table 2. Specific roles and responsibilities domain competency statements (Cont'd.)

| | |
|---|---|
| *RR6 | Communicate with team members to clarify each member's responsibility in executing components of a treatment plan or public health intervention. |
| *RR7 | Forge interdependent relationships with other professions to improve care and advance learning. |
| RR8 | Engage in continuous professional and interprofessional development to enhance team performance. |
| *RR9 | Use unique and complementary abilities of all members of the team to optimize patient care. |

*Indicates targeted learning outcomes for this study.

Knowledge of roles and responsibilities is a prerequisite to effective teamwork and collaborative practice, and is threaded through the other three IPEC domains. Without an accurate understanding of what each team member brings to a situation, a team runs the probable risk of under- or over-utilizing the skills of its members. Students who have progressed to the upper levels of an academic program will have had more clinical experience in the presence, or in collaboration with, other disciplines which adds to their understanding of others' roles and responsibilities. Upper level students also have had time to develop their own professional role identity which can prepare them to engage in an IPE (Deon, 2005; Oandasan & Reeves, 2005).

Beyond knowledge of one's own and other team members' skills and attitudes, the RR domain can be summarized into three "C"s: coordination, cooperation, and collaboration (IPEC Expert Panel, 2011). Cooperation is an attitude that displays willingness to work together interactively. Coordination is a skill that entails the organization and synchronization of interdependent actions of a team by arranging and directing the sequence and timing of events (Marks et al., 2001). Collaboration, the highest level skill, combines the skills and attitudes of coordination and cooperation as the ultimate goal of interprofessional education (IPEC Expert Panel, 2011).

Participants in this study come with baseline knowledge of other disciplines as well as accumulated knowledge of their own. Components of this domain are embedded in both instruments used to measure teamwork attitude and skills in this study (TAQ and TPOT respectively), and most closely align with the leadership, situation monitoring, and mutual support subscales.

Interwoven into the RR domain is the interprofessional communication (CC) domain that is addressed next. A team that is successful at interprofessional communication can articulate their role, and offer clear explanations of their contribution from their professional perspective in a way that encourages other members to consider their ability to assist rather than challenge.

**Interprofessional communication.** The third competency domain, interprofessional communication (CC) consists of 8 individual competency statements which incorporate spoken, written or informatics-based communication (Table 3).

Table 3. Specific interprofessional communication domain competency statements

| Item | Competency Statement |
|---|---|
| CC1 | Choose effective communication tools and techniques, including information systems and communication technologies, to facilitate discussions and interactions that enhance team function. |
| *CC2 | Organize and communicate information with patients, families and healthcare team members in a form that is understandable, avoiding discipline-specific terminology when possible. |

Table 3. Specific interprofessional communication domain competency statements (Cont'd.)

| | |
|---|---|
| CC3 | Express one’s knowledge and opinions to team members involved in patient care with confidence, clarity, and respect, working to ensure common understanding of information and treatment and care decisions. |
| CC4 | Listen actively, and encourage ideas and opinions of other team members. |
| *CC5 | Give timely, sensitive, instructive feedback to others about their performance on the team, responding respectfully as a team member to feedback from others. |
| *CC6 | Use respectful language appropriate for a given difficult situation, crucial conversation, or interprofessional conflict. |
| CC7 | Recognize how one’s own uniqueness, including experience level, expertise, culture, power, and hierarchy within the healthcare team, contributes to effective communication, conflict resolution, and positive interprofessional working. |
| CC8 | Communicate consistently the importance of teamwork in patient-centered and community-focused care. |

* indicates competency of interest in this study

According to IPEC Expert Panel (2011), effective IP communication is organized, possesses respect, clarity, confidence, competence, timeliness, and lacks jargon or attitudes of hierarchy. The act of communicating, or speaking among team members is only part of this domain, with nuances of attitude and tone. A prerequisite to IP communication comes from an attitude of willingness to communicate, one which includes receptiveness, openness, and agreement to interact and collaborate, which contributes to successful team communication (IPEC Expert Panel, 2011).

It is relevant to point out that potential barriers to team communication can be explained by Allport’s theory of Social Identity (1954) as described above, and Pettigrew’s (1998) Intergroup Contact Theory. Pettigrew’s work built on Allport’s theory stating that in order for groups to overcome stereotype-related barriers, there needs to be understanding (knowledge) and acceptance (attitudes) of the members of the "out-group," change of behavior (skills), and reappraisal of the intergroup (in-group combined with out-group). These concepts are integrated into the KSA statements of the RR domain with overlap into the CC domain. Intergroup Contact theory has been referenced by researchers and educators who plan interprofessional education to bring awareness, and establish ways to minimize the extent of negative stereotype attitudes that can interfere with learning (Gierman-Riblon & Salloway, 2013; Mohaupt et al., 2012).

Strategies from the literature, and used in this study, for minimizing stereotype attitudes associated with IPE include: preparation of common learning outcomes for all participants, providing informal social time, and educator role-modeling of an attitude of support for other disciplines. Best practices for preparing students for collaborative learning and/or practice is to allow a social time for team members to get acquainted prior to team activities, and to balance the makeup of the teams to avoid one "in-group" dominating the rest (Pettigrew, 1998). Additionally, providing pre-education information regarding team member roles, responsibilities, and leadership expectations can establish the right tone for learning activities (Deon, 2005; Gierman-Riblon & Salloway, 2013).

**Teams and teamwork.** The final and fourth domain in the IPEC Core Competencies (2011) is Teams and Teamwork (TT). There are eleven specific competency statements (Table 4) in this domain that relate to understanding of teams and teamwork development, engaging in shared planning and decision-making within professional groups, utilizing effective leadership skills that foster collaboration and shared responsibility, and use of quality improvement and evidence based practice to guide revision of team processes (IPEC Expert Panel, 2011).

Table 4. Specific teams and teamwork domain competency statements

| Item | Competency Statement |
|---|---|
| TT1 | Describe the process of team development and the roles and practices of effective teams. |
| TT2 | Develop consensus on the ethical principles to guide all aspects of patient care and team work. |
| *TT3 | Engage other health professionals—appropriate to the specific care situation—in shared patient-centered problem-solving. |
| *TT4 | Integrate the knowledge and experience of other professions—appropriate to the specific care situation—to inform care decisions, while respecting patient and community values and priorities/preferences for care. |
| *TT5 | Apply leadership practices that support collaborative practice and team effectiveness. |
| *TT6 | Engage self and others to constructively manage disagreements about values, roles, goals, and actions that arise among healthcare professionals and with patients and families. |
| *TT7 | Share accountability with other professions, patients, and communities for outcomes relevant to prevention and health care. |
| *TT8 | Reflect on individual and team performance for individual, as well as team, performance improvement. |
| TT9 | Use process improvement strategies to increase the effectiveness of interprofessional teamwork and team-based practices. |
| TT10 | Use available evidence to inform effective teamwork and team-based practices. |
| *TT11 | Perform effectively on teams and in different team roles in a variety of settings. |

*Indicates targeted learning outcomes for this study.

Team leadership is an important element of the TT domain, and leadership characteristics are explained in the context of healthcare teams (IPEC Expert Panel, 2011). Ideally, the leader of a team is determined by the situation, and each team member has the potential and responsibility to lead when appropriate. Team leaders that are effective have a clear understanding of the roles and responsibilities of the team members and can foster an atmosphere of shared planning, decision-making, and responsibility. The team leader takes on the role of coordinator, responsible for building and maintaining shared vision and ensuring collaboration of members that capitalize on individual differences to efficiently share the work of the group. Additionally, the team leader addresses the affective state or attitude, which can have a significant influence on team actions and outcomes. A good team leader assesses team attitude and guides it toward one that conveys the importance of the team, as opposed to the individual (IPEC Expert Panel, 2011).

Several competency statements in this domain directly relate to team attitude and skills, and are measured as learning outcomes in this study. This research study measures outcomes that span all four domains with concentration on the teams and teamwork domain that incorporates components of the other three.

**Summary of IPE studies**

I have conducted a critical review of interprofessional education literature by searching several databases (Google Scholar, Ebsco Host, CINHAL, Academic Search Complete) using search terms separately and in combination including "interprofessional," "education," "interdisciplinary," and "multidisciplinary" from 1999 to 2015. I further refined the search to include only academic journals, limited to education, and healthcare.  The date of 1999 was chosen to correspond with the landmark Institute of Medicine document *To Err is Human,* which marked a turning point in interprofessional teamwork research by identifying its relationship to reduction of medical error, quality, and safety.  I uncovered four common themes in IPE research that are discussed in this section: (a) A dramatic increase in IPE research, (b) methodological weaknesses, (c) variability in learner outcomes, and (d) variability of education method. I will explain how these completed IPE studies informed the design of this research study.

**Dramatic increase in IPE research.**  The number of IPE research studies has greatly expanded in the past ten years.  This trend is likely related to the national initiatives compelling health care providers to become interprofessional collaborative teams in order to impact reduction of medical error (AHRQ, 2000; Kohn et al., 1999).  In a recent report from the IOM, Reeves et al. (2015) identified eight literature reviews of 407 studies between 2010 and 2014 alone, with an additional 174 IPE studies identified from the last 2000-2008 literature review report.  A summary of this review follows.

The earliest review from 1966-2005 searched for evidence of best teaching methods in IPE, and learning outcomes (Hammick et al., 2007).  Zhang, Thompson, and Miller (2011) identified 25 studies between the years of 1999 and 2009 that included both IPE and simulation, and found that the most common quantitative research design was a posttest measures only (*n* = 11).  A review by Courtenay, Nancarrow and Dawson (2013) looked at IPE studies from January 2000 until April 2013 that focused on trauma care and teamwork, and found that the 24 studies included based on quality limiters, were equally divided between descriptive and evaluative designs.  It was noted that evaluative studies often lacked a control group, and used small sample sizes. This study will not have a control group, but a comparison group receiving two different methods of team training. The sample size is small due to the choice to do team leveled research.

In a review of IPE literature reviews, Reeves et al. (2015) reported one systematic (Reeves, Perrier, Goldman, Freeth, & Zwarenstein, 2013), and three scoping reviews (Abu-Rish et al. 2012; Brandt, Lutfiyya, King, & Chioreso, 2014; Reeves et al. 2011) were conducted that are also relevant to the topics of this study. Each included quantitative, qualitative and mixed methods of research design. The combined total of studies for all four reviews was 698 spanning 2005-2013. This study will utilize quantitative methods only.

The systematic review by Reeves et al. (2013) revealed only 15 studies (9 new studies in addition to the 6 studies from a review in 2008), that met the standard Cochrane criteria that looks only at experimental research designs of randomized control trials (RCT), controlled before and after (CBA) studies, and interrupted time series (ITS) studies. The scoping review by Reeves et al. (2011) looked at 104 studies where half used a CBA design, 10 were RCT, and 18 used a posttest only design. This review showed an increase in quality regarding the use of a control group, and a pre-/ post-evaluation. The most likely reason for posttest design only studies is due to the difficulty in scheduling groups of professionals unless formal curriculum exists. Logistics is one of the most difficult barriers to overcome in IPE research that utilizes face-to-face methods such as simulation. Overall, reviewers recommended more studies use a control group, experimental design (Courtenay et al., 2013), and avoid posttest only design (Zhang et al., 2011). This study did not have a control group, and quasi-experimental as ex post facto design.

**Methodological weaknesses in IPE research.** Design components that were specifically identified in the reviews across IPE studies were the lack of or variation in conceptual theory, small sample size, variation of discipline participants, variation in learning outcomes, variability of education method, and time delivery of education. Each of these topics will be briefly discussed as they apply to this study.

*Conceptual theory*. Researchers use a conceptual theory or model to frame a study in order to validate the grounding of design, intervention, or evaluation method. It was noted that most researchers did not incorporate a conceptual theory into their study (Reeves et al., 2011); however, studies that followed this review have improved somewhat in this area, but have used many different theories. Conceptual theories that have been identified in IPE include Allport's (1954) Social Identity theory, Knowles (1980) theory of adult education, reflection on practice (Schon, 1987), problem-based learning (Barrows & Tamblin, 1980); Kolb, experiential learning (1984), Bandura's self-efficacy theory (1977), and Lave and Wenger's (1991) situated learning theory. This variety of theories in the literature creates a lack of consistency in IPE research.

For this study, Allport's (1954) Social Identity Theory will provide the theoretical framework to correspond with team-based interprofessional education. This theory incorporates the concepts of attitude and skills that are affected when different groups of individuals have been brought together for a shared purpose. This framework suggests that pre-conceived attitudes exist between in-group and out-group members, and this aligns with assessment of teamwork attitude in this study as explained in Chapter 3. The work of individuals when brought together as a team (i.e., team skills) can be informed by this theory as well, as this research design brings ad hoc team members together to perform complex skills requiring teamwork. These ad hoc teams will need to overcome pre-conceptions that may include attitudes of hierarchy, misunderstanding of roles, and mistrust of others' abilities, which is part of Social Identity Theory framework. The concept of time in this study also relates to this theory, in that time spent with the out-group, as well as other strategies, is an integral variable that will be studied related to how time can affect integration of individuals into a functioning team. The impact of time in training on the outcomes of teamwork attitudes and skills will be informed by this theory, with the expectation that more time spent will lead to increased positive teamwork attitude and skills.

***Small sample sizes.*** An opportunity to strengthen IPE research by increasing sample size was noted in multiple reviews of the literature (Brandt et al., 2014; Courtenay et al., 2013; Hammick et al., 2007). Brandt et al. (2014) found a majority of studies reviewed spanning 2008-2013, (62%) reported sample sizes less than 50. Some large scale studies are noted in the literature, but reviewers recommend future studies attempt to increase sample size, and to include multiple sites in order to broaden generalizability to other populations (Courtenay et al., 2013; Reeves et al., 2015). As an ex post facto study, this study consists of 161 individuals who make up 19 teams.

***Variation in discipline participants.*** There is wide variation in the combinations and ratios of discipline participants in the IPE literature. The most common disciplines included in IPE are nursing and medicine, with the least frequent veterinarians and public health workers (Brandt et al., 2014). Zhang et al. (2011) found that approximately half of the studies (n = 12) in their review of IPE using simulation, engaged other professions in addition to medicine and nursing. Overall, IPE studies were completed using a variety of combinations of HCPs, with up to 20 different professions represented in the literature (Brandt et al., 2014). There are no recommendations for designing IPE with specific numbers or types of HCPs, only that the design closely mimic best clinical practice, and avoid over-representation of one discipline that can lead to domination of the largest group (Allport, 1954; Deon, 2005), Beyond the type of discipline in IPE, the licensed and prelicensed variation also exists. While research has been completed on licensed professionals or pre-licensed students, few studies have incorporated both in an effort to bridge the academic to the practice setting, and presents an opportunity to build future research (Brandt et al., 2014; Reeves et al., 2015). This study will include a mix of nursing, medical, and respiratory therapy undergraduate students.

***Variability in learner outcomes.*** IPE literature reviews have noted a wide variety of learner outcomes measured. Research in IPE is often designed with learning outcomes classified according to Kirkpatrick's (1998) four-level model of educational outcomes: reactions, KSA improvement, behavior observed, and patient, system or process. A modified version expanded these classifications to six levels of reaction (I), modification of attitudes/perceptions (II), acquisition of knowledge/skills (III), behavioral change (IV), change in organizational practice (V), and benefits to patients/clients (VI) (Barr, Koppel, Reeves, Hammick, & Freeth, 2005). It is this modified version that will be referenced in the following discussion.

The earliest review by Hammick et al. (2007) found most experimental studies were designed to measure individual outcomes at Kirkpatrick levels I and II, with a positive effect noted on knowledge and skill outcomes, and less positive effect on attitudes. In contrast to this finding, it was noted in a later review that most studies (77% out of 83) addressed attitudes toward IPE, followed by knowledge and skill measurement as the second most frequent (30%) (Abu-Rish, et al., 2012). Descriptive studies measured outcomes such as attitude, values and perceptions rather than behavior and performance (Courtenay et al., 2013). Later studies reviewed by Reeves et al. (2015) found that reactions or perceptions/attitude, and changes in knowledge or skills were found to be positively affected by involvement in IPE.

Fewer research studies targeted outcomes measured above Kirkpatrick levels I and II (Reeves et al., 2015). Some addressed changes in behavior outcomes such as skills or competency demonstration (level III) by evaluating live or videotaped patient care in the clinical setting or simulation lab as this study did. While few studies looked at outcomes above level III related to system, patient, or organizational practice effects, some studies noted level VI outcomes of professional practice, patient care, health outcomes, and patient satisfaction (Reeves et al., 2015).

Recommendations by reviewers for future IPE research have been to focus on behaviors rather than perception/attitude outcomes (Courtenay et al., 2013; Hammick et al., 2007; Reeves et al., 2015), determine sustained long-term effect (Courtenay et al., 2013), and attempt to demonstrate the effect of IPE with simulation on patient or community health (Zhang et al., 2011). Evaluation in this study will include teamwork attitude and team skills, Kirkpatrick levels I and III.

***Variability of education method.*** The education methods of an IPE event are rightfully chosen in order to meet desired learning outcomes. There were commonalities noted in some areas, and variability in others. A commonality found in IPE research was the use of a didactic component combined with simulation-based education, which was the most common approach (Zhang et al., 2011). Didactic content was researcher-designed or standardized curriculum that was delivered in a face to face, or online format. Additionally, educators used small group discussions, problem-based learning in the form of case studies, and reflective exercises to allow for processing of an education event to stimulate deeper learning (Zhang et al., 2011). It was common practice to include pre-event learning to provide preparation for IPE in the form of reading or interactive content; this practice aligns with adult learning theory (Knowles, 1984), and best practice in allowing students to come to IPE with prerequisite knowledge. The combinations of education interventions makes it difficult to know which component had the most impact on positive learning outcomes. One reviewer recommended designing IPE that can evaluate components separately, along with the use of quality improvement (QI) processes of plan-do-study-act, where small interventions are developed, tested and modified, rather than combining several untested components into a large research study (Zhang et al., 2011). The education methods in this study are didactic delivered in online and face-to-face, small group discussion, and simulation.

***Time delivery of education.*** There is noted variability in the IPE literature regarding the timespan for delivery of the education components (didactic, simulation, and other strategies). There are no examples of IPE research where a comparison has been made between deliveries that occur in a one-time immersion experience (i.e., one full or partial day experience) compared to time-distributed delivery spanning several weeks. There are examples in the literature of each, but none comparing the methods.

The one day design can range from 2 to 8 hours incorporating multiple methods of teaching/learning as described above. The time-distributed design uses repeated small doses of IPE learning that spans several weeks (Reeves et al., 2015). This style is the model used in most formal courses that meet over a longer period dispensing smaller doses of learning at a time. There are learning theories that support this gradual method of learning (Benner, 1984; Kozlowski & Bell, 2002), while there are none to support the use of the one-time delivery method. Despite the theoretical foundation, there are many barriers that discourage educators from designing IPE that is time-distributed as opposed to a one-day event, including increased faculty time and effort, added cost, difficulty scheduling, and academic curriculum approval processes if a formal course is to be developed. This study sought to compare education delivery over two different timeframes, with evaluation of learning outcomes.

## The Pedagogy of Simulation

This section explores the pedagogy of simulation, one of the methods of education used in this study. I begin with a brief recognition of the learning theory of constructivism which provides the framework for this teaching method, followed by a discussion of the Jeffries and Rizzollo (2006) model of Simulation in Nursing Education, the International Nursing Association of Clinical Simulation and Learning (INACSL) standards that provide consistency and guides best practice in simulation, and end with a review of simulation research.

Learning by doing is the basis of simulation. When engaged in a healthcare clinical simulation, participants are presented with a re-creation of a life-like experience that carries the expectation of thinking and performing in a way that would mimic real clinical practice. Simulation educators agree that simulation-based learning is an example of constructivism learning theory (Meakim et al., 2013). Constructivism theory describes learning that an individual creates based on experiences and interaction with their environment (Meakim et al., 2013). Manikin simulation is framed by a patient care scenario that is situated in a clinical context. Thinking, learning, and decision-making evolves from interpretation of information derived from the “patient”, environment, supportive props and documents (i.e., health record), and fellow participants. This sequence encourages the learner to create meaning through a process that is personally relevant. This active form of learning leads to knowing by doing, and constructing meaning out of experience; an ideal match to constructivism theory (Meakim, et al., 2013).

**Nursing Education Simulation Model**

The Nursing Education Simulation Model by Jeffries (Ed.) was designed to provide a consistent framework, to guide educators in the pedagogy of simulation, and was used to design the simulations in this research study (2007). While the model, (Figure 2) contains nursing in the title, it was based on an extensive literature review and collaboration between nursing, medicine, and anesthesia, implying interprofessionalism.

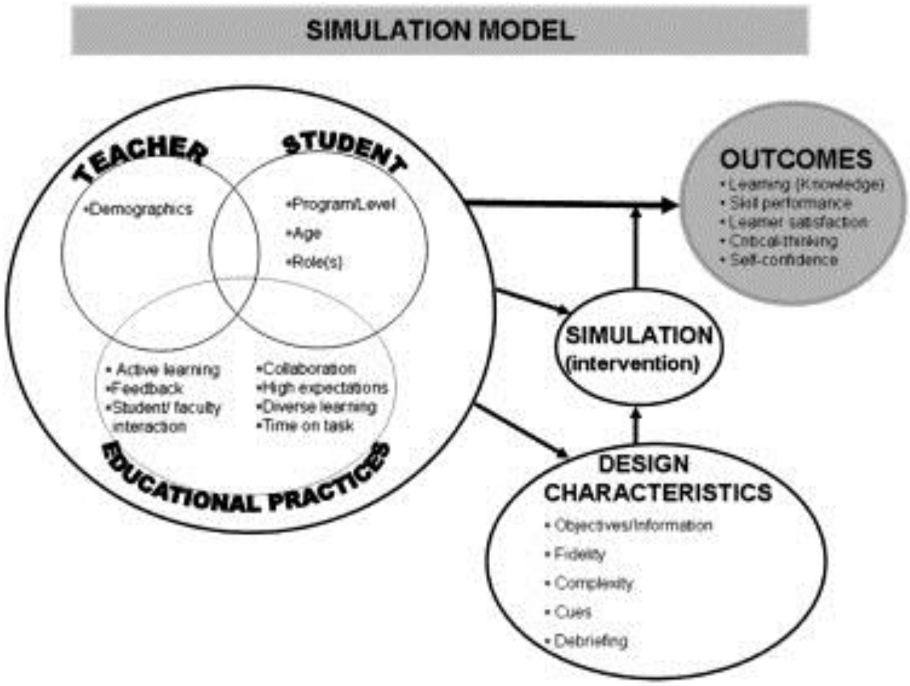


Figure 2 *NLN/Jeffries Simulation Framework model* (Jeffries, 2007)

The Simulation Framework model identifies three domains of the teacher, the student, and educational practices derived from Chickering & Gamson’s (1987) classic learning theory of seven good practices in undergraduate education. It is notable that these particular factors are not represented on the Interprofessional Learning Continuum (IPLC) model described in the preceding IPE section of this chapter, yet are relevant when the IPE contains simulation pedagogy. Outcomes of student learning are noted, and some are comparable to the IPLC model learner-specific outcomes. While the IPLC model was used to inform the overall study, this model was used to inform the simulation component of this research study.

As identified in the Jeffries model, design characteristics are variables that influence the simulation contributing to learning outcomes; these design characteristics include objectives, fidelity, complexity, cues, and debriefing. Some of these characteristics are represented in the INACSL Standards described in the next section, but complexity is discussed here, as well as clinical context which relates to complexity. These characteristics are determined when designing a simulation experience, and each represent a variable in the equation leading to learning outcomes.

Complexity relates to the difficulty level of a simulation, meaning how hard it will be for participants to know how to correctly progress in the scenario. Difficulty can be raised by setting high learner expectations through embedding complex or high level skills, or multiple competing stimuli that requires prioritization; these are guided by learning objectives. Educators determine appropriate complexity level with consideration of learner ability based on expected knowledge and skills, with the with the intention of setting the bar high enough for a challenge, but not so high that goals are unachievable. Another way to raise complexity is to make the simulation interprofessional, which requires students to consider and respond to the actions and decisions made by others. Simulation complexity in this study was high, effected by the IPE design, and a multifaceted clinical scenario of a cardiac arrest.

Although not represented in the model, the choice of clinical context, the clinical setting and situation of the simulation scenario, can be an important component of a simulation. The creation of a clinical context provides the learner with a situation to apply their actions and decision-making that adds to their construction of meaning and potential transfer to other similar situations. The use of a clinical context for learning is supported by Situated Learning theory that recognizes important learning occurs when newcomers (students) are engaged in the socio-cultural environment of practitioners in order to move toward full participation and independence in the area of practice (Lave &

Wenger, 1991). In this theory, it is also postulated that learning occurs even by observing the actions of others that are being role-modeled in a given profession. This theory applies to the pedagogy of simulation, and especially supports the contention that observers of a simulation gain meaningful learning as do those who are actively engaged.

The simulation scenario in this study was designed to meaningfully engage each of the disciplines involved. Adult learning theory dictates that learning should be meaningful and directly related to practical application (Knowles, 1984). Choosing a clinical context that represents actual practice also applies to adult learning theory. The clinical context chosen for the simulation was based on a patient newly admitted to the hospital with an acute myocardial infarction that quickly develops a cardiopulmonary arrest. This scenario engages all professions involved, and is an authentic example of real practice.

**INASCL Standards**

The International Nursing Association of Clinical Simulation and Learning (INACSL) is an internationally recognized authority on simulation practices in healthcare. This group released the first set of standards for simulation education in 2011, and updated in 2013. The NCSBN (National Council of State Boards of Nursing) recommends the use of these standards when designing simulation education in nursing. There are seven standards that are included in Table 5. These standards constitute best practices in simulation and were used to design the simulations for this study.

Table 5. INACSL standards of best practice: Simulation (2013)

| Standard | Title | Details |
|---|---|---|
| Standard I | Terminology | Definitions of terms used in simulation. |
| Standard II | Professional Integrity | Learners are expected to maintain professional behavior and attitudes, and confidentiality of simulation experiences. |
| Standard III | Participant Objectives | Objectives that are identified by domain, aligned with learner abilities, course and program outcomes, based on evidence, achievable within set timeframe, and incorporates a holistic patient view. |
| Standard IV | Facilitation Methods | The type and amount of cueing used during a simulation. |
| Standard V | Facilitator | Expectation that facilitator will have training in simulation, and responsible for establishing psychologically safe learning environment, appropriate level of fidelity, preparation materials, evaluation and feedback methods. |
| Standard VI | Debriefing | Reflective learning following simulation guided by a facilitator who has been trained, has observed the simulation, and who follows a structured framework that is congruent with the learning objectives. |
| Standard VII | Evaluation | Formative, summative, or high stakes based on learner preparation, and purpose of the exercise. |

**Terminology, Standard I.** The first standard, Terminology, creates consistency in language across simulation research and practice (Meakim et al., 2013). INASCL (Standard I) defines simulation (as noted in Chapter I). Jeffries (2007) defined simulation as a learning experience that simulates the work environment for the purpose of applying knowledge, skills and critical decision-making. For the purposes of this paper, terms including simulation-based education, simulation-based learning experience, and simulation-based training will be synonymous with the term simulation.

**Professional integrity, Standard II.** There is a common expression used by simulation educators, "Whatever happens in simulation, stays in simulation." This mindset is intended to establish psychological safety in the learning environment where mistakes can occur without judgment or criticism, and constructive feedback will be provided for the purpose of improving competency (Gloe et al., 2013). This standard also embeds the concept of confidentiality of both the components of the scenario in order to maintain authentic experience for other participants who have not yet been part of the simulation, as well as confidentiality regarding performance(s) of fellow participants. These standards contributed to cultivating an atmosphere of safe learning in this study, via declaration of a safe learning environment during orientation to the simulation.

**Participant objectives Standard III.** This standard describes the importance of establishing clear learning objectives for a simulation as the starting point for planning. There are six specific criteria that include identifying the domain (knowledge, skill, competency), aligning with learners' knowledge and experiences, aligning with course and program outcomes, basing on evidence based practice, setting the timeframe that allows achievement of objectives, and incorporating a holistic patient view (Lioce et al., 2013).

**Facilitation method Standard IV.** The facilitation method, such as extent of learner cueing, is to be determined prior to implementation of a simulation and guided by choosing the best method for achieving learning objectives, as well as consideration for the expertise of learners (Franklin et al., 2013). More learner cues can be used for novice when formative learning is the focus, whereas fewer cues are used for summative learning and higher expertise levels of students. Cues can come from the “patient” (manikin or actor), the facilitator, or other embedded events in the scenario design.

The event-based approach to training (EBAT) is a method where simulations are designed to embed decision-making triggers every few minutes to stimulate learners to respond to a new event (Fowlkes, Dwyler, Oser, & Salas, 1998). The EBAT method links targeted competencies to training design so that opportunity to demonstrate mastery of objectives can be evaluated by observation and feedback. The EBAT method was used to design the cardiac arrest scenario used in this study, and is found in Appendix A.

**The facilitator, Standard V.** There are nine criterion in this standard including an expectation that facilitators have training and/or mentoring in teaching with simulation, responsibility to establish psychological safety for learners by articulating expectations during all phases, to provide opportunity for students to prepare for the experience, to determine an appropriate level of fidelity, to predetermine a method of evaluation, and to communicate feedback to the learners through debriefing (Boese et al., 2013). Each of these criterion were addressed in planning the simulation experience for this study.

**Debriefing, Standard VI.** A critical component of simulation is the reflective learning that follows active learning called the debriefing stage. This standard does not direct which structured framework should be used, but reinforces that debriefing should be purposeful and planned to best assist learners’ engagement in self-analysis and objective reflection of learning (Decker et al., 2013). Debriefing encourages the learner to objectively critique their performance and create a cognitive frame for future application; an important component of experiential learning. According to Schon (1987), the art of reflection on learning allows learners to critically analyze what occurred in an experience, apply meaning in ways that allows them to understand how their actions may have resulted in a particular outcome. The debriefing phase of simulation is a perfect application of Schon's theory of reflection on action.

Because debriefing is such an important component of simulation learning, I expand on this topic beyond the INACSL Standard. There are three phases of debriefing: prebriefing, debriefing, and closing. In the prebriefing phase of debriefing, the facilitator should identify the format, summarize objectives, identify the timeframe, and expectations of the participants regarding confidentiality, participation, and professionalism, as well as an attitude of acceptance that simulation is a learning experience designed to improve practice (Decker et al., 2013). Generally, open-ended questions are prepared prior to the simulation event to uncover not just what occurred, but why it occurred (processes). Using Socratic-style questioning can guide the learners to analyze and reflect on how their actions resulted in patient outcomes.

One recommendation is to begin the debriefing phase by acknowledging learners' emotions that resulted from the experience in order to defuse and release anxieties, stress, or other feelings; this release can make it easier to then focus on learning objectives (Fritzsche, Leonard, Boscia, & Anderson, 2014). In the closing phase, the educator should end with a summary of learning points, and an upbeat message about learning as a formative process rather than an evaluation, assuming that is the intention (Decker et al., 2013).

When simulations are complex, involving multiple disciplines, complicated interventions or multi-tasking of team members, it is recommended that facilitators address clinical skills separate from teamwork skills when debriefing (TeamSTEPPS National Implementation Plan, 2014, Watts et al., 2014). Some researchers address this issue by debriefing in multiple stages, such as separate debriefing by discipline as well as the entire group of learners (Watts, et al., 2014). It's important to help learners see the whole picture, especially when multi-disciplinary roles were engaged to build understanding of others' team roles, and contribute to competency in the IPEC Roles and Responsibilities domain (IPEC Expert Panel, 2011). It is possible that team members, engrossed in their own role, are unaware of the other team members' actions; in these cases, debriefing with video playback can be helpful (Chronister & Brown, 2012).

**Evaluation, Standard VII.** Formative evaluation is intended to guide the learner to improve in a new area of knowledge, skill or attitude. Summative is meant to evaluate achievement of outcomes, presuming learners possess the baseline knowledge to accomplish the goal(s) without, or with minimal cueing. High stakes evaluation entails a detailed evaluation of performance according to an observer/rater preferably using a validated and reliable tool (Sando et al., 2013). Evaluation in this study was determined as summative with no learner cues from educators, although there was no attachment of a grade or points awarded based on simulation performance.

**Summary of application of the INACSL standards.** In summary, the INACSL standards are recognized as an important reference for best practices in simulation education and research, and were therefor used to inform the simulation portion of this research study. Simulation in this study is an important intervention supplemented by pre- and post-simulation learning activities. Examples of how the INACSL standards were applied are as follows: clear learning outcomes were written in collaboration with interprofessional educators whose students participated in the simulations, the facilitation method chosen was to provide limited cueing in line with summative evaluation and in recognition of expected knowledge and experience of the participants. Additionally, the facilitator and debriefing standards were met with expert educators in simulation and debriefing, use of structured debriefing derived from pre-established debriefing cues, and debriefing clinical skills separate from team skills. Evaluation and feedback occurred in debriefing and post-event journaling that fostered reflection on actions.

**Summary of Simulation Research**

In a landmark study, Jeffries and Rizzolo (2006) identified five learning outcomes referred to in the Nursing Education Simulation Model including knowledge, skills, satisfaction, self-confidence, and critical thinking. Selected literature reviews and primary research will be discussed in this section grouped according to these outcomes and related to the outcomes in this study.

Systematic reviews conducted to examine outcomes of simulation studies began with Nehring and Lashley (2009), who found 13 studies that identified primarily satisfaction, self-confidence, knowledge, self-ratings, and skills or competency in descending order of frequency. Lapkin, Levett-Jones, Bellchambers, and Fernandez (2010) also conducted a review of nursing simulation studies from 1999 and 2009, and found that simulation was associated with improved critical thinking, skills, and knowledge outcomes. Literature reviews in simulation spanning the years 2000-2010 were completed by both Yuan, Williams, Fang, and Ye (2012) and Norman (2012).

Yuan's group looked at nine English and seventeen Chinese HFHS (high fidelity human simulation) studies that met their quality of study criteria, and found that knowledge and skills were the most often evaluated outcomes, and calculated mean increases in knowledge scores as ($M$ = 0.53) and skills ($M$ = 1.15) when meta-analysis was conducted. The review by Norman (2012) examined 17 HFHS studies that used undergraduate student participants, and found that the learning outcomes that were positively affected by simulation were knowledge, skills, communication, and safety. It is notable that higher learning outcomes were not often addressed, including competency, which is a performance that utilizes knowledge, skills, attitudes, and critical thinking. This omission presents an opportunity to build in this area of simulation research. Learning outcomes in this study consist of both teamwork attitude and team skills that make up two components of teamwork competency.

**Simulation effect on knowledge.** Knowledge as an education outcome can vary widely depending on the learner's baseline of knowledge, and instrument used for measurement. Because of this variability, the process of measuring knowledge gain has been inconsistently reported in simulation literature. When targeting assessment of knowledge gain following intervention with simulation, the research design is often a pre/post-test. Jeffries and Rizzolo (2006) conducted a large multi-site, multi-method experimental design comparing nursing students (n = 403) learning from three different methods: simulation with low fidelity, simulation with high fidelity, and paper/pencil format case studies. In measuring knowledge outcomes, they were unable to show significant effect at both levels of simulation compared to traditional methods of the paper/pencil group. Alinier, Hunt, Gordon, and Harwood, (2006) conducted a study of

99 undergraduate nursing students in a pretest/6-month posttest design and found significant increase in knowledge gain. A study by Kardong-Edgren et al. (2007) was also able to demonstrate significant increase in knowledge for their pilot study (n = 14) of nursing students following a simulation intervention. Finally, Chronister and Brown (2012) conducted a study of 37 undergraduate nursing students enrolled in a critical care course, and found no increased knowledge gain in the area of cardiopulmonary arrest care in a pretest/1-week posttest design.

When considering IP studies, knowledge of roles and responsibilities was found to be positively affected when using simulation by some researchers (Baker et al., 2008; Reising, Carr, Shea, & King, 2011). Reising et al. (2011) designed a study with student groups of nurses and doctors (n = 60), comparing a traditional roundtable discussion method of training with simulation-based training for a mock code/cardiac arrest event. One significant flaw in the design for the simulation group was they did not participate in a debriefing post-simulation prior to data collection which discounted the valuable learning that occurs with reflection of the experience.

Based on these selected studies, there is inconsistent evidence that simulation can impact knowledge outcomes. This dissertation study did not measure knowledge separately, but was a subcomponent of teamwork competency with the assumption that knowledge must be present to apply in skills performance which was measured. Knowledge was also indirectly assessed by asking participants to rate their feelings of preparation for a cardiac arrest patient as a baseline measure only.

**Simulation effect on skills.** Skill outcomes associated with simulation research have included those which are psychomotor, interpersonal, teamwork, or communication.

The experiential nature of simulation lends itself well to skill assessment, and there have been a large number of studies that measure skill acquisition or improvement in simulation research; a representation is included here.

Simulation research studies that have targeted skill outcomes have addressed issues of correct skill technique, correct timing, and efficiency or speed. Evaluation of skills is often accomplished with live or recorded observation methods. Studies have found a positive effect of simulation on individual skill technique and efficiency (Arnold et al., 2009; Chronister & Brown, 2011; van Schaik et al., 2011). While performance of individual skills is not directly measured in this study, it is a significant component of a cardiac arrest scenario that incorporates many skills as part of the team response.

Communication skills among healthcare students have also been addressed in IP simulation literature, and relates directly to the third IPEC Core Competency domain. Results have shown a positive effect for improving communication skills when simulation methods are used (Booth & McMullen-Fix, 2012; Stewart et al. 2010). Stewart et al. (2010) designed a descriptive study where upper level nursing and medical students (n = 49 and 46, respectively) were engaged in simulations to evaluate a quantitative instrument consisting of four domains of (a) knowledge and skill development, (b) communication and teamwork, (c) professional role identity and awareness, and (d) attitude to shared learning. Results revealed all domains had higher scores for nursing compared to medicine with the strongest difference in communication (M = 84.8, 79.9, respectively; alpha = 0.89), although was not statistically significant. Communication skills were evaluated in this study as a subscale of teamwork skills on the TPOT instrument.

**Simulation effect on attitudes.** Attitudes of participant satisfaction and self-confidence were common in early simulation studies, and results have shown that typically, satisfaction with learning and self-confidence have been positively influenced by simulation learning (Jeffries & Rizzolo, 2006; Schoening, Sittner, & Todd, 2006). Satisfaction is not addressed in this study, but self-confidence is encompassed in a measurement of baseline "feelings of preparation" before the simulation. As a single item question, it is not expected to capture overall self-confidence but provide basic information related to the student's state of knowledge and self-confidence with that knowledge.

An IP simulation study by Baker et al. (2008), evaluated attitudes of nursing (n = 101) and medical (n = 42) student participants after a cardiac arrest resuscitation scenario. Attitudes were measured with a 1-6 Likert scale with 6 indicating a more positive attitude. Results indicated higher attitude scores for nurses compared to medical students (mean range 5.3-5.81 vs. 5.02-5.76, respectively). Analysis of individual items on the attitude survey revealed the lowest mean score for nursing was the item that stated interprofessional participants added value to their training; the lowest mean score for medicine was the item that stated their profession must depend on the work done by other professions (Baker, et al., 2008). These low mean scores reflect specific negative attitudes among participants, and may have influenced the achievement of teamwork competency. Attitude toward interprofessional learning was assessed in this dissertation study with the TAQ scale at the pre- and post-simulation points.

**Simulation effect on clinical judgment.** Clinical judgment and critical thinking are seen as higher levels of learning, and an integral component of competency in nursing education.  INASCL's Standard I, defines clinical judgment as incorporation of knowledge, skills, and critical thinking in a clinical context (Meakim et al., 2013). Possibly due to its complexity, there are fewer research studies that have attempted to measure this outcome.  Some researchers evaluated the perception of critical thinking ability (Johnson, Zerwic, & Theis, 1999; Rhodes & Curran, 2005) and found a positive relationship with the use of simulation-based learning.  Brown and Chronister (2009) used a custom standardized test to measure critical thinking, and found no increase in post-test critical thinking scores for a group of undergraduate nursing students (n = 140) who received weekly simulations compared to those who participated in a single simulation.

While clinical judgment is a higher level cognitive process, competency is the performance component that subsumes clinical judgment, and is therefore more aligned with observation research that was used in this study.  Competency is explored further in the following section, specifically related to teamwork competency which aligns with this study.

## Teamwork and Collaborative Practice

The purpose of IPE is to develop competency in teamwork and interprofessional collaborative practice (IPEC Expert Panel, 2011).  Teamwork is at the heart of collaborative practice, and not an inherent skill, but requires training and development.  I begin this section with a brief discussion of general team theory which informs teamwork education, and then explore more closely the team-training curriculum of TeamSTEPPS which was used in this study.  Finally, I describe the measurement of teamwork attitude and skill competency with the two instruments used in this study and conclude with selected primary research focused on team outcomes.

**Team Theory**

Basic team theory uses the model of teamwork as an input, process, output (IPO) cycle (Brannick, Salas, & Prince, 1997). Input components consist of team members and their knowledge, skills, attitudes, resources such as equipment and money, and the environment. Team processes incorporate the work of the team including communication, cooperation, coordination, and collaborative actions; these processes can broadly be viewed as team skills. Outputs of team processes in healthcare may be measured at the patient level with physical or psychological changes, adverse complication rates, and satisfaction, or at the team level with increased knowledge, skill, efficiency, satisfaction, self-efficacy, and attitude. Theoretically, output can cycle back and become team input variables. Team output is often used in research as a measure of teamwork effectiveness, and teamwork skills and attitudes were targeted in this study.

Team attitude can include subtleties of cohesion, potency, collective efficacy, and situational awareness; considered emergent states that occur at different times and fluctuate with different contexts and situations (Marks et al., 2001). These emergent states can become team input and/or proximal outcomes of the team. Cohen and Bailey, (1997) recognized psychosocial aspects of teams including shared mental models, norms, affect, and cohesion. Perception of hierarchies is an example of a negative attitude that can impair the collaborative nature of teamwork, and is a risk when members are made to feel less valued (Allport, 1954). An attitude of shared leadership and valuing among team members is a positive example, and a goal for effective teamwork (TeamSTEPPS Instructor Guide 2.0, 2014).

Team processes, how members act together, directly relates to team outcomes. The monitoring of ongoing progress toward a goal with self-regulation, assistance of others, and attention to morale of the group are all included in this phase of team process (Marks et al., 2001). They are interactive activities that depend on timing during the transition or action phase (Brannick et al., 1997; Marks et al., 2001). Teams that are successful in the action phase use their skills of coordination, synthesis, assistance, and collaboration, which are also found in the teams and teamwork domain of the IPEC Core Competencies (IPEC Expert Panel., 2011). Unsuccessful teams in the action phase are uncoordinated, inefficient in their movements, lack a common goal (shared mental model) or have low morale which leads to lower productivity.

While the action phase is essentially the work of the team, the transition phase consists of the cognitive processes of evaluation, reflection, planning, and revision. An effective team in the transition phase uses effective communication techniques to insure that all members are aware of what is happening, what the important facts are, and engages in team decision-making toward a shared goal. Planning is either deliberate where provisions are made for anticipated events, or contingent where complications or events are predicted and a back-up plan is preconceived. Ineffective teams, or those who fail to make deliberate or adequate contingent plans, must be reactive and respond to problems as they occur. Reactive decisions can leave members unaware of plans for action making the action phase chaotic and unfocused (Marks et al., 2001). Team phases of action and transition are recognized as cyclical, with the end of one phase marking the beginning of the next and potential overlap and simultaneous episodes among team members. These are competencies that can be the focus of development in team training, and were addressed in the conceptualization of this study which requires teams to possess a shared mental model of response to a patient situation that can lead to unexpected developments that they will need to respond to.

Interpersonal processes in teamwork such as conflict management, occurs in either the transition or action phases. Other examples include motivation, confidence building, and affect management. Each of these can be influenced by the salience of the team task which can contribute stressors for performance that can cycle back into team input (Marks et al., 2001). Conflict management, communication that entails dealing with differences of opinion, is a natural occurrence when multiple professionals such as an IP team, are brought together with different perspectives. When conflict management is reactive, it is dealt with at the time of the disagreement, a common occurrence in healthcare, and can be positive or negative. Reactive conflict management can be effectively addressed by clearly defining the source of the disagreement, developing problem-solving skills, openness, and willingness to accept differences of opinion (Marks et al., 2001). Effective conflict management relies on effective communication techniques and can lead to productive debate that explores others' viewpoints constructively when team members are equally valued. Ineffective conflict management can result in resentment and decreased willingness to contribute to the problem-solving issues as part of a team (Marks et al., 2001). Conflict management skills can be a focus of team training and has been addressed in team-related research. While this was not a planned component of this study, unplanned conflict did occur and was part of the team process, and evaluation occurred as the mutual support subcategory of the TAQ and TPOT.

**TeamSTEPPS team training.** TeamSTEPPS® is a team-training curriculum and program developed by the United States Department of Defense Patient Safety Program, and was the education component in this study. The development of this curriculum was led by a panel of experts convened in 2003 to identify effective team competencies and team training based on 20 years of literature. Collaboration with the Agency for Healthcare Research and Quality (AHRQ) and the American Institutes for Research (AIR) led to the first version of TeamSTEPPS released in 2005, and was later updated to version 2.0 in 2014 (TeamSTEPPS Instructor Guide 2.0, 2014). This program incorporates lessons learned in teamwork science, human factors, team performance, organization improvement, and change strategies.

TeamSTEPPS is often considered the national standard for medical and healthcare team training for practicing and pre-licensure healthcare professionals (Clapper & Kong, 2012; AHRQ, 2012). Rosen et al., 2008 recommended the use of TeamSTEPPS to serve as a framework to plan education and assessment of teamwork competencies in IPE with simulation, citing that good teamwork skills can create a barrier to medical error for emergency medical residents. The Department of Health and Human Services and AHRQ have championed this program for the purpose of addressing elements of teamwork that can impact safety and quality in healthcare (Agency for Healthcare Research and Quality, 2000).

There are five major domains that make up the TeamSTEPPS curriculum: Team Structure, Team Leadership, Mutual Support, Communication, and Situation Monitoring

(TeamSTEPPS Instructor Guide 2.0, 2014). The TeamSTEPPS domains will be briefly summarized here to explain each of the five areas that constitute the major areas of team performance, all referenced from the TeamSTEPPS Instructor Guide 2.0, (2014) and Clapper and Kong, (2012) except where noted. A model representing the TeamSTEPPS domains as well as three outcomes of knowledge, performance and attitudes, can be seen in Figure 3.

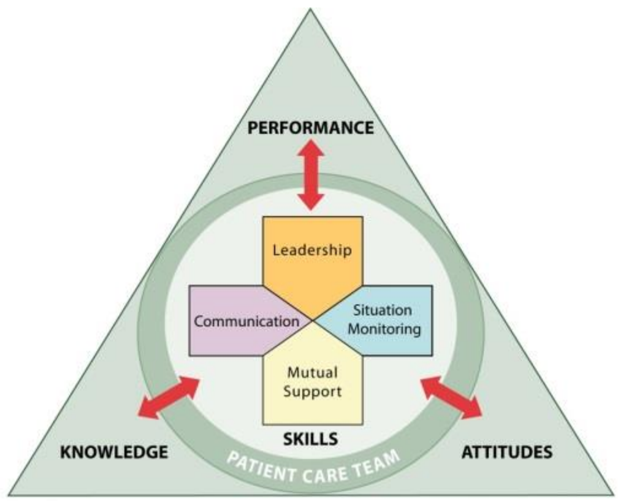


Figure 3. TeamSTEPPS team training model

The Team Structure domain relates to gathering necessary team members who include the patient and family members, for the purpose of collectively working toward a goal. The Patient Care Team circle surrounding the other four domains in the center of the model represents team structure. Successful performance in this domain would be a team that gathers the right people with the right skill sets to meet a goal. Recognizing the needs of the situation, gathering members who can meaningfully contribute, and utilizing each team member to their fullest potential are all components of this domain. The recognition and use of team members as described here parallels the RR domain as described in the IPEC Core Competencies (IPEC Expert Panel., 2011).

Leadership is the second domain in the TeamSTEPPS curriculum. The goal of leadership is to identify the best leader for the situation, not according to hierarchical structure. In this model, any team member could potentially lead the team depending on the situation. Effective team leader behaviors can be found in Table 6 (TeamSTEPPS Instructor Guide 2.0, 2014).

Table 6. Effective leadership behaviors

| |
|---|
| Define, assign, share, monitor, and modify a plan |
| Review the team’s performance |
| Establish “rules of engagement” |
| Manage and allocate resources effectively |
| Provide feedback regarding assigned responsibilities and progress toward the goal |
| Facilitate information sharing |
| Encourage team members to assist one another |
| Facilitate conflict resolution |
| Role model effective teamwork |

Situation monitoring, the third domain, is essentially team awareness of the needs and actions of one another. Components include situation awareness (knowing what’s going on around you), cross monitoring (watching each other’s back), and ensuring that everyone has a shared mental model (being on the same page). Shared mental models enable the team to anticipate and predict each other’s needs; identify changes in the team, task, or teammates, and ability to adjust the course of actions as needed to move toward a goal.

Mutual support, the fourth domain consists of three major activities including: assisting one another, providing and receiving feedback, and exerting assertive and advocacy behaviors when patient safety is threatened. Effective communication strategies designed to assist team members to address conflict in team situations are an important part of this domain. Acronyms including CUS (I am Concerned, Uncomfortable, or feel this is a Safety issue), and DESC (Describe the problem, Express your concern, Suggest alternatives, and describe the Consequences of actions) are acronyms that describe conflict resolution communication skills to achieve mutual support.

Communication is the fifth and final major component of the TeamSTEPPS model. Communication is a backbone of teamwork and plays a role in the other domains of team structure, leadership, situation monitoring, and mutual support. As noted earlier, communication is represented in the IPEC Core Competencies as well with many similarities between models in this area (IPEC Expert Panel, 2011). Communication goes beyond verbal words, to include awareness of the person one is communicating with, delivery technique (clear and brief), verbal tone, and body language.

## Teamwork Evaluation

TeamSTEPPS not only provides curriculum, but also recommends instruments that were developed to measure effectiveness. I chose two of these instruments for this research study to measure attitude toward teamwork using the TeamSTEPPS Teamwork Attitude Questionnaire (TAQ), and to measure teamwork skill competency with the

TeamSTEPPS Teamwork Performance Observation Tool (TPOT) which are described in the following sections. I chose these instruments primarily because they align with TeamSTEPPS curriculum and domains, and because of the evidence of validity and reliability for each.

According to the Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999), there are a total of 5 domains of validity evidence. A discussion of the relevant types of validity for each tool follows as well as evidence of reliability for the TAQ and TPOT instruments.

**TeamSTEPPS-Teamwork Attitude Questionnaire (TAQ).** The TAQ is an instrument developed for the purpose of measuring an individual's attitude toward teamwork as described in the TeamSTEPPS curriculum (Baker, Krokos, & Amodeo, 2008). Although other instruments measure teamwork attitude, I found none others in the literature that would assess teamwork attitude according to the five TeamSTEPPS domains (Baker et al., 2008). A copy of the TAQ is available online on AHRQ.org, and is provided in Appendix B.

***Initial development.*** The developers of the TAQ instrument included a group of researchers experienced in the area of instrument development, item writing, team principles, and TeamSTEPPS curriculum. Evidence of content validity was addressed at the beginning of the process by linking survey items to one of the five domains. An initial pool of 49 items were written based on knowledge of each of the TeamSTEPPS domains, with 7 items linked to team structure, 9 to communication, and 11 each to leadership, situation monitoring, and mutual support. This version was pilot-tested using paper copies on TeamSTEPPS training participants (n = 346) at a variety of military training facilities, and a sample of healthcare civilians (n = 149) sampled from a mid-Atlantic professional conference. After allowing for removal of partially completed surveys, the final sample consisted of 449, with 91.7% reporting they were direct care providers including nurses, doctors and dentists (Baker et al., 2008).

Statistical testing of the results of the pilot version followed, and included the use of standard procedures for computing means, standard deviations, and Cronbach's alpha. Using these data, and working toward the goals of equal items in each subcategory, and minimum number of items to adequately capture each construct, the researchers eliminated survey items that were considered repetitive, or that did not clearly contribute to measurement of the intended construct, resulting in a revised version of 30 items.

The final version contains six items under each subcategory, with individual Cronbach's alpha ranging from .70-.83, an acceptable level of internal validity evidence. These relatively low alphas may be the result of elimination of the high number of original items in order to create equal number of items per category. The decision to achieve equal numbers is not based on good practice of survey development and questionable, but rather should be determined statistically by factor analysis. If this was done by the researchers, it was not reported in the T-TAQ manual. Of the 30 items, four were reverse coded; three in mutual support and one in communication subcategory which can help identify scoring error where a rater may score all items the same without discriminating. Inter-correlations between constructs were calculated for the pilot test and revealed ranges from .36-.63 indicating there is some overlap of constructs, but a reasonable level of variance, providing preliminary evidence of construct validity (Baker et al., 2008).

The TAQ 2.0 version is a three-page tool that lists 30 statements divided by the TeamSTEPPS subcategory headings with a 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. According to the TeamSTEPPS TAQ manual, scoring of the tool can be done by either calculating the score for each individual construct, or an overall average of all five constructs (Baker et al., 2008). An open comment section is noted at the end of the survey labeled, "Please provide any additional comments in the space below" with approximately a three-inch vertical space that allows for qualitative comments.

***Ongoing evidence of validity and reliability.*** Reporting of further psychometric testing of the TAQ since it's development has been limited in the literature. A systematic review of the literature by Courtenay et al. (2013) identified that the most common outcome assessed in IPE was of safety or teamwork attitudes using the SAQ (safety attitude questionnaire), or the TAQ. Attitudes were assessed either as a needs assessment prior to implementing a team-training intervention, or as a pre/post to evaluate change surrounding an intervention. Both methods of administration timing are demonstrated in the literature, and the TAQ manual supports administration timing at the discretion of the researcher, with or without team training, or as a part of a quality improvement project (Baker et al., 2008).

Evidence of validity can be found in the literature by examining research studies that used the TAQ instrument. An example of the pre/post-administration of the TAQ comes from a study by Vertino (2014), who used the instrument with a group of licensed nurses and nurse techs (n = 18) on a single clinical unit where team training was implemented. Results of this study indicated a significant increase in TAQ scores following training with unadjusted mean pretest 4.20, posttest 4.64, change score of 0.44. Significance was calculated when controlling for years of experience and pretest score with ANCOVA analysis for total score ($F_{1,13} = 106$; $p < 0.001$), and all 5 domain scores at $p < 0.001$. While this sample was small, it offers some evidence of content validity.

Sawyer, Laubach, Hudak, Yamamura, and Pocrnich (2013), also used the TAQ as a pre/postmeasure to assess a change in teamwork attitude among physicians, nurses and respiratory therapists (n = 42) related to TeamSTEPPS team training. Results indicated an improvement from mean pretest of 4.4 $\pm$ 0.8 to a posttest mean of 4.7 $\pm$ 0.8 (95% CI -0.34- to -0.22, $p < .001$), effect size using Cohen's $d$ and Pearson's $r$ was small to moderate ($d = 0.34$ and $r = 0.39$). Interrater reliability was good calculated with Cohen's $\kappa$ of 0.86.

Similarly, Gordon et al. (2013) administered the T-TAQ as pre/posttest surrounding team simulations on a group of neonatal nurses and midwives (n = 45), and found an increase in total scores from pre-127 to post-131 that was not statistically significant. Another study in the neonatal clinical setting was by Colacchio, Johnston, Zigmont, Kappus, and Sudikoff (2012) who used the T-TAQ as a baseline measure of an interprofessional team of licensed and unlicensed members (n = 176). Rationale for pre-event only measure of attitude was to establish if attitude was appropriate for team training; confirmed with the mean per group ranging from 4.25 to 4.49 on a 5-point scale.

The T-TAQ was pilot-tested and continues to be used with a variety of healthcare professionals. Nursing and medicine were the most common disciplines but studies involving the T-TAQ with other disciplines include pharmacy (Brock et al., 2013; Caylor, Aebersold, Lapham, & Carlson, 2015; Shah, Heitmann, Mangolds, Zgurzynski, & Bird, 2014), physician assistants (Brock et al., 2013; Colacchio et al., 2012), respiratory therapists (Colacchio et al., 2012; Sawyer et al., 2013; Shah et al., 2014), and non-licensed professionals such as business professionals and patient care associates (Colacchio et al., 2012).

**TeamSTEPPS Team Performance Observation Tool (TPOT).** The TPOT instrument is designed to measure observable team competency skills of groups engaged in simulated or actual patient care. This instrument was chosen for my study because it is grounded in team theory that directly correlates with the TeamSTEPPS team-training curriculum, and because of evidence of validity and reliability. There are few tools that measure teamwork skills in the literature, and none that correlate with the domains as described by TeamSTEPPS. The TPOT is a one-page checklist of 23 items divided into five TeamSTEPPS domains. Each item describes observable behaviors to be rated on a 5-point scale ranging from 1 = very poor, to 5 = excellent. Team Structure, Communication and Mutual Support subscales consist of four items each, Leadership has six items, and Situation Monitoring includes five. Each subscale can be scored separately, or as a total according to the instrument's guidelines. A copy of the TPOT is available online on AHRQ's website, and is provided in Appendix C.

***Initial development.*** The Team Performance Observation Tool (TPOT) was originally designed to address a gap in valid and reliable team performance evaluation tools that could be used to measure team processes in the context of emergency room trauma resuscitation (Baker, Capella, Hawkes, Gallo, & Clinic, 2009). The development process began with interviews of 31 trauma team members from medicine, nursing, and respiratory therapy disciplines, from multiple organizations for the purpose of identifying key trauma resuscitation behaviors and overall team competencies. Researchers used 23 of the 31 interviews to develop the instrument model, and 9 interviews were used for validation purposes. Based on the interviews, items were written by experienced researchers in the areas of teamwork, item writing, surveys, and test development. Items were categorized into four domains of team leadership, situation monitoring, mutual support, and communication. The subcategory of Team Structure was not in the first draft of the tool, but later added as the fifth major construct of team performance. The final list of 23 items and four subscales was scrutinized by experts to ensure coverage of the entire intended construct of team performance during trauma resuscitation (Baker et al., 2009). This approach provides evidence of construct and face validity. To complete this phase, five trauma physicians were asked to view two trauma simulations performed as good and poor examples of trauma resuscitation teamwork. Items on the tool were evaluated to verify that behaviors were observable and clearly written (validity), and to verify the videos were appropriate examples of good and bad teamwork (reliability) (Baker et al., 2009).

The next phase of development consisted of trialing the tool to determine appropriateness of the individual items. Trauma nurses and ER registrars were chosen for rater-training because of their physical assignment in the ER where the scoring would ultimately occur, and familiarity with the trauma response process. In preparation for trialing, rater-training was implemented following a three step approach: (1) one-hour tool review and item discussion, (2) group practice scoring of four trauma response videos followed by discussion and feedback, and (3) independent rater scoring of same four trauma response videos with score comparison. This process led to further refinement and rewording of items. In the third step, using the revised 21-item tool, the raters independently scored four videos and responses were calculated to assess interrater agreement. Intra-class Correlations (ICCs) were computed by combining scores of 5 = excellent and 4 = good into one category, and combining scores of 2 = poor and 1 = very poor to establish four levels of good (5 and 4), average (score of 3), poor (2 and 1), and not observed. A moderate level of agreement across scenarios was found with ICC = .54, and an acceptable 75% average agreement on items among raters (Baker, et al., 2009).

Following this initial pilot testing, the tool was used by the trained observers to evaluate 33 live trauma resuscitations over 3 months in multiple sites. Statistical analysis for internal consistency was conducted by calculating alpha levels across all domains which ranged between .53 and .64 for each subscale, and .83 for the overall scale, supporting evidence of validity and reliability of the total score, and lacking evidence for use of the subscales alone. Intercorrelations of the four subscales ranged from .70 to .92 indicating there is some overlap of the subscales as expected. Baker et al. (2009) concluded that either the observers or the tool were not sensitive enough to distinguish individual subscales alone, but the instrument was statistically stronger as an overall team performance evaluation, and recommended use as a whole at that time.

***Ongoing evidence of TPOT validity.*** The first type of evidence of validity is content validity which is used to establish that a tool is measuring the targeted construct for the population being studied. Content validity also addresses whether a tool or instrument is inclusive of all aspects of the targeted construct it is meant to measure.

Evidence of content validity can be established by expert review of the instrument, researcher review of the scholarly literature, and by determining alignment with professional standards (Gall, Gall, & Borg, 2007).

Evidence of expert review is noted in the initial development process of the TPOT that began with writer experts in teams and research. Ongoing expert review and revision is evident in the most current version 2.0 of the TPOT (2014) which underwent changes from the original 1.0 version. The total items decreased from 25 to 23, with an overall decrease in Team Structure items from 6 items to 4, Leadership expanded from 5 items to 6, Situation Monitoring increased from 4 items to 5, Mutual Support section was decreased from 5 to 4 items, and the Communication section was decreased from 5 to 4 items. The design by expert writers, pilot testing, and process of ongoing review and revision, all add to the instrument's validity for measuring team performance. Sawyer et al. (2013) supported the use of the TPOT instrument in a resuscitation clinical context stating clear alignment with teamwork theory, and other studies have been conducted in different settings.

Researcher review of the literature in the development phase of an instrument lends evidence of content validity. Similar to the pilot testing sample and context, Capella et al. (2010) used the TPOT in a pre/poststudy that evaluated teamwork during trauma resuscitation for nurses, medical residents and faculty ($n$ = 73), and found that all TPOT domains and overall scores demonstrated significant improvement following team training (p = .001-.009), indicating validity for noting changes in teamwork competency.

Validity for using the TPOT in contexts outside of trauma came from later studies including Sawyer et al. (2013) who designed a study that evaluated teamwork in a neonatal resuscitation context for a sample (n = 42) of doctors, nurses and respiratory therapists. Content validity and relationship to other variables validity were justified for this alternate context by expert review noting alignment of TPOT and TeamSTEPPS with the standards of Neonatal Resuscitation Program (NRP) teamwork behaviors (Sawyer et al. 2013). Internal structure validity was evaluated by comparing scores of teams led by clinical experts, and teams led by less experienced medical fellows. Results found that the TPOT was able to distinguish differences in teams led by an expert attending physician, and a less-experienced fellow physician at baseline before team training (attending 3.0 $\pm$ 1.4; fellows 2.6 $\pm$ 1.2; [95% CI -0.77 to -0.13] p = .011) (Sawyer, et al., 2013). This finding supports internal structure validity of the TPOT.

Alignment with professional standards contributes evidence of content validity (Gall, Gall, & Borg, 2007). As described in the development phase, the TPOT was aligned with TeamSTEPPS curriculum, but additionally there is evidence of alignment with the IPEC Core Competencies (IPEC Expert Panel, 2011). The IPEC domains of Values/Ethics (VE), Roles/Responsibilities (RR), Interprofessional Communication (CC), and Teams and Teamwork (TT) demonstrate strong consistencies with the TeamSTEPPS curriculum and the TPOT instrument. There are elements of leadership in the TT domain, communication is a domain in both of these models, situation monitoring is found in the RR domain, and mutual support can be identified in the VE domain. The IPEC Core Competencies are highly regarded in healthcare professional arenas as being developed by an interprofessional, international panel of experts in research and teamwork. This alignment with IPEC Core Competencies provides strong evidence of content validity.

Evidence of relationship to other variables validity is established when a new instrument designed to measure the same construct as an established tool, with known validity and reliability, measures similarly to that tool, or when a tool measures expectedly for known differences in the variable of interest (Gall, Gall, & Borg, 2007). Initial evidence occurred during development of the TPOT when raters viewed both good and bad examples of team performance engaged in trauma resuscitation (Baker et al., 2009).

Ongoing validity evidence came from Zhang, Miller, Volkman, Meza, and Jones (2013) who conducted a study using the TPOT to measure team performance in groups of nursing and physical therapy students engaged in a simulated clinical experience. In an effort to decrease the subjectivity of the tool, the researchers operationalized the items into targeted behavioral markers (TBM) and were able to support validity by computing a negative correlation between the TPOT overall rating, and the number of medical errors committed by 24 teams (Spearman's rho = -0.531, $p = 0.008$), indicating high teamwork scores were related to fewer errors. A positive correlation was found between the TPOT and a time-based patient outcome (Spearman's rho = 0.803, $p < 0.001$) indicated high teamwork skills were related to the desired longer time at the bedside as was an indicator of good teamwork in that particular scenario (Zhang et al., 2013). Sawyer et al. (2013) also reported such evidence when higher scores on the TPOT were earned by teams led by attending physicians (considered experts) compared to groups led by the less experienced medical fellows. The evidence is promising and supports the valid use of the tool for distinguishing different levels of team performance in trauma and neonatal resuscitation.

Evidence of internal structure validity pertains to the relationship of each measurement item of a tool, in that individual measures will be consistent across other items focused on the same construct (Gall, Gall, & Borg, 2007). Internal structure refers to the soundness of the tool's ability to measure the target construct both individually and collectively. Most constructs are complex and consist of many facets, so it is reasonable to expect that measuring something, such as team performance, will require multiple items to capture all of the nuances of that construct. Evidence of internal structure validity ensures that all of these items are scoring relatively in the same direction, and that the list is inclusive to capture the construct in its entirety. Statistical analysis was conducted at the point of development of the TPOT with the final version demonstrating subscale alphas of .53, .57, .64, and .63 for leadership, situation monitoring, mutual support, and communication, respectively, and an overall tool alpha of .83 (Baker et al., 2009). Acceptable alpha levels are recognized at .70 or higher, therefore the low subscale alphas indicate that the use of subscales alone lacked suitable validity at that point. The overall tool alpha level does however meet the acceptable alpha level and offers evidence of internal structure validity when used in its entirety (Gall, Gall, & Borg, 2007).

***TPOT evidence of reliability.*** Classical test theory describes reliability as the extent of absence of measurement error in a score. While an instrument is developed to measure a certain characteristic, the measurement of that characteristic is subject to a certain amount of measurement error (Gall et al., 2007). Evidence of reliability can assist interpretation of an instrument's results, and pairing it with a tolerance for a certain level of measurement error can assist research consumers to make conclusions.

Evidence of reliability of stability is pertinent to quantitative measurement by observation, and is often noted in consistency of measurement by the same rater (intra-rater) and across different raters (interrater) (Gall, Gall, & Borg, 2007). Stability refers to the consistent scoring of a tool so that measurement error is minimized. An example of a tool's stability reliability is a test that is administered to the same person in consecutive intervals, under the same conditions, with similar results assuming no other extenuating circumstances exist in the retest (Gall et al., 2007).

Evidence of reliability of the TPOT interrater reliability testing using correlation ($\geq$ 0.80 is desired and considered good) was conducted at the time of tool development. Intra-class correlation (ICC) was calculated by combining ratings 4 and 5 (good and excellent) on the scale, and ratings 1 and 2 (very poor and poor), yielding a 4-point rating of good, average, poor and not applicable. Average ICC calculation of rater agreement on each item of the TPOT was .54, and average level of agreement was 75% among four raters. This level is considered moderate agreement (Baker et al., 2009; Gall et al., 2007). Sawyer et al. (2013) also reported interrater calculations when trained observers used the tool to evaluate neonatal resuscitation team performance, and found agreement to be good (Cohen's K = 0.86). In the study by Zhang et al. (2013), moderate interrater reliability (K = 0.452, $p < .001$) was achieved when operationalized targeted behavioral markers were identified for items on the instrument. They also demonstrated substantial test-retest reliability ($p < 0.001$) (Zhang et al., 2013).

Evidence of reliability of internal structure pertains to internal consistency that determines the extent to which a response by an individual on a single item of a tool tends to respond in a similar way on other items of the same tool (Gall, Gall, & Borg, 2007). Evidence of reliability of internal structure was established with initial development as described above, and supported by Zhang et al. (2013) with a calculated Cronbach's alpha of 0.921 for the total score; strong evidence of internal consistency reliability (Gall, Gall, & Borg, 2007).

Based on the available evidence, the TPOT has moderate to strong support as a valid and reliable instrument for measuring team performance in interprofessional groups engaged in trauma and neonatal cardiac arrest resuscitation. I used this instrument on inter-professional teams of students from medicine, nursing and respiratory therapy in the clinical context of adult resuscitation, thereby extending the evidence to use in an additional related context.

**Summary of Primary Research on Team Competency**

I chose to use the TeamSTEPPS team-training curriculum for this study, augmented with simulation because I believe it is a highly respected and validated curriculum for teaching teamwork principles. When team competencies were the focus of outcomes, the standardized curriculum most often used was CRM (crew resource management), which originated in aviation in 1979 to minimize error (Helmreich, Merritt, & Wilhelm, 1999), and TeamSTEPPS team training which incorporates CRM concepts along with human factors (HF), and Highly Reliable Organizations (HRO) theory (Clapper & Kong, 2012). There are many examples in the literature of studies that utilized TeamSTEPPS curriculum and evaluation tools. Primary IPE research that used CRM or TeamSTEPPS and simulation are discussed in more detail in the following section, with a selection of studies that share the same characteristics as this research study presented in detail.

Team or group learner outcome measurements were noted in a review by Courtenay et al. (2013) pertaining to trauma care. Evaluation studies (*n* = 12) tended to use CRM training, and team outcomes of knowledge gain, roles and responsibilities and correct ordering of skills. Descriptive studies addressed the leadership component of teamwork, and identified the importance of effective coordination and facilitation of collaborative decisions across disciplines (Courtenay et al., 2013). A common thread found in this review was the assessment of team composition and structure perception (attitude) which was associated with maintaining team stability (the Team Structure domain of TeamSTEPPS). Reviewers recommended focusing on interactive team processes rather than individual tasks and attitudes (Courtenay et al., 2013).

Team skills and competencies have been identified as outcome measures in the research literature. Measurement of teamwork skills or competencies is usually done by rating video or live observation of clinical teamwork, with a checklist instrument. Research evaluating teamwork skills according to CRM or TeamSTEPPS domains, was conducted by Kyrkjebo, Brattebo, and Smith-Strom (2006); Aebersold, Tschannen, and Sculli, (2013); and Paull et al. (2013). Researchers that used TeamSTEPPS team training in chronological order includes Capella et al. (2010), Weaver et al. (2010), Infante (2012), Brock et al. (2013), Goliat, Sharpnack, Madigan, Baker, and Trosclair (2013), Vertino et al. (2014), Shah et al. (2014), Watts et al. (2014), and Caylor et al. (2015). Studies that most closely resemble my proposed study will be described in detail below.

A study by van Schaik, Von Kohorn, and O'Sullivan (2008) designed an IP simulation scenario with the context of cardiac arrest resuscitation using post-licensure participants. Assessments were designed for measurement of pre/post self-efficacy in team roles, specifically leadership for medical residents, and team skills including communication, assessment (when and how to get help), and airway management for nurses. Pre- and 2-year post-test measures demonstrated that medical residents involved in the simulations scored significantly higher leadership confidence, and self-efficacy scores than those who received didactic only training ($p < .015$). Nurses scored significantly higher on team skill competencies ($p < .05$). Although a different measurement tool was used, both leadership and skill competency are components of overall teamwork, and directly relevant to the outcomes identified in my study.

Brock et al. (2013) conducted a research study for medical, nursing, pharmacy, and physician assistant (PA) students ($n = 149$) following a four hour modified TeamSTEPPS training, with three of the hours spent in simulation. The unique component of the design was the simulations created were a variety of clinical topics, and participants were allowed to self-select which simulations to participate in according to their interest and applicability to their practice. There were multiple post-intervention outcome measures that demonstrated a positive statistically significant effect including attitude ($p < .001$), self efficacy ($p = .005$), advocacy ($p < .001$), knowledge ($p < .001$), interprofessional communication ($p < .001$), and the major categories of TeamSTEPPS: team structure ($p = .002$), situation monitoring ($p < .001$), mutual support ($p = .003$), and communication ($p = .002$).

Capella et al. (2010) conducted an in situ study with a sample of medical residents, medical faculty, and nursing staff in an Emergency Department setting (n = 73). Using a pre/post design surrounding a modified TeamSTEPPS training, team performance was measured during actual trauma rescusitations. Results using the TPOT instrument were significant for all TeamSTEPPS domains with increases noted post-training in subcategories ($p$ = .001), and overall score ($p$ = .009). They also evaluated time efficiency to certain clinical benchmarks and found positive effects (ED to CT scan, $p$ =.005; ED to OR, $p$ = .02) where the team performed faster post-team training; a finding with potential for critical impact on patient outcomes.

Sawyer, et al., (2013) implemented TeamSTEPPS training for a group of nurses, physicians, and respiratory therapists, and found significant improvements in team competency in a neonatal resuscitation context as measured by pre/postTPOT. Each domain and overall scores were significantly improved: team structure (pretest 2.5, posttest 4.2 [95% CI -2.0 to -1.4]; $p$ <.001), leadership (pretest 2.6, posttest 4.4 [95% CI -2.0 to -1.4]; $p$ <.001), situation monitoring (pretest 2.5, posttest 4.3 [95% CI -2.2 to -1.5]; $p$ <.001), mutual support (pretest 2.9, posttest 4.3 [95% CI -1.8 to -1.0]; $p$ <.001), and communication (pretest 3.0, posttest 4.4 [95% CI -1.6 to -1.1]; $p$ <.001). Effect size was large with $d$ = 1.49 and $r$ = 0.6.

In summary, teamwork is a necessary skill in the healthcare setting for delivery of high quality and safe patient care, and has received significant attention from national initiatives aimed at improving team competency skills as related to patient safety. TeamSTEPPS offers a standardized curriculum and training program that is based on team theory and validated with multiple research studies, supporting effective use with a variety of disciplines and clinical contexts. Team outcomes should be measured as a benchmark of effective team training which may include attitude, knowledge, skills, or competency. TeamSTEPPS-related instruments, TAQ and TPOT, offer satisfactory evidence of validity and reliability for measuring teamwork attitude and team skill competency respectively.  Both of these instruments were used to evaluate learner outcomes following team training and simulation.

# CHAPTER III

# METHODS

The purpose of this study was to test a model of interprofessional education using simulation to improve teamwork and collaborative practice competencies in groups of undergraduate nursing, medical and respiratory therapy students. As part of a program evaluation project in 2014-2015, my course faculty colleagues and I offered two different time deliveries of interprofessional team training, one short-term over a few hours in one day, and one long term distributed over several weeks in an IRB-approved field-based study. At that time, outside of the dissertation process, interprofessional simulations were implemented with the support of special funding from The College of Health Professions as a way to promote interprofessional education for students. As a full-time faculty within that college, my colleagues and I decided to provide education using two different procedures (time distributed, and immersive) to evaluate the best way to teach students teamwork and collaborative practice.

Following additional IRB approval at The University of Akron, this dissertation study consisted of two phases, one that occurred at the time of team training during the 2014-15 academic year, when demographic and teamwork attitude surveys were collected three times over two semesters (see Table 7), and in the second phase when archived video-recordings of the simulations were accessed for teamwork skill analysis during the 2015-2016 academic year.

Table 7.  Team and individual sample description

| Training event | Teams (*f*) | Students (*f*) | Percentage | Training Method |
|---|---|---|---|---|
| 1(December) | 3 | 60 | 35.5 | Time Distributed |
| 2 (February) | 8 | 45 | 26.6 | Time Distributed |
| 3 (April) | 8 | 56 | 33.1 | Immersive |
| Total | 19 | 161 | 95.2 | |

Ex post facto survey data were analyzed along with new data from scoring of the simulations to allow for both attitude and skills to be evaluated related to teamwork competency.  Video recording is standard practice in healthcare simulations at The University of Akron, and these files had been archived and stored on a secure electronic server.  The nature of field-based research, especially when it involves the complexity of interprofessional simulation-based education, is such that these events are challenging and costly to plan and implement, therefore secondary analysis of these events was a practical decision to learn from these past events where a wealth of data can be accessed without additional cost.

I describe in this chapter the components of the research method that was used during data collection in 2014-2015 including the design, setting, participants, and sampling procedures.  I also include details related to the faculty who contributed to the planning and implementation of the education program, the team-training curriculum, the simulations, and the instrument used to evaluate pre/post-team attitudes for each education delivery method.  I also discuss the access of electronic archived video-recordings of simulations, and the instrument used for analysis of teamwork skills. I conclude this chapter with a description of the statistical data analyses chosen for evaluating the research questions of the study.

## Research Design

This study drew from multiple quantitative designs including ex post facto analysis strengthened by procedures of randomization, use of validated instruments, and video rater training procedures. Teamwork attitude survey data collected in 2014-2015 was accessed ex post facto in combination with new data collection derived from review of archived video-recordings. Although ex post facto design carries certain disadvantages related to inability to make changes to data collection that has already occurred, other steps were used to embed elements of quasi-experimental design to counter-balance the disadvantages. These steps included random assignment of students within a cohort onto teams for simulation activities, the use of validated instruments to measure team attitude and skills, and standardized training for video raters. Each of these will be described in the following sections, and were implemented to strengthen the validity of the study. A quantitative design was chosen for this study based on review of the literature, in order to build on other studies that have established some evidence of the influence of team-training on healthcare providers' attitudes toward teamwork, and acquisition of teamwork skills (Abu-Rish et al., 2012; Baker et al., 2008; Barr et al., 2005; Brock et al., 2013; Courtenay et al., 2013; Hammick et al., 2007; Oandasan & Reeves, 2005; Reeves et al., 2011; Reeves et al., 2015). This study will contribute to the literature evidence that is collected at the team unit level rather than the individual level which is a noted gap in healthcare team research, as well as both teamwork attitude and skill components of teamwork competency.

## Research Setting

For effective simulation based education, it is vital to have a training environment that can realistically recreate the clinical practice setting, offer technology and clinical teaching support, and space capacities for the intended number of IPE learners. The Austen Simulation Center (ASC), located near The University of Akron campus, met these requirements and was the setting where data collection took place. A state-of-the art facility, ASC specializes in simulation-based training, was readily available to students and faculty, and possessed the equipment and personnel to support teaching with simulation and research. The simulation rooms were designed to appropriately represent the critical care patient room environment. Each space was equipped with a cardiac monitor display, a full body, high-fidelity manikin in a hospital bed, and other health equipment used in clinical practice. The authenticity of the simulation setting is necessary to minimize disbelief that the manikin is an actual patient, and leads the student to act as though providing care to a real person. Each simulation room was set up to video record activity from three to four different angles that is stored on a secure password protected server. Control rooms were equipped with one-way glass to allow the educators and technicians operating the manikin to remain out of sight from the learners. Additionally, a large auditorium-style classroom was available for large group activities used for briefing and debriefing at the beginning and end of a simulation event.

## Procedures

There were five basic steps included in this research study that were followed during the 2014-2015 academic year that generated ex post facto data for this dissertation. These steps included: (a) participant selection, (b) team training (immersive/short or time-distributed/long version), (c) interprofessional team assignment, (d) demographic and teamwork attitude assessment, and (e) team simulations. A sixth step, (f) teamwork skill competency assessments, using archived video recordings, generated the final component of data.

### Participant Selection

There were three types of healthcare students engaged in collaborative learning during the 2014-2015 data collection. The first type was baccalaureate nursing students, the second type respiratory therapy students, and the third type medical students. These students were identified by collaborating faculty who chose students that met the study criteria as described below. The core education team consisted of three nursing, two respiratory therapy, and one medical educator; all had many years of experience in teaching and using simulation-based methods. Additional educators and technicians were utilized for simulation implementation in supportive roles as employees of the simulation center.

**Participant characteristics**. There were three required characteristics of all healthcare student participants for this study: (a) upper level course enrollment, (b) experience with simulation learning, and (c) prerequisite clinical knowledge pertaining to care of patients with cardiac arrest (the clinical context of the simulation scenario). The rationale for requiring upper level students is supported in IPE literature, because students in upper level courses have a stronger sense of their professional role identity and are better able to represent their viewpoint when engaged in shared decision-making with interprofessional groups (D'eon, 2005). All students selected were in their third or fourth year of their respective undergraduate programs.

The second participant characteristic was experience with simulation learning. This characteristic was chosen because learner outcomes are less likely to be effected by a familiar teaching method. Learning that occurs with human patient simulation is different from more traditional learning methods, or clinical experiences with actual patients. Students in simulation are expected to respond to cues provided by a manikin intended to represent an actual human patient. Unfamiliarity with this type of learning may result in invalid or unreliable responses, due to their adjustment to the teaching method. Prior experience with simulation-based learning helps to minimize this bias, and provide validity to data collection of teamwork skill competencies measured during the simulations. A best practice in simulation learning is to remove barriers that prevent students from accepting the simulated experience as an authentic clinical experience; controlling for experience with simulation ensured all learners were at the same level for this potential barrier (Decker, 2007; Oandasan & Reeves, 2005).

The third participant characteristic, possession of prerequisite knowledge of care required for a victim of cardiac arrest, was important for maintaining the focused learning objectives on teamwork. The TeamSTEPPS team training guide emphasizes the importance of not combining unknown clinical contexts with team training, but rather to use one that is familiar so as not to distract from applying team behaviors (TeamSTEPPS Instructor Guide 2.0, 2014). The clinical context provides a situated learning cognitive frame that gives structure to the learning experience, and supports higher level understanding and recall in future similar events (Lave & Wenger, 1991). Patients with a cardiac arrest require interprofessional teamwork that was relevant to all disciplines involved, and examples in the literature are noted for using this context for development of teamwork competencies (Sawyer et al., 2013; Watts et al., 2014). Strengthening team skills during cardiac resuscitation can ultimately lead to the outcome of higher quality patient care when applied to real clinical practice. Consideration was also given to create a patient care scenario that would be representative of actual practice to authenticate the importance of student learning. When a learning activity is recognized as relevant to future practice, it will be more likely to fully engage student attention and effort toward learning (Knowles, 1984; Oandasan & Reeves, 2005).

To ensure that student knowledge related to care of a cardiac arrest victim was established, students were instructed to prepare for this, and were given resources related to care of cardiac arrest pre-simulation. All health profession students are required to maintain basic life support (BLS) certification which teaches the steps for treating a cardiac arrest victim. Established curriculum in the critical care nursing course, from which nursing students were recruited, included weekly topics that built on BLS concepts in didactic and simulation leading up to the IP event. Medical and RT students also received classroom and clinical experiences that related to care of the cardiac arrest patient prior to the IP simulations. This baseline learning served to establish adequate knowledge base for the simulation, and was assessed with a survey item on the day of the simulation; survey details are shared later in this chapter.

**Nursing student selection.** Nursing students were recruited from the Nursing in Complex and Critical Situations (8200:430) course at The University of Akron, School of Nursing, College of Health Professions during the 2014-2015 academic year. These students were chosen because I am an established instructor in this critical care nursing course, and have a clear understanding of the students, curriculum, teaching methods, and learning outcomes that align with the goals of this study. I designed the learning event with this student population in mind, aware of their characteristics as fourth-year students, experience learning with simulation, and baseline knowledge of cardiac arrest. I also recognized that practicing nurses in critical care are required to have effective teamwork skills and attitudes, thereby aligning with desired practice outcomes for the course (Bell, 2008).

Random sampling of students is not practical due to the design features, and availability of students with required characteristics. The nature of interprofessional education with simulation requires physical proximity and common schedule availability to implement, therefor access to students who meet study criteria and schedule availability is somewhat limited. Through reporting of student characteristics included in demographic data collection, this sample can be critiqued for representativeness of other baccalaureate nursing students enrolled in a critical care course. The number of nursing students ranged from 34 to 49 for each cohort, based on course enrollment. Total nursing students were divided equally between eight teams with four to six nursing students per team. Limitations of the facility and faculty resources needed to implement the simulations restricted the number of teams to no more than eight for each session.

**Respiratory therapy student selection.** The purposive recruiting of respiratory therapy (RT) students was based on faculty input regarding alignment with student learning objectives, their meeting the three required student characteristics of the study, and availability for scheduled IP simulations. Collaborating faculty (Ms. Kelli Chronister and Mr. Marc Haas) were current UA faculty in the respiratory therapy program in the School of Allied Health, College of Health Professions. During planning, both identified potential student participants from those enrolled in the third or fourth year of the RT program. During the 2014 fall semester, fourth year students were chosen from the UA 2790:421 Advanced cardiac life support (ACLS) and pediatric advanced life support (PALS) course which contains content regarding care of patients with cardiac arrest. Spring semester students were enrolled in a different course, but had the experience of the fall courses before their participation. Faculty verified that the RT students had all been exposed to simulation learning, and therefor meet that required participant characteristic. The number of RT students ranged from 4 to 8 for each IP event with assignment to one or two teams to allow for representation of the RT discipline on all teams.

**Medical student selection.** Medical students with the desired characteristics were identified and recruited by Dr. Rami Ahmed, a collaborating medical educator from Summa Health Systems, with experience in Emergency Medicine, as well as simulation-based and IP education. The medical students chosen were enrolled in an emergency medicine rotation where they were expected to be prepared to lead a response to a cardiac arrest patient. Additionally, medical faculty confirmed the students had previous simulation learning experience in their education program. The number of medical students ranged from 4 to 6 for each event, and because recruited medical students were fewer than the total number of teams, each was assigned to one or two teams to allow for medical representation in each simulation.

**Informed consent.** All students were provided informed consent following the same procedure, with core educators providing an explanation of the study verbally in person, or electronically via email using the standard script (see Appendix D). Questions were answered, and reassurances given that participation was voluntary, there was no effect on the student's grade earned in a course, and the minimal risks and projected benefits of participation. A written signed consent was obtained from those agreeing to participate (see Appendix E) on the day of the IPE event. Students who chose not to be part of the study were permitted to participate in the simulations provided they sign the Consent for Photography form that allowed for video recording of the simulations. Non-study participants did not complete the demographic or attitude surveys.

Recording simulation is standard practice in the School of Nursing to allow educators to use them for quality improvement of teaching strategies, for student evaluation, or for student self-assessment. Consent for viewing and rating simulation video recordings in this study was covered with the signing of the Consent for Photography form, and additionally with the signing of the study consent form at the time of the simulations in 2014-2015. Nursing students sign the Consent for Photography on admission to the School of Nursing, all other simulation participants signed this form on the day of the simulations regardless of study participation. All team simulations were recorded and stored on a secure server, with access granted to primary faculty by the simulation center.

**Summary of sample characteristics.** The sample used in this study consisted of both individual students and teams of students. The number of individuals and teams used in this study, along with their assignment to one of the two training methods used were noted earlier in Table 7. Although students were divided onto eight teams on each date, technical error resulted in loss of video-recording for five of the teams on the first date, with only three videos available for data collection.

Demographic information was derived from an eight-item survey (Appendix G) administered at the beginning of each simulation training day. These details were used to better understand the sample that was used in this study. A description of chosen demographics for the total sample broken down by profession, including gender, experience with IPE, completion of prework learning and age, are summarized in Tables 8 and 9.

I chose demographic items based on review of the literature for other IPE studies, and to assist with generalizability of results to students with similarly distributed demographics. Some conclusions can be made by analyzing the breakdown of the sample's characteristics. While the total number of students appears unbalanced by profession, the team makeup of one medical student, one or two respiratory therapy (RT) students, and four to six nursing students is comparable to professional practice ratios for a cardiac arrest response. The higher number of nursing students, 76.4% of the total sample, was due to the fact that the IPE experience originated from nursing faculty for the purpose of exposing students to an interprofessional learning experience. As part of the curriculum in that course, all enrolled were required to participate. The medicine and respiratory therapy students were recruited as volunteers by collaborating faculty, and

Table 8. Detailed sample demographics by profession

| Survey item | Nursing | | Medicine | | Respiratory | | Total/ All | |
|---|---|---|---|---|---|---|---|---|
| | *f* | % | *f* | % | *f* | % | *f* | % |
| Gender | | | | | | | | |
| Male | 23 | 18.7 | 9 | 69.2 | 4 | 22.2 | 36 | 21.3 |
| Female | 100 | 81.3 | 4 | 30.8 | 14 | 77.8 | 118 | 69.8 |
| Missing | | | | | | | 15 | 8.9 |
| IPE experience | | | | | | | | |
| Yes | 80 | 65 | 11 | 92 | 5 | 28 | 96 | 56.8 |
| No | 43 | 35 | 1 | 8 | 13 | 72 | 57 | 33.7 |
| Prework completion | | | | | | | | |
| Yes | 115 | 93.5 | 10 | 76.9 | 18 | 100 | 145 | 90.1 |
| No | 7 | 5.7 | 3 | 23.1 | 0 | 0 | 10 | 6.2 |
| Total | 123 | 76.4 | 13 | 8 | 18 | 11.2 | 161 | |

Table 9. Age in years of participants by profession

| Discipline | n | Mean Age (years) | SD | Min | Max |
|---|---|---|---|---|---|
| Nursing | 123 | 24.4 | 5 | 20 | 47 |
| Medicine | 13 | 24.8 | 1.6 | 23 | 28 |
| Respiratory Therapy | 18 | 25 | 4.9 | 20 | 37 |

came from a smaller pool, therefor resulted in fewer students. The main recruiting barrier for medicine according to their educator, was schedule conflict issues. Respiratory therapy student recruitment was advocated by collaborating faculty and incorporated into classroom activities, but was limited by the smaller class size in comparison to nursing.

Gender characteristics of the total sample are weighted more heavily female (69.8%) than male. This too can be explained by the heavier representation of nursing students in the sample with a high percentage of female gender, which is typical in practice. Additionally, the majority of the respiratory therapy students in this sample are female adding to the overall higher percentage. Because the balance of profession and gender mimics what naturally occurs in clinical practice, I do not feel this is a bias in the sample.

Prior involvement in interprofessional learning was reported in over half of the total sample. A comparison by profession reveals that medical students reported much more previous experience with IPE as compared to nursing and RT students. This difference underlines local education program practices where incorporation of IPE into curriculums is more common in medicine, and least common in RT. The level of novelty to IP learning for the students may influence their attitudes and skills when working with others outside of their own discipline. For example, if a student has never had exposure to IP learning, it could lead to higher anxiety or negative attitudes toward other professionals as explained by Social Identity Theory (Allport, 1954).

Compliance with pre-simulation learning which consisted of viewing a voice-over recording slideshow about TeamSTEPPS, was very high across all disciplines. There were some differences in educators for assigning this pre-work with RT faculty using classroom time, nursing faculty assigning independent viewing followed by a required online discussion, and the medical faculty assigning independent viewing alone. Validity of the nursing responses who answered they did not complete this is questionable, because it was part of a graded discussion assignment that was tracked at 100% compliance. Reasons for the disconnect on the survey item for nurses may be rater or survey error causing misunderstanding, misreading of the survey question, or true responses indicating discussions were done without viewing. For medical students who reported not completing the assigned pre-work, it is possible they had previous teamwork knowledge and decided not to view, rater or survey error similar to nursing, or they came to the simulations without a baseline of teamwork knowledge. Upon further inspection, of those that were not compliant, three medical students included one student on each day of data collection, and the seven students were distributed at random with two each on the first two days, and three on the third day. Random team assignment lowered the probability of combining non-compliant students on the same team. Compliance was high overall, and not likely to have a significant biased effect on teamwork outcomes.

**Team Training**

The team training program used in the instructional setting was a modified version of the TeamSTEPPS® Fundamentals curriculum. Delivery method of this curriculum constituted the primary independent variable of this study; one group received training over several weeks in a distributed delivery, and the other group received training over several hours in a one-day immersive training. The delivery method was alternated by cohort every 8 weeks. It is not logistically possible to use more than one training method for each cohort of student learners due to practicality for faculty and other resources, therefore assignment to treatment groups was determined by cohort so that an entire nursing class was provided with the same training method.

The modifications to the TeamSTEPPS curriculum was to provide an overview of all subcategories of teamwork, followed by a concentration on Situation Monitoring, Mutual Support, and Communication as the most salient for the learning outcomes. Providing a full scale TeamSTEPPS training was not possible given time constraints, therefore the other educators and I decided to focus on these categories that were most relevant to the simulation, and most in need of reinforcement through practice. Situation Monitoring includes such skills as awareness of the big picture, and lending support where it is needed, all the while maintaining a shared mental model (TeamSTEPPS Instructor Guide 2.0, 2014). Mutual Support entails responding to the needs of the team with back up behavior, as well as how to communicate professionally when conflict among team members occurs; another area identified by educators that students need developed. Communication techniques are associated with each subcategory and were included in the modified training as well.

**Time-distributed team training.** Delivery of team training curriculum to nursing students occurred at three delivery points over a 7-week period. This was the training method for two cohorts, once in fall semester of 2014, and once in spring semester of 2015. An overview of TeamSTEPPS team training was assigned to students to view during the first week of the course as a 20-minute video recording. A reflective exercise followed this viewing in the form of an ungraded reflective journal. The second and third delivery occurred in the fourth and sixth weeks of the course as a voice-over slide presentation focused on Mutual Support and Situation Monitoring subtopics of the

TeamSTEPPS curriculum; each were followed by a small group online discussion. In the seventh week students engaged in three interprofessional simulations over 2 hours.

Non-nursing students in the study also received some of the same education components described for the nursing students. Because these students were not enrolled in a common course, but rather brought together specifically for the simulation event, inclusion of classroom content was determined by their own faculty. To provide common learning for the RT and medical students, they were given online access to an abbreviated version of the voice-over slideshow team training presentation in the week before the simulations. All students were informed that viewing the slideshow was a requirement for participation in the IP simulations. The recordings were researcher-created using slides provided by the standard TeamSTEPPS curriculum. Additionally, all students were instructed to prepare independently for simulations by reviewing the care of a patient in cardiac arrest.

The purpose of assigning pre-simulation learning activities to all students was to provide a common learning experience, provide scaffolding for learning, and to insure there was a shared mental model of what was meant by teamwork, and specifically situation monitoring, mutual support, and communication expectations. This knowledge component serves as a mental reference and cognitive frame for application of teamwork skills in the simulation experiences. (TeamSTEPPS Instructor Guide 2.0, 2014, (National Research Council, 2000)). Verification that the student actually viewed the recording was incorporated as an item on the demographic survey as reported earlier in Table 8.

**Immersive team training**. Students who were in the immersive training group received team training on the day of the IP simulation event only. Pre-classroom learning included an assignment to view the same 20 minute TeamSTEPPS® overview recording before class, up to five days before the immersive training. Earlier on the day of the IP simulations, the nursing students' scheduled two-hour class was dedicated to team training, beginning with a brief review of the concepts from the video recording, followed by guided small group case study discussions. In an effort to minimize differences beyond time delivery of training between groups, the same didactic TeamSTEPPS slides targeting Mutual Support and Situation Monitoring components, and the same case studies used for discussions were used for this group as was used in the time-distributed learning group. Additionally, educators were consistent between training methods for didactic and discussion activities, using the same content and case studies. For this group, the IP simulations began 1 hour following the face-to-face classroom activities. A difference that did exist between training groups was the use of online discussions in the time-distributed group versus face-to-face in the immersive group. The decision to use face-to-face discussions was a logistical one that required immersive training to occur in one day progressing from didactic delivery to discussion application, and culminating in simulations. Time-distributed logistics dictated the need for online discussions at repeated points of teamwork training.

**Interprofessional Team Assignments**

Assignment of students to IP teams for simulations consisted of multiple steps. I made the decision to randomly assign participants to teams for two reasons, to mimic the nature of actual clinical practice where professionals do not choose their team, but rather work with others who are scheduled at the same time (called ad hoc teams), and to decrease the risk of bias that could occur if students self-selected. Self-selection could have influenced group dynamics either positively or negatively due to preconceived opinions of their peers, or experiences working together before the IP simulations, and would have been a potential threat to validity of study results.

My two primary goals for team assignment were to achieve a diversity of professions and a target team size of four to seven members.  These goals were set to parallel the ratio and team size found in clinical practice.  Additionally, the literature reports similar team sizes and diversity for IP simulations for teamwork research and for cardiac arrest simulations (Sawyer et al., 2013; Watts et al., 2014).  The most common size of learner groups has been five to ten individuals (Oandasan & Reeves, 2005; Reeves, 2000).

All nursing students enrolled in the critical care course were required to participate in the simulations as an established learning program.  As described, those who chose not to participate in the study were excused from survey completion only. Working from the class roster, I randomly assigned four to six nursing participants per team by alphabetically placing the first student on team one, the second on team two, and continuing to the eighth team, then repeating until all students were assigned.  Medical and RT students were equally distributed to teams in a similar random manner, assigning one or two students per team.  There were always at least two professions represented on all teams.  When medical or RT students were assigned to two teams, they completed the simulation with both teams.  Students were not permitted to change their team assignment.

## Teamwork Attitude Assessment

Baseline data collection occurred on the day of the simulation event, and included a 30-item Teamwork Attitude Questionnaire (TAQ) available in Appendix B. Pre-simulation teamwork attitude was collected using the TAQ instrument as a baseline when students came to the simulation center, prior to orientation to the IPE event. The decision to assess team attitudes pre-simulation, rather than pre-team-training was based on logistical limitations that did not allow access to all students prior to the day of the simulation training event. Post-simulation measurement of teamwork attitude using the same TAQ instrument was collected immediately following their IP simulations. These surveys were used in this dissertation study as ex post facto data due the prior collection in the academic year 2014-2015.

## Team Simulations

At the time of simulation implementation (2014-2015 academic year), scenarios were scheduled in four 30-minute stations that teams rotated through over a 2-hour period. Each simulation was designed to last approximately 15-20 minutes using the event-based approach to training (EBAT) format. The EBAT design divides a simulation into event sets where specific cues are embedded to act as triggers for learners to act or respond to, all geared toward stated learning objectives (Fowlkes et al., 1998). The EBAT map of the cardiac arrest simulation, including corresponding debriefing cues, can be found in Appendix A. The basic scenario began with report about a stable patient presenting with a cardiac condition that quickly deteriorates to a cardiac arrest. Students are expected to respond to this condition with treatments including CPR (cardio-pulmonary resuscitation), medication and electrical therapies, ending with recovery to return of spontaneous circulation (ROSC). Students have patient information in a mock health record, realistic equipment including life-like medications, live defibrillators, and a cardiac monitor to use in their response.

Each simulation station had one team performing in an active role, engaged in patient care, and another team in the observer role using a peer performance checklist. The purpose of the checklist was to provide purpose to their observations, and to give them objective evidence to use in a peer-peer debriefing session that followed the simulation. After the first team completed the simulation, learners switched roles for a similar but different cardiac arrest scenario. Debriefing occurred after both teams completed the simulations.

Structured debriefing immediately following simulation lasted approximately 15-20 minutes, led by one or two educators. For the purpose of consistency, a predetermined list of debriefing cues was used focusing on teamwork learning objectives (Appendix A). The debriefing method used was debriefing with good judgment which uses an advocacy/inquiry style similar to Socratic questioning. The term “good judgment” is used to describe evaluation that is not negative or demeaning, but also not overly positive when critique is needed to improve a learner’s behavior (Decker, 2007; Fanning & Gaba, 2007; Mort & Donahue, 2004; Rudolph, Simon, Rivard, Dufresne, & Raemer, 2007). Best debriefing practices were observed that fosters reflection of participants, sharing of rationale for behaviors, clinical decisions, emotions associated with the experience, and application to actual practice (Decker et al., 2013; Fritzsche et al. 2004; Hravnak, Tuite, & Baldisseri, 2005). Effective debriefing is demonstrated when learners speak more than facilitators, and reflections on action are shared according to learning objectives. To ensure quality debriefing and consistency among educators, I conducted an educator briefing to discuss expectations prior to each simulation event.

## Teamwork Skill Competency Assessment

As earlier disclosed, teamwork skill competency was assessed ex post facto via video recording for students in this research study. These videos were viewed and scored by trained observers using the Teamwork Performance Observation Tool (TPOT). This phase of data collection is considered ex post facto because the team training and simulations had already been completed, but was an unused source of data. The addition of these data along with the collected demographic and teamwork attitude surveys, allowed for a more robust assessment of influences on teamwork competency which theoretically includes both components of attitude and skills.

**Simulation video rater training.** There were three independent raters who coded the videos for teamwork skill behaviors using the TPOT instrument. One of the raters was a TeamSTEPPS Master Trainer (rater 2) and the other two completed the TeamSTEPPS Fundamentals training course (raters 1 and 3). This training supports their qualification for coding TeamSTEPPS behavior based on familiarity and understanding of teamwork as defined by TeamSTEPPS curriculum. Additionally, all raters have a critical care clinical background, two as critical care nurse instructors, and one a graduate assistant who practices as a critical care nurse while enrolled in a nurse anesthesia program. Their clinical expertise ensures understanding of the critical care simulation scenarios, and further supports validity of their rating ability.

Prior to data collection, I met with the first rater for 3 hours to review the instrument, discuss the items under each subcategory, and to operationalize the items with targeted behavioral markers (TBM). This is the method described by Zhang et al. (2013) for increasing intra-rater and interrater reliability with the TPOT instrument. TBMs are examples of behavior that represent an item on the TPOT instrument with consideration for the simulation scenario. Once the TBMs, were identified, we viewed and individually rated a video, discussed rationale for our scoring, revised the TBMs for clarity, and repeated the process. The decision was made to eliminate three items on the instrument that were not in line with the design of the scenario, leadership item b, and mutual support items c and d. The mutual support items were unable to be rated because conflict between team members was required for these items, and was not built into the scenario. The leadership item b was identified as too similar to item c, which both had to do with balancing workload among team members. A total of five iterations of TBMs were trialed before agreeing on the final version.

An Intra-Class Correlation (ICC) calculation is used to determine rater agreement as a form of reliability by comparing the variability of different ratings of the same subject. An ICC of 0.8 or higher was deemed acceptable interrater agreement. For this calculation, the TPOT scores were condensed from five levels to three, with scores of 1 and 2 combined to represent lower demonstration of skills, scores of 4 and 5 were combined to represent higher skill rating, and a score of three was considered average or expected behavior. This collapsing of scores to three levels for calculating ICC reliability was modeled from the method used by the developers of the tool (Baker, Capella, Hawkes, Gallo, & Clinic, 2009). The final version of TBMs yielded an ICC > 0.8 for two raters, myself and rater 1, and, therefore, was deemed acceptable for data collection.

Raters 2 and 3 received a 3-hour structured training for use of the TPOT that included an explanation of the instrument and TBMs, and practice rating videos. Independent scoring of the same three training videos as was used with rater 1 was completed, debriefed, and clarifications made. By the end of the third video, scores compared with ICC calculations to rater 1 was achieved at greater than 0.8. Following training, all raters scored each of the videos independently and submitted to me for data entry. Items that were scored differently by 2 points or more on the rating scale by different raters, were revisited by consulting the qualitative written comments and reassessment by the raters.

**Participant Protection of Privacy**

All data collected during the 2014-2015 academic year have been kept confidential, with surveys stored in a secure location. All completed surveys and consent forms when collected were placed in a confidential sealed envelope until used for data entry. Surveys did not contain names or markings that could identify the participant beyond the identifiers of the demographics. Electronic data in the form of data entry into SPSS were stored on my University-owned password protected laptop computer and USB drive kept in a secure location. Hard copies of scored videos, consent forms, and completed surveys have been stored in a locked cabinet in my office and will be destroyed at the end of 5 years. Videos were accessed and viewed only by trained observers for the purpose of this research, and stored on secured USB drives, and my University-owned computer hard drive.

## Data Analysis

Data analysis procedures are complex for this study due to the number of variables and variety of data collection that occurred on the individual and team levels. In this section I describe the initial steps of data screening, associated with univariate and multivariate statistical analyses, procedures to calculate team level data, and comparisons between treatment groups in order to establish equality. Finally, I describe the statistical analysis procedures chosen to address the research questions, and provide rationale for appropriateness. All quantitative data were analyzed using SPSS (version 22.0) software except where noted.

**Pre-analysis Data Cleaning**

Prior to the analyzing, variables were screened for missing data and miscoded entries. Results of screening items from the demographic survey revealed no miscoding by running explore procedures in SPSS, with no entries found outside of the defined limits. Missing items were not replaced for any of the eight items on the demographic survey. Overall, there were 8 (5%) missing discipline entries, 6 (3.7%) missing gender entries, 8 (5%) missing IP experience entries, 6 (3.7%) missing prework entries, 7 (4.3%) missing entries each for feelings of preparation for a cardiac arrest and anxiety related to IPE and 6 (3.9%) missing age entries. These percentages of missing data were minimal and not likely to cause misrepresentation of the data.

Data screening of the teamwork skills (TPOT) and teamwork attitude (pre-TAQ and post-TAQ) items were performed using the SPSS explore procedure. There were no missing or miscoded items on the TPOT data entries as revealed by examination of the minimum and maximum entries, and further steps were not required. The pre-TAQ screening revealed there were no miscoded items that were recorded outside of the 1-5 range, but there were missing items.  A total of nine participants (5.6%) were identified who did not complete the entire pre-TAQ and were eliminated from the dataset. Additionally, two surveys (ID 1 and ID 4) were missing six or seven consecutive items, equivalent to one page of the TAQ survey, and were also eliminated from analysis.  To determine if these eliminations were part of a pattern, further inspection was undertaken. Of those eliminated, 10.7% and 5.7% missing pre-TAQ surveys were from the immersive and distributed treatment groups respectively, and by discipline 7.8% and 10.5% of nursing and RT, indicating no pattern that would risk a group's underrepresentation in further analysis.  There were two surveys (ID 12 and ID 98) that revealed a single item omission on the survey, and I replaced these items with the mean score for that item. Replacement of a single missed item in data screening procedures with the item's mean score is an acceptable way to prepare data for further analysis according to Mertler and Vannatta, (2010).

Of those remaining in the dataset after elimination from pre-TAQ screening, the process continued with screening of the post-TAQ surveys.  There were three (1.9%) who did not complete the entire survey and were eliminated from analyses.  This minimal amount did not warrant further scrutiny for patterns.   There were five participants who each had one missing item (ID 34, 57, 82, 84, and 133), and these were replaced with the item mean score.  These missing items were minimal, and showed a non-systematic distribution.

Because the TAQ was to be used as team level data, the effect of missing surveys was assessed at the team level.  Teams with more than one missing pre-TAQ survey occurred on two teams who had two or three missing surveys (Team 11 on day 1, and

Team 24 on day 2), both in the time-distributed training group. Two different teams had two or three missing post-TAQ surveys (teams 31 and 35 on day 3) in the immersive team training group. Teams with more than one member failing to report teamwork attitude may influence team scores made up of five to eight people. I made the decision not to eliminate these teams from team level attitude analyses to prevent further decreasing the team sample size; however, interpretation will be subject to this limitation in data collection.

**Reliability Testing of Teamwork Scales**

Internal consistency was assessed for the TAQ and TPOT scales by calculating the Cronbach's alpha for each subscale and total scale. The total TAQ scale consisting of 30 items had a high level of internal consistency as determined by a Cronbach's alpha of .88. The total TPOT scale of 20 items also had a high level of internal consistency as determined by a Cronbach's alpha of .93. (Table 10).

Table 10. Summary of Cronbach alpha scores for TAQ and TPOT scales

| Subscale | TAQ items | TAQ Alpha | TPOT items | TPOT alpha |
|---|---|---|---|---|
| Team Structure | 6 | .76 | 4 | .73 |
| Leadership | 6 | .87 | 5 | .88 |
| Situation Monitoring | 6 | .88 | 5 | .82 |
| Mutual Support | 6 | .71 | 2 | .83 |
| Communication | 6 | .52 | 4 | .80 |
| Total scale | 30 | .88 | 20 | .93 |

The TAQ scale consists of 30 items employed to measure teamwork attitude with five subscales. Individual subscales alpha scores were all above the acceptable .7 level except communication (.521) primarily due to item 6 which was written in reverse code that would raise the level of alpha to .821 if eliminated. Because the overall scale alpha was high, the communication item 6 was not eliminated, and the total score was deemed reliable for measuring teamwork attitude.

The TPOT scale consists of 23 items originally, and after deletion of one leadership item (item b), and two mutual support items (items c and d), only 20 items were used in this study. The decision to delete these items was based on researcher and rater agreement when operationalizing items into targeted behavioral markers as described in an earlier section of this chapter. Since the total scale resulted in a very high alpha as revised, the revised scale was deemed appropriate for measuring teamwork skills reliably.

**Description of Participants According to Profession**

Descriptive analyses were done to explore differences among professions, and also to compare team training groups before IP simulations. Leading up to the simulations, all learning occurred at the single professional level, thus marking this assessment made at the point pre-simulation separates single profession training from multi-profession training. Pre-simulation states were analyzed to gain a better understanding of the participants prior to the face-to-face simulation events to explore for potential influences on teamwork behaviors. These descriptions can also have implications for educators to determine the need to revise pre-simulation procedures from a quality improvement perspective.

Because the focus of learning outcomes in this study was on teamwork, it was important to establish sufficient baseline clinical knowledge for the simulation to reduce bias that could occur due to distraction of an unfamiliar patient condition. If students are unfamiliar with the clinical context in a team exercise, they will be less able to focus on teamwork behaviors (TeamSTEPPS Instructor Guide 2.0, 2014). Measurement of student knowledge and preparation for care of a cardiac arrest victim, and anxiety related to IP learning was assessed with two researcher-designed survey items on the demographic questionnaire. The survey item feelings of preparation for a cardiac arrest asked student to rate on a 1-4 scale with 1 = very unprepared at all and 4 = very prepared. The second item, anxiety related to interprofessional education (IPE) asked students to report their level of anxiety on a 1-4 scale with 1 = very stressed/anxious and 4 = not stressed/anxious at all. These individual items were treated as continuous level data to allow for further statistical analyses relevant to the research questions.  A summary of descriptive statistics of these scores can be found in Table 11.

Table 11.  Individual means and standard deviations of pre-simulation survey items by profession and all disciplines

| | Nursing | | Medicine | | Respiratory | | Total/All | |
|---|---|---|---|---|---|---|---|---|
| Survey question | *M* | SD | *M* | SD | *M* | SD | *M* | SD |
| Feeling of preparation for cardiac arrest | 2.8 | .63 | 2.9 | .64 | 3.2 | .51 | 2.90 | .65 |
| Anxiety for IPE | 2.27 | .82 | 3.08 | .64 | 2.67 | .77 | 2.39 | .83 |
| Frequency totals | 123 | | 13 | | 18 | | 154 | |

As noted in Table 11, the overall sample reported acceptable levels of preparation with a range of 2.8 to 3.2 for each discipline, which aligns with feelings of somewhat prepared on the scale for this item.  This overall level of preparation along with procedures of random team assignment that would protect from clustering students with lower ratings onto the same team should adequately lower any risk of bias.  Although there were slight variations, the overall sample reported acceptable levels of preparation.

Anxiety levels associated with interprofessional learning was assessed to determine if high anxiety levels were present which could interfere with teamwork behaviors.  As noted in Table 11, there is some variation with a lower mean for the nurses which would imply that nursing students have a slightly higher level of anxiety, but is fairly consistent across professions.  Again, although there are slight variations, the overall sample reported acceptable levels of anxiety.  The effect of these differences are protected by random assignment of individuals to teams, decreasing the likelihood of organized bias.

## Establishing Initial Equality of Treatment Groups

Because I could not randomly assign students to treatment groups, but treatment allocation was determined by cohort, it is important to establish initial equality of each group prior to IP simulations. Although some differences in characteristics were noted according to professional discipline, it is important to note that individual participants were randomly assigned to the teams, thus initial differences were assumed to be distributed randomly across the 19 teams and thus protecting against threats to internal validity. This initial equality will lend itself towards understanding the degree of internal validity. Further statistical comparisons were performed to confirm equality of the two training groups according to baseline measures of feelings of preparation for cardiac arrest, anxiety related to IPE, and teamwork attitude pre-simulation, and these data are reported later in this section. Establishing this equality at baseline contributes to internal validity of measures taken post-simulation.

**Calculation of team level data.** Data collected from the demographic and TAQ surveys occurred on the individual level, and data derived from coding team simulations related to teamwork skills were coded at the team level. In order to make comparisons of these variables, it was necessary to identify a common unit of analysis. I chose to convert individual data to the team level for the primary reason of wanting to evaluate the teams as a collective unit. Even though attitudes, anxiety, and knowledge preparation occur at the individual level for each team member, theoretically the characteristics of one or more team members can influence the entire team. Additionally, my interest in team level analysis related to the paucity of these types of comparisons in the literature on team training and IPE.

Based on the research questions for this study, it was necessary to convert the individual data collected on four variables to team level data: feelings of preparation for a cardiac arrest renamed TeamPrep, anxiety related to interprofessional education renamed TeamAnxiety, and teamwork attitude before and after simulation renamed TeamPreTAQ, and TeamPostTAQ. These scores were calculated by averaging scores of all team members on the variables of preparation and anxiety, and averaging the total scores of team attitude.

Univariate assumptions of normality and linearity were assessed for each team variable in preparation for statistical analyses, and descriptive results are found in Table 12.

Table 12. Pre-simulation variable descriptive and normality statistics by treatment group

| Variable/Group | *M* | SD | Min | Max | Skew | Kurtosis |
|---|---|---|---|---|---|---|
| Feelings of preparation | | | | | | |
| Immersive | 2.87 | .35 | 2 | 3 | -2.82 | 8.00 |
| Distributed | 2.75 | .57 | 1 | 3 | -2.37 | 5.30 |
| Anxiety for IPE | | | | | | |
| Immersive | 2.13 | .99 | 1 | 4 | 0.86 | 0.84 |
| Distributed | 2.06 | .85 | 1 | 3 | -0.13 | -1.65 |
| Pre-TAQ attitude | | | | | | |
| Immersive | 124.18.5 | 7.26 | 110.57 | 135.14 | 0.90 | 0.06 |
| Distributed | 125.09 | 3.16 | 118.80 | 130.75 | 0.31 | 0.23 |

Normality was assessed with review of Shapiro-Wilk statistic, and skewness and kurtosis. Shapiro-Wilk statistic verified normality ($p > .05$) for all team variables except TeamPrep which also demonstrated increased kurtosis. Although there was some violation of normality for TeamPrep, I decided to go forward with analysis recognizing the robustness of testing to the violation of normality, and the risk of non-normality in social science research.

Linearity was assessed by examining bivariate correlations to determine relationships between variables. Results of these correlations are found in Table 13.

Table 13. Bivariate Pearson correlations of independent and dependent variables (n = 19 teams)

| Variable | Team pre-attitude TAQ | Team post-attitude TAQ | Team skill TPOT | Team prep |
|---|---|---|---|---|
| Team post-attitude (TAQ) | .672** | | | |
| Team skill (TPOT) | -.008 | .225 | | |
| Team prep | -.024 | .220 | .165 | |
| Team anxiety | -.165 | -.177 | -.274 | .509* |

*Correlation is significant at the .05 level (2-tailed)

**Correlation is significant at the .01 level (2-tailed)

There were two statistically significant correlations in these pairs, one between pre- and post-attitude measurements, and one between anxiety and preparation. Both of these are theoretically expected, and logical. Other variables have low correlations, between team skills and pre-simulation attitude was not expected theoretically. This lack of correlation relationship implies that the affective state does not impact the ability to perform well as a team. Another very limited correlation is between team anxiety and team pre-simulation attitude. This finding implies that even when anxiety is present, it does not affect attitude toward teamwork, which is a good thing.

Further comparison of treatment groups was assessed with individual *t*-test analyses for each variable comparing immersive one-day training to time-distributed training. Homoscedasticity was assessed using the Levene's test which was not statistically significant, indicating equality of variance between groups on all analyses of each variable. Results of the independent samples *t*-test for analysis of feelings of preparation $t$ (22) = -.239, $p$ = .813 revealed no difference between training groups. The independent samples t-test for anxiety related to IPE $t$ (22) = -.291, $p$ = .774 also confirmed there is no difference between training groups for this variable. Baseline pre-simulation teamwork attitude (TeamPreTAQ) comparisons between treatment groups was assessed using an independent means $t$ test of the total scores, and results confirmed the same level of pre-simulation teamwork attitude between treatment groups, $t$ (22) = .80, $p$ = 0.430.

**Statistical power and analyses.** Although these team level calculations were necessary to perform team level analyses, this conversion resulted in a decrease in statistical power by reducing the total sample size (n) from 161 individuals to 19 teams. This small sample size is a limitation of the study, but examples in the literature reveal equivalent or lower sample sizes when team level data are used. Additionally, Norman (2010) reports that small sample sizes are quite robust to inferential statistical testing with little risk of inflating type II error. The nature of team based research is such that the process of combining individuals onto teams will naturally result in smaller sample sizes. In some cases such as this study, this reduction will influence statistical power. To increase statistical power for team level data analysis, the a priori level of statistical significance was set at $p < 0.10$ for team level data (Mertler & Vannatta, 2010). Post hoc calculated statistical power is reported with each research question analyses noted in this section.

Statistical tests were chosen that could answer research questions regarding the effect of team training on teamwork competency, including attitudes and skills. Due to limitations in power as a result of a small sample size, I determined not to use multivariate analysis of variance (MANOVA), but to evaluate the outcome of teamwork skills using an independent samples t-test, and teamwork attitude using two-way split plot ANOVA to compare team training treatment interventions. I also chose multiple regression as appropriate analyses to capture the influence of multiple predictor variables on the outcomes of each criterion variable if assumptions could be met.

The first research question was answered with an independent samples t-test which is a univariate comparison of means between an independent variable with two groups, and a dependent continuous variable. This design allowed comparison of team training methods on the outcome of team skills using the TPOT total score earned during the cardiac arrest simulation. Power analysis using G*Power calculator, revealed that a sample of 19 teams, and alpha of .10, an effect size of 0.5, power was calculated at 0.41, (Faul, Erffelder, Lang, & Buchner, 2007)

Research question two addresses a pre-post comparison of teamwork attitude before and after interprofessional simulation experience, with comparison between team training methods. In order to compare the change of attitude over time and between the two training groups, a split plot two-way ANOVA test was chosen. This research question was analyzed at the team level using the total score on the TAQ at both time points, pre- and post-simulation. This analysis allowed a determination of whether different team training methods, experience during the simulation, or a combination of both could be related to the outcome of teamwork attitude. For 23 teams in this sample who completed the pre- and post-team attitude surveys, a power analysis using G*Power calculator estimated, with an alpha of .10, effect size of .25, a power of 0.83 for ANOVA between and within interactions (Faul et al., 2007).

Research questions three and four were answered with multiple regression analyses to explore which predictors of a weighted linear combination of multiple independent variables on a single criterion dependent variable (Mertler & Vannatta, 2010). Based on theoretical relationships, I identified four team level predictor variables including team training, feelings of preparation, anxiety for IPE, and pre-simulation attitude to explore the relationship with two separate criterion variables of teamwork skills, and post-simulation teamwork attitude. A separate multiple regression was run for each of the criterion variables using the same predictor variables to establish which have the most effect on teamwork skills in question three, and teamwork attitude for question four. Power analysis for a sample of 19 with four predictors at an alpha of 0.10, a medium effect size of .15, would yield a power of 0.56 (Faul et al., 2007).

As anticipated with the small sample size, power analysis on some of the tests fall short of the desired 0.8, according to Cohen (1988), however, these do come fairly close. Going forward with team level analyses despite the limitation of a marginal loss of power, was a decision I based on my hope for future repetition of the study which would allow for meta-analyses. Team level research is a gap in the literature, therefore I believe it holds value by adding something meaningful for other researchers to build on.

CHAPTER IV

DATA ANALYSIS AND RESULTS

## Introduction

This study was conducted to determine if there are differences in two different team training methods delivered over two different timeframes on healthcare provider students' teamwork competency in teamwork skills and attitudes. Analyses of collected data seeks to discover if there is a difference in training methods, as well as other influences on teamwork competency such as anxiety, preparation or pre-existing attitudes related to teamwork. Included in this chapter are the steps taken to quantitatively analyze self-reported survey items and evidence obtained from team simulations.

This chapter is organized into sections that align with each research question. Analyses were performed at the team level on all questions with a total of 19 teams formed from 161 individuals. Of these teams, 8 received one-day immersive team training, and 11 were given time-distributed team training. Because of the small sample size ($n$ = 19), the level of significance *a priori* was set at $p < 0.10$ to raise statistical power (Mertler & Vannatta, 2010). I include details that explain pre-screening procedures, assumption testing, quantitative analyses and statistical results with interpretation of significance and effect size with each research question. All analyses were completed using SPSS software, version 22.0. I share statistical results of each question individually, and a summary of results at the end of the chapter.

## Analyses for Research Questions

Prior to inferential statistical testing, pre-screening procedures for univariate and multivariate analyses were performed that are required for the methods chosen in this study. There were four team level variables included in this screening: post-simulation team attitude (TeamPostTAQ), team skills (TeamTPOT), team preparation (TeamPrep), and team anxiety (TeamAnxiety). Univariate outliers were screened for first by examining descriptive statistics, looking for the minimum and maximum entries beyond the boundaries of the range for each variable; no extreme values were revealed requiring no further action. Screening for multivariate outliers was done using the Mahalanobis distance test for each of the same team variables. The critical value of $\chi^2$ at $p < .001$ and df = 4 is 18.467, indicating any Mahalanobis distance greater than 18.467 would be considered an outlier. None of the team variables met these criteria, and therefore required no further action. Additional assumption testing and results are included with each research question.

**Research Question 1: What is the optimal training method to prepare professionals to benefit from participation in an interprofessional simulation for performing teamwork skills? ?**

This research question asks for a comparison of the different team training groups, one-day immersive and time-distributed methods, on the dependent variable of teamwork skill. Teamwork skill was operationalized as team total scores on the TPOT rated during a cardiac arrest simulation scenario. The dependent variable, total team scores, has the potential range of 20-100 for the 20 items rated on a 1-5 scale. An independent samples *t* test was identified as the appropriate analysis to answer this question.

In addition to screening for outliers and using a continuous dependent variable and categorical independent variables, assumptions for performing an independent samples *t* test include (a) observations are independent of each other, (b) are normally distributed, and (c) equal variance among groups is present (homoscedasticity) (Laerd Statistics, 2015). Evidence of meeting the first assumption is confirmed as part of the sampling design through random assignment of participants to treatment groups by cohort. Univariate normal distribution was first assessed by evaluation of the Shapiro-Wilk statistics. The Shapiro-Wilk statistic was significant ($p = .035$) for the immersive group, and acceptable (> .05) for the distributed group team skill total scores (TPOT). Due to the statistically significant Shapiro-Wilk, further assessment of normality was sought from a z-score calculation of the skewness and kurtosis statistics, with significance level of .01 equal to plus or minus 2.58 (Laerd Statistics, 2015). The calculation revealed the immersive training total skills score skewness -1.7 (SE .75), z = 2.28, and kurtosis of 2.89 (SE 1.48), z = 1.95. The distributed training total skills score skewness -.369 (SE .66), z = .558, and kurtosis -1.15 (SE 1.28), z = .901. Based on these calculations, the assumption of normality was successfully met. Homoscedasticity was assessed with the Levene statistic as part of the *t*-test analysis output which was satisfied ($p > .05$), supporting the assumption of equal homogeneity of variance. Based on satisfaction of assumptions, I went forward with *t* test analysis.

An independent *t*-test was conducted to determine if there was a statistically significant difference in teamwork skills between team training groups, comparing one-day immersive training to the time-distributed training. The immersive team training team scores were higher than the time-distributed training teams, a statistically significant difference *M* = 8.32, 90% CI [-16.03, -.62], $t(17) = -1.88$, $p = .077$. A summary of descriptive statistics and results are included in Table 14.

Table 14. Descriptive and t-test results for team skills by training method

| Team Training method | *n* | *M* | SD | SE | Min | Max | *M* difference | Sig (*p*) |
|---|---|---|---|---|---|---|---|---|
| Immersive | 8 | 83.9 | 8.99 | 3.18 | 64.5 | 92 | -8.32 | .077* |
| Time-Distributed | 11 | 75.5 | 9.89 | 2.98 | 59.0 | 88 | | |

**a priori p* < .10 level of significance

Based on *t* test results, the teams who were trained with the one-day immersive method scored higher team skills than those who were trained over a longer period of time. With a total score range of 20-100, both groups were near the top 25% of the range. A mean calculation for each group indicates that the immersive team mean is 4.16, and time-distributed is 3.775 for twenty items. Using the quality indicators of the scale, these are both close to 4 which is identified as “good”. As another point of comparison, although the make-up of teams differs, mean scores reported by Sawyer, et al., (2013) using the 23 item version found scores of expert physicians at 3.0 + 1.4, and less experienced physicians at 2.6 $\pm$ 1.2. A calculation of the Cohen’s *d* of .09 indicates a very small effect size (Cohen, 1988).

**Research Question 2: Does teamwork attitude change following interprofessional team training and simulation while controlling for team training method?**

A split plot ANOVA, also called a two-way mixed ANOVA, was conducted to answer this research question. This statistical analysis allows a comparison of within and between group differences. In this study the within groups were be a comparison over time for study participants who rated their pretest teamwork attitude, participated in simulation, and then rated their team attitude again as a posttest measurement. The between groups was a comparison of the two different training methods, 1-day immersive and time-distributed. This analysis was done at the team level for participants who completed both pre- and post-simulation TAQ surveys ($n$ = 24) with 8 teams in the immersive training group, and 16 teams in the distributed training group. The *a priori* level of significance was set at $p < .10$ for this sample size. To maximize score variability, the team's total scores were used (Presimulation TAQ, and Postsimulation TAQ) with a possible range of 30-150 with higher numbers representing a more positive attitude toward teamwork.

According to Laerd Statistics (2013) there are seven assumptions that are required for a mixed ANOVA analysis. The first three variable criteria assumptions were met which identifies a need for continuous dependent variables (i.e., TAQ scores), within-subject variable with at least two categories (i.e., pre- and posttime points), between subject factor at least two categorical independent groups (i.e., team training). Assumptions four and five describe the need to establish no significant outliers and normal distribution for the independent variables, however state this test is robust to moderate violations of normality. Pre-screening procedures revealed no significant outliers as assessed by boxplot. Normality for each combination of groups was assessed with the Shapiro-Wilk test ($p > .05$) satisfying this assumption. The sixth assumption, to have homogeneity of variance for each combination of groups is assessed with the Levene's test in SPSS, which was found to be not significant ($p > .05$) and therefore satisfying this assumption. The final assumption is the presence of sphericity, equal variances of between and within subjects factor that is required when there are three or more groups which does not apply to this data.

A two-way ANOVA was performed, and results of descriptive statistics with means, standard deviations are included in Table 15.

Table 15. Means and standard deviations of pre-/post-simulation attitude TAQ scores by training method and for nurse-only teams

| | Team training method | | | | | |
|---|---|---|---|---|---|---|
| | Immersive | | Distributed | | All groups | |
| Survey | M | SD | M | SD | M | SD |
| Pre-sim TAQ | 124.18 | 7.27 | 125.09 | 3.16 | 124.78 | 7.26 |
| Post-sim TAQ | 128.73 | 8.06 | 128.44 | 5.11 | 128.57 | 6.07 |
| Change from pre-post | +4.55 | | +3.35 | | +3.79 | |
| Nurse Pre-sim TAQ | 125.30 | 9.0 | 124.80 | 3.50 | 124.98 | 5.73 |
| Nurse Post-sim TAQ | 130.05 | 9.3 | 128.38 | 4.58 | 128.94 | 6.38 |
| Nurse change from pre-post | +4.75 | | +3.58 | | +3.96 | |

The rows of data that are identified as "nurse" were calculated by removing the medical and respiratory therapy student ratings on each team. This was done separately to determine if there was a bias imposed on the calculations that included them for the time-distributed teams, where these non-nursing students did not receive training over time, but in the week prior to simulation, the same as in the immersive training groups. The descriptive statistics are similar in the teams with all members compared to the nurse only teams, and separate analyses were performed to assess the difference.

As noted in Table 15, the scores between training groups were similar, with both types of training showing an increase in teamwork attitude in the post-test assessment. Evaluation of the effect of training and simulation experience on teamwork attitude in two-way mixed ANOVA analysis begins with analysis of the interaction between simulation and training method, followed by evaluation of main effects if the interaction is not significant. Results that were calculated with all team members (including medical and respiratory therapy students) are summarized in Table 16.

Table 16. ANOVA results for effect on teamwork attitude (TAQ)

| Pre-Post teamwork attitude | Sum of Squares | df | F | Sig. (p) | Partial $\eta^2$ |
|---|---|---|---|---|---|
| Simulation*training interaction effect | .496 | 1, 22 | .046 | .832 | .002 |
| Simulation effect (Within groups) | 158.26 | 1, 22 | 14.67 | .001** | .400 |
| Training effect (Between groups) | 5.09 | 1, 22 | .099 | .756 | .004 |

**$p \leq .001$ level of significance

As noted by the significance level greater than .10, results revealed there was not a statistically significant interaction between team training and simulation on teamwork attitude, $F(1, 22) = .046$, $p = .832$, partial $\eta 2 = .002$. This result implies that team training and simulation experience together does not significantly influence teamwork attitude, and the effect size is minimal.  The next step when there is no interaction between independent variables on the dependent variable is to look at each independent variable for main effect alone (Laerd Statistics, 2013).

Also noted in Table 16, there is the statistically significant difference for the within group comparison.  The main effect of simulation (pretest to posttest) showed a statistically significant difference in teamwork attitude scores, $F(1, 22) = 14.67$, $p = .001$, partial $\eta^2 = .400$.  This results indicate that the change in pretest to posttest scores, which were separated by experience in the team simulation, were significant with a moderate effect size according to the partial eta squared result of .400.  The significance of the change following simulation experience was statistically significant at the $p < .005$ level for each training group, and for all groups combined according to pairwise comparison statistical output.  However, the main effect of training showed there was not a statistically significant difference in teamwork attitude between intervention groups $F(1, 22) = 13331.78$, $p = .756$, partial $\eta^2 = .004$.  This result indicates that team training did not have an effect on team attitude, indicating whether students received one-day immersive or time-distributed training, their attitudes were equally effected with increases in both training groups.

An additional split plot ANOVA was performed using only nursing students on the teams to determine if there was a bias caused by the influence of teamwork attitude scores from the other team members who did not get distributed team training before simulation.  Descriptive statistics were included in Table 15.  This second analysis of the mixed 2-way ANOVA began with satisfaction of assumptions including confirmation of homogeneity of variance as assessed by Levene's test ($p > .05$), and Box's test of equality of covariance matrices confirmed homogeneity of covariance ($p > .001$). As with the first analysis (with all professions factored into team scores) there was not a statistically significant interaction effect of simulation time and training method, $F(1,22) = .334$, $p = .569$, partial η2 = .015. The main effects results were also similar to the first analysis with all team members, showing a statistically significant effect of within groups (between pre- and post- measure), $F\ (1, 22) = 16.8$, $p < .001$, partial $\eta^2 = .433$, and non-statistically significant effect of between training groups $F\ (1,22) = .190$, $p = .667$, $\eta^2 = .009$. These results confirm that the change from pre- to post-simulation teamwork attitude was statistically significant, and was not affected by the training method.

**Research Question 3: Which predictor team variables, pre-training teamwork attitude, feelings of preparation, or level of anxiety are most predictive of simulation teamwork skills?**

This research question investigates the effect of predictor variables on teamwork skills during an interprofessional simulation with multiple regression (MR) analysis. The criterion outcome variable for overall teamwork skills was operationalized using the team TPOT total mean score. Three predictor team variables were used in this model: team preparation for cardiac arrest (TeamPrep), team anxiety for IPE (TeamAnxiety), and team pre-simulation attitude (TeamPreTAQ). The team training method was not controlled for in this analysis, rather all teams were combined to evaluate the overall effect of these predictors ($n$ =19).

There are eight assumptions for conducting a multiple regression. Two assumptions, independence of observations, and no extreme outliers have been addressed in previous data screening which confirmed data are compliant with no outliers revealed. Two assumptions are related to the types of data being used. The dependent variable, or criterion variable, must be on a continuous scale (interval or ratio) such as teamwork skills using the TPOT scores. An assumption regarding the reliability of the TPOT instrument was satisfied by the Cronbach alpha calculation of .932 which is excellent. Two or more independent variables, also called predictor variables, may be measured on a continuous or nominal level. Likert-type scales, such as those used in this study, must be entered as continuous or nominal (Laerd Statistics, 2015).

While there is some controversy over using Likert type data as continuous data, there are examples in the literature that support their conversion to continuous data without violation or increased Type II error (Norman, 2010; Allen & Seaman, 2007). The argument stems from the inability to determine the equal distance between ordinal scale points, and therefore does not warrant treatment as continuous. Norman (2010) defends and offers evidence that statistical analyses are robust with ordinal Likert scales, and the dilemma lies only at the point of interpretation. Therefore, interpreting a calculated number that lies between ordinal descriptors is up to the researcher, based on theoretical understanding of the scale. Scores that are a result of a sum of multiple Likert measures will be interval, but individual Likert items may carry some error (Norman G. , 2010), therefor interpretation of these results should be in light of these limitations when related to the single Likert items of feelings of preparation and anxiety.

The remaining four assumptions are discovered in SPSS as part of the analysis output for a multiple regression, and relate to (a) normality, (b) linearity between predictor and criterion variables, (c) lack of multicollinearity and (d) homoscedasticity

(Laerd Statistics, 2015; Mertler & Vannatta, 2010). Univariate normality was assessed using the Kolmogorov-Smirnov statistic, skewness and kurtosis for each variable. Evidence to support normality was noted in the Kolmogorov-Smirnov statistics which were greater than 0.05 for each predictor and criterion variables, and skewness and kurtosis were within acceptable ranges.

Linearity between independent and dependent variables is required when running multiple regression analysis, and this was assessed by examination of bivariate correlations as part of the multiple regression output (Table 17).

Table 17. Correlation matrix of multiple regression variables

| | TPOT skills avg | Pre-TAQ attitude avg | Team Prep |
|---|---|---|---|
| Pre-TAQ attitude avg | .009 | | |
| Team Prep | .166 | .062 | |
| Team Anxiety | -.271 | -.092 | .638** |

**$p < .05$ level of significance

Linearity was limited in some of the relationships, with the lowest between TeamPreTAQ (attitude) and TeamTPOT (skills) ($r = -0.009$). Correlations between TeamTPOT and TeamAnxiety and TeamPrep were also fairly low suggesting low correlations. Only the correlation between team anxiety and team preparation was significant ($p = .002$); all others were not ($p > .10$). Additionally, residual plots were examined and were deemed non-curvilinear. Because this analysis is exploratory in nature, I decided to use all of these variables supported by theoretical relationships to teamwork skills. Multicollinearity was assessed with the coefficients table as part of the multiple regression output which revealed all independent variable tolerance statistics were greater than 0.1, and VIF less than 10, thereby ruling out multicollinearity (Mertler & Vannatta, 2010). The assumption of homoscedasticity is determined by a non-significant Box's test which was confirmed. The means, standard deviations, and ranges for the predictor measures are provided in Table 18.

Table 18. Means, standard deviations (SD) and ranges for predictor variables

| Variable | Mean | SD | Range |
|---|---|---|---|
| Team preparation | 2.84 | .52 | 1-4 |
| Team anxiety | 2.45 | .36 | 1-4 |
| Team pre-attitude (avg) | 4.16 | .17 | 1-5 |

Standard multiple regression was conducted by entering all three predictor variables into the model at one time, with the criterion variable set as team TPOT total. With a liberal a priori significance set at $p < .10$ to account for the small sample size, regression results revealed an overall model of three predictors that statistically significantly predicted teamwork skills, $R^2 = .341$, $R^2_{adj} = .209$, $F(3, 15) = 2.585$, $p = 0.092$. The change in $R^2$ represents the change in variance accounted for by adding the all variables (Mertler & Vannatta, 2010). These results indicate that the three variables of team preparation, team anxiety and team pre-simulation attitude (pre-TAQ) accounts for a moderate 34.1% of variance in teamwork skills (TPOT). A summary of the regression analysis is presented in Table 19.

Table 19. Multiple regression analysis for team skills summary

| Independent variables | B | $SE_c$ | β | Sig | t | Partial *r* |
|---|---|---|---|---|---|---|
| Team preparation | 1.084 | .533 | .659 | .060* | 2.381 | .50 |
| Team anxiety | -.969 | .430 | -.735 | .039** | -2.641 | -.55 |
| Team Pre-TAQ | -.286 | .722 | -.160 | .698 | -.747 | -.16 |

Note. $SE_c$ = Standard error of the coefficient. *$p < .10$, **$p < .05$ level of significance

B is the unstandardized coefficient score, and beta weights (β) are standardized so that analysis can be used to understand the effect of each predictor on the criterion variable when squared. The variable of team preparation for a cardiac arrest (TeamPrep) beta = 0.659, $0.659^2 = 0.434$, indicating that 43.4% of the variance in teamwork skills can be accounted for by this variable. The variable of team anxiety for IPE (TeamAnxiety) beta = -.735, $.735^2 = .553$ indicating 55.3% of the variance in teamwork skills can be attributed to a lower anxiety rating as indicated by the negative beta number. Team pre-simulation attitude (Team PreTAQ) beta score of -.160, $.160^2 = .0256$ indicates a negative pre-simulation teamwork attitude has the least influence accounting for 2.6% of variance on teamwork skills.

Partial *r* correlation coefficients represent the relationship between the predictor variables and the criterion variable of teamwork skills after partialling out the other predictor variables. The partial *r* value indicates a positive correlation between team preparation and teamwork skills, implying that higher feelings of preparation for the clinical condition is associated with higher teamwork skills. A negative correlation found between team anxiety and teamwork skills, demonstrates that lower anxiety correlates with higher teamwork skills. The correlation between teamwork pre-simulation attitude and team skills was slightly negative indicating lower pre-simulation attitudes were associated with higher teamwork skills.

These findings indicate the strongest predictors of higher teamwork skills were higher levels of preparation for the clinical condition (cardiac arrest in this case) and lower feelings of anxiety related to interprofessional education, with little effect noted from pre-existing attitude toward teamwork. These results establish that preparation and anxiety can effectively predict performance of teamwork skills.

**Research Question 4: Which predictor team variables, pre-training teamwork attitude, feelings of preparation, or level of anxiety are most predictive of post-simulation teamwork attitude?**

This research question uses a multiple regression analysis to investigate the effect of predictor variables on teamwork attitude following team training and an interprofessional simulation. The criterion outcome variable of post-simulation teamwork attitude was operationalized using the team post-TAQ total scores. These scores were rated individually after simulation, and were calculated into team level scores by averaging each team member’s total score. Three predictor team variables were used in this model: average preparation for cardiac arrest (TeamPrep), average anxiety for IPE (TeamAnxiety), and average teamwork attitude (TeamPreTAQ). Team training method was not controlled in this analysis, but all teams who completed the TAQ surveys were included from both training methods (n = 24 teams).

The assumptions and predictor variables are the same as with Question 3; therefore, the results of assumption testing remain consistent, with exceptions noted that relate to the different criterion variable. The assumption of reliability of the total TAQ scale was satisfied with a strong Cronbach alpha of .88. Linearity between predictor and the criterion variables was assessed by examination of bivariate correlations as as part of the multiple regression output, and summarized in Table 20.

Table 20. Correlation matrix of multiple regression variables

| | Post-TAQ attitude | Team Prep | Team Anxiety |
|---|---|---|---|
| Team Prep | .177 | | |
| Team Anxiety | -.130 | .638** | |
| Pre-TAQ attitude | .808** | .062 | -.092 |

**p < .05 level of significance

The correlation between pre- and post-TAQ scores was statistically significant, and was not unexpected since it is theoretically reasonable that pre-simulation attitude would relate to a post-simulation attitude rating. Although post-simulation attitude showed low correlations with team anxiety and team preparation, I decided to use them in the model which again was exploratory in nature, and had a theoretical relationship to teamwork attitude. Multicollinearity was assessed with the coefficients table as part of the multiple regression output which revealed all predictor variables tolerance statistics were greater than 0.1, and VIF less than 10, thereby ruling out multicollinearity (Mertler & Vannatta, 2010). The assumption of homoscedasticity determined by a non-significant

Box's test was confirmed.  The means, standard deviations, and ranges for the predictor measures are provided in Table 17 with Research Question 3.

A standard multiple regression was conducted by entering all three predictors into the model at one time, with the criterion variable set as team attitude post-TAQ total. With a liberal *a priori* significance set at $p < .10$ to account for the small sample size, regression results revealed an overall model of three predictors that significantly predict teamwork attitude, $R^2 = .701$, $R^2_{adj} = .642$, $F\ (3, 15) = 11.741$, $p < 0.001$.  The $p$ value is less than 0.10 and therefore there is enough evidence to recognize that there's a linear relationship between post-simulation teamwork attitude and at least one of the predictors. The change in $R^2$ ($\Delta R^2$) represents the change in variance accounted for by adding the group of variables, and these results indicate that the three variables of team pre-attitude, team preparation, and team anxiety accounts for 70.1%, a large amount of variance in post-simulation teamwork attitude.  A summary of statistical coefficients is summarized in Table 21.

Table 21.  Multiple regression analysis for teamwork attitude summary

| Independent variables | B | $SE_c$ | β | Sig | t | Partial *r* |
|---|---|---|---|---|---|---|
| Team preparation | .187 | .123 | .282 | .149 | 1.52 | .37 |
| Team anxiety | -.128 | .099 | -.240 | .217 | -1.28 | -.32 |
| Team Pre-TAQ | .891 | .166 | .768 | <.001** | 5.35 | .81 |

**$p < .05$ level of significance

The standardized coefficients beta weights from the coefficients table were analyzed to understand the effect of each predictor on the criterion variable when squared. Pre-TAQ total attitude beta = 0.891, $0.891^2 = 0.7939$. We could say that the team Pre-TAQ total attitude variable accounted for 79.39% of the variance in the team Post-TAQ total attitude criterion. Secondly, for the variable team preparation for a cardiac arrest (TeamPrep), beta = 0.187, $.187^2 = 0.0349$. We could say that the feelings of preparation variable accounted for 3.49 % of the variance in the team Post-TAQ total attitude. Lastly, the variable of anxiety for IPE (Team Anxiety), beta = -0.128, $0.128^2 = .0164$. We could say that pre-simulation anxiety variable accounted for 1.64% of the variance in the team post-TAQ total attitude. Only the coefficient of team pre-simulation attitude (TeamPreTAQ) was statistically significant.

The partial *r* values indicate a positive correlation between team post-simulation attitude and both team pre-attitude and team preparation indicating increases in preparation and pre-simulation attitude can be associated with higher post-simulation teamwork attitude. The negative correlation with team anxiety indicates lower anxiety correlates with higher teamwork attitudes.

These findings indicate that the strongest predictor of post-simulation teamwork attitude was pre-simulation attitude, with little additional effect noted from team preparation and team anxiety. These results differentiate the prediction ability of feelings of preparation that relates to knowledge, and the affective characteristic of anxiety as having little influence on teamwork attitude.

## Summary of Research Findings

In summary, four research questions were posed in this study.  The first question asked if there were differences in teamwork skills with a comparison between team training methods. The results indicated there were statistically significant differences, with higher scores for the immersive team training groups, and a small effect size.  The second question asked if there was a difference between training method groups for influencing teamwork attitude.  The results indicated that there was not a difference between training groups, but there was a within group difference demonstrating a relationship between pre-simulation and post-simulation attitude scores.

The third research question asked if there were significant predictors for teamwork skills among three background characteristic predictors: feelings of preparation, feelings of anxiety, and pre-simulation teamwork attitude.  Results revealed a statistically significant model with these predictors with highest prediction correlations in feelings of preparation and feelings of anxiety for the outcome criterion variable of teamwork skills.

The fourth research question asked if there were significant predictors for teamwork attitude among three background characteristics:  feelings of preparation, feelings of anxiety, and pre-simulation teamwork attitude.  Results indicated a statistically significant model fit, with pre-simulation teamwork attitude a statistically significant predictor.

# CHAPTER V

# DISCUSSION

The purpose of this study was to determine if there is an optimal team training design to prepare students for interprofessional simulation, between two methods delivered over different time periods, for developing team competencies consisting of teamwork attitude, skills, and knowledge. The TeamSTEPPS Teamwork Attitude Questionnaire (TAQ) and TeamSTEPPS Team Performance Observation Tool (TPOT) formed the basis of measuring teamwork attitude and skills respectively. Teamwork knowledge was indirectly measured in the demonstration of skills, presuming knowledge as a prerequisite, and by use of a self-report question on the demographics survey where students rated their feelings of preparation. There were 19 teams made up from 161 healthcare students from nursing, medicine, and respiratory therapy disciplines with teams identified as the unit of measure for this study.

This chapter is organized into four sections. The first is discussion of the findings. The second is a discussion of the limitations of the study. The third section will include discussion of the implications for healthcare education. The final section provides recommendations for future research.

This research study sought to provide evidence of teaching effectiveness using two different time-delivery methods of team-training to prepare students for interprofessional simulation, for developing teamwork attitude and skills. Teaching methods in both groups included scaffolding, modeling via video demonstration of teamwork during cardiac arrest, peer discussions, and teacher feedback to reinforce learning prior to simulation (National Research Council, 2000). One method provided online education that was time delivered over seven weeks in small portions, culminating in an in-person interprofessional simulation event. The other method delivered the same content in an immersive one-day delivery leading to an in-person interprofessional simulation event. Team training didactic content for both methods was founded on the standards of TeamSTEPPS team-training curriculum. The interprofessional simulations provided a vector or an opportunity for students to use their team training knowledge and apply these concepts through teamwork skills while responding to a simulated cardiac arrest patient. In addition to comparing training methods, individual factors including levels of anxiety, feelings of preparation, and pre-existing teamwork attitudes were examined for influence on teamwork skills and attitudes.

The Social Identity Theory (Allport, 1954) framework was tested for informing the outcome of this study related to the formation of interprofessional teams, and the impact on attitudes and skills associated with team training and simulations. Interprofessional training such as that which was provided in simulation, can be expected to influence teamwork attitude and skills. Theoretically more time spent in the presence of "new" team members would be expected to have greater impact on overcoming stereotypes or other negative attitudes, and improve team skills.

The following four research questions guided this study:

1. What is the optimal training method to prepare professionals to benefit from participation in an interprofessional simulation for performing teamwork skills?

2. Does teamwork attitude change following interprofessional team training and simulation while controlling for team training method?

3. Which predictor team variables, pre-simulation teamwork attitude, feelings of preparation, or level of anxiety are most predictive of simulation teamwork skills?

4. Which predictor team variables, pre-simulation teamwork attitude, feelings of preparation, or level of anxiety are most predictive of post-simulation teamwork attitude?

## Discussion of Findings

The population in this study was healthcare provider undergraduate students from nursing, medicine, and respiratory therapy programs. The reason for choosing these students was to provide experiences in team training that would serve as cognitive frames for future licensed practice that occurs after graduation. In a large multi-site study of nursing students, Hayden, Smiley, Alexander, Kardong-Edgren and Jeffries (2014) provided compelling evidence that practices in simulation are transferrable to clinical practice. The underlying motivation for training healthcare professional students in good teamwork, is to better equip them for real-life interprofessional collaborative practice, where their knowledge, skills, and attitudes can result in safer and higher quality patient care (IPEC Expert Panel, 2011). The professions represented in this study commonly perform in teams while providing patient care in acute care settings, and certainly during a cardiac arrest as was the clinical context for the simulation in this research. I present in this section, major findings derived from statistical analyses, with elaboration related to the importance of these findings.

Quantitative measures using two different instruments, one for teamwork attitude (TAQ) and one for teamwork skills (TPOT), were used to evaluate learning outcomes.

Both the TAQ and the TPOT mirror the TeamSTEPPS teamwork curriculum with subcategories of team structure, leadership, communication, situation monitoring, and mutual support. Teamwork attitudes were measured both before and after the simulation for comparison of change over time, and for comparison between two different training methods. Teamwork skills were measured during the simulation event for comparison between two different training methods. Additional measures were gathered from questions contained on a demographics survey that provided sample descriptions of age, gender, and experience with IPE as well as self-reported completion of pre-work, and perceived levels of feelings of preparation and anxiety before the simulation. Lessons learned from this study can be used by educators to make decisions on how to best train interprofessional student groups for promoting development of teamwork attitudes and skills.

**Effectiveness of Immersive Team Training**

One of the findings from this study was that teamwork skills were statistically significantly higher for teams that received the single day immersive team training that occurred over several hours compared to teams who were trained gradually over several weeks, with a very small effect size. The practical difference in these findings are minimal, but the implications are that a one-time event was not less effective, and may be considered a legitimate alternative when multiple event scheduling is not possible. The implication for these results lies in the logistics which is a common challenge in IPE, which requires alignment of schedules, curriculum, and learning priorities. Arranging schedules of learners becomes even more challenging when multiple disciplines are involved, yet for true team training, it is best to have diversity as seen in actual practice.

Evidence that training can be effective in a one-day model, reduces the logistics to arranging one block of time as opposed to arranging repeated episodes. However, the challenge of a one-day immersive model is the extended time that would be required as opposed to shorter blocks of time that would typically occur with a time-distributed model. Logistically, the immersive method may require blocking off a larger number of hours preceding simulations, unless online pre-simulation learning is chosen.

This style of immersive team training used in this study can be compared to Just in Time Training (JiTT) education pedagogy which has examples in the literature of effective student learning in higher education classrooms. Just in Time is a teaching pedagogy that recognizes the value of learners' previous knowledge, and uses it as a foundation to build on. Class time is used to elevate learning to a higher learning level, using active learning methods that encourage self-motivated student engagement (Simkins & Maier, 2010). Just in Time Training uses the same premise as the Flipped Classroom or Reverse Classroom where the traditional non-active forms of learning occurs outside of, and prior to class, and using face-to-face class time for problem-solving or other active learning methods (Jamu, Lowi-Jones, & Mitchell, 2016; Simkins & Maier, 2010). Studies that have examined student response to this type of learning found higher satisfaction, higher classroom attendance, and higher attitudes toward life-long learning (Simkins & Maier, 2010). The benefit of this type of education is that the short term memory can be used to recall necessary knowledge rather than relying on long-term memory. It is not unlike "cramming" for a test the night before a big exam. The difference would be that the content is introduced at a point immediately preceding its use, but with the added benefit of knowledge application that occurs in simulation to help code the information for longer term memory.

The results of this study that supports immersive training for development of teamwork skills can be compared to other studies that evaluated teamwork skills although there are none in the literature that compared both types of time delivery team training. Most studies utilized a one-event immersive type design, and like this study, demonstrated statistically significant effects on attitudes and skills among other measures (Brock et al., 2013; Capella et al., 2010; Sawyer et al., 2013).

Traditionally in education, complex topics such as teamwork skills are taught using repeated exposure over time, building in complexity (National Research Council, 2000). The evidence that supports effective learning in one day, offers options to educators who are unable to arrange repeated education over time, but are able to align schedules on one day only. Healthcare educators are faced with full curriculums, time schedules, state and national board and accreditation requirements, so having evidence that effective options for scheduling IPE in a single episode would be beneficial and useful for planning.

**Interprofessional Team Simulations Can Increase Teamwork Attitude**

Another finding from this study was the confirmation that teamwork attitude can increase over a short period of time following simulation experiences. Pre-simulation and post-simulation teamwork attitudes were measured by self-report using the teamwork attitude questionnaire (TAQ) survey. When compared to baseline pre-simulation attitude scores, the post-simulation attitude scores were higher for all students regardless of team training method with a moderate effect size. The practical differences in teamwork scores are difficult to gauge, along with the change of approximately four points on the total scale between pre- and post-simulation. The fact that scores were fairly high at the pre-simulation point may indicate that the students in this sample were open to teamwork and working with others outside of their profession.

An important component of these results is that the change in attitude occurred over a short period of time for teams that received either the single day immersive training or the time-distributed training. Baseline measures of pre-attitude were assessed less than 2 hours before the post-attitude measure was taken, with only simulation experiences in between. This finding supports the ability to positively increase teamwork attitude over a short period of time, and with interprofessional simulation experiences. The importance of attitude relates to the affective domain that includes openness and appreciation of acting as part of a team. A positive attitude of appreciation for teamwork can be seen as an initial step towards changing from a culture of individualism to one of working together collaboratively. Unless negative teamwork attitudes are overcome, knowledge and skills in teamwork can go unused.

Teamwork attitude has been a topic of several studies in the literature, and findings have been mixed regarding effect of team training on teamwork attitude. Results of this study indicate team-training positively effects teamwork attitude for both time delivery models provided. Other studies have demonstrated improvement in teamwork attitude following team training, with short immersive-type interprofessional education (Kenaszchuk, Rykhoff, Laura, McPhail, & van Soeren, 2012; Lefebvre, Wellmon, & Ferry, 2015). Kenaszchuk et al. (2012) found that a three-hour workshop using case-study style simulation significantly influenced teamwork attitude for a group of nursing and medical students ($N$ = 167, $p$ = .05) compared to a control group without training. Lefebvre, Wellmon and Ferry (2015) found similar results in a small group ($N$ = 51) for a one-day education program that included a cardiac arrest simulation for nursing and physical therapy students. Significant findings were noted for attitude measures toward teamwork and collaboration ($p$ =.03) and for team value ($p$ = .012).

An example of time-distributed training is a study by Wong, Gang, Szyld, and Mahoney, (2016) that spanned 1 year. An interprofessional group of critical care nurses and medical staff received team training with multiple modalities including didactic review of roles and responsibilities, 3 hours of simulation, a written handout, repeat in-situ biweekly simulations, and a monthly newsletter reinforcing teamwork principles. Pre and post 1-year measurements of attitude with the TeamSTEPPS Teamwork Attitude Questionnaire (TAQ) revealed statistically significant improvements in the total, and four of the five subscales (excluding communication subscale). The results of this dissertation study corroborate previous studies that demonstrated both immersive and time-distributed methods of team training can positively affect teamwork attitude.

**Pre-simulation States of Anxiety and Preparation Effect on Team Skills**

A finding of this study was discovering that pre-simulation levels of anxiety and feelings of preparation can predict teamwork skills in an interprofessional simulation, but pre-existing attitude toward teamwork does not have an impact on teamwork skills. Participants rated their feelings of anxiety and preparation before they participated in interprofessional simulations in a single question, each on a 4-point scale. These questions capture only a snapshot version of their emotions, and is not meant to be an all-inclusive measurement of either construct. Both anxiety and feelings of preparation are multifaceted, but for the purposes of this study, it was measured simply at the pre-simulation point to determine if variances in these levels had an effect on their learning outcomes.

Anxiety related to interprofessional education may be effected by other emotions such as uncertainty associated with forming a team with unfamiliar team members, related to a sense of hierarchy among professions, or based on anticipation of the simulation. Simulation can be stress-producing for learners who may feel under pressure to perform in front of others and their educators. This phenomenon is recognized in simulation literature, and is mentioned in the standards. INACSL Standard II states that educators need to establish a culture of psychological safety for learners, meaning one that is a non-threatening, judgment-free environment where students are allowed to make mistakes as part of the learning process (Gloe et al., 2013)).

The inverse relationship of anxiety as a predictor of teamwork skills, a result of this study, can be used by educators to embed methods and procedures to lower participant anxiety in the pre-simulation phase. These steps can be as simple as expressing in the simulation prebriefing that participants are not expected to perform perfectly, but to recognize mistakes made as opportunities for learning. It is also recommended that prebriefing should include a promise of confidentiality among learners about what happened in simulation, or how individuals performed. The sentiment, “What happens in simulation, stays in simulation” should be conveyed to lower stress related to high expectations, and can also result in improved teamwork skills.

The other predictive association found was between levels of feelings of preparation and team skills. Like anxiety, feelings of preparation can be affected by multiple influences including knowledge base, and confidence. Possessing knowledge is inherent to feeling prepared for a simulation experience. Without the prerequisite knowledge, performance of required interventions would be very difficult, and likely lead to anxiety as was confirmed. Possessing knowledge, but not feeling confident in applying that knowledge, would also affect how an individual rates their level of feelings of preparation. As with anxiety, educators can use the results of this finding to utilize methods for increasing students' feelings of preparation by reinforcing both knowledge required, and confidence in that knowledge. Addressing their feelings of preparation before a simulation can result in increased teamwork skills during a simulation.

**Pre-simulation Attitude Effect on Post-simulation Attitude**

A finding of this study was that the greatest predictor of post-simulation attitude is pre-simulation attitude. When looking for the most influential variables on post-simulation teamwork attitude among predictors of pre-simulation preparation, anxiety, or teamwork attitude, there was a clear and strong relationship with the level of pre-simulation teamwork attitude for all teams in this study. Additionally, feelings of preparation and anxiety were only weakly related to teamwork attitude. Simulation educators, in recognition of the importance of attitude in the pre-simulation period, can implement measures that maximize positive feelings regarding working with other professionals as part of a healthcare team. Cultivating a positive attitude toward teamwork can have a lasting effect, and potentially transition into actual practice.

Standards for interprofessional education include several statements that are specific to attitude according to the Core Competencies of Interprofessional Education Collaborative Expert Panel (2011). Of the specific statements within the four domains that make up the IPEC Core Competencies, those that speak specifically to attitude are found in the values and ethics domain, with emphasis on respect for others and teamwork, appreciation of diversity, and limitations of self as well as acting with honesty, respect and integrity.  Similarly, attitude competencies are represented in all four of the Quality and Safety Education for Nurses (QSEN) domains that are broadly acknowledged in nursing academia, and the framework for the nursing curriculum at The University of Akron.  The attention to attitude in these frameworks of IPEC and QSEN, verify that attitudes are something that should be assessed and addressed for healthcare professionals.

**Relevance to Social Identity Theory**

As described throughout this study, the theoretical framework used was Social Identity Theory (Allport, 1954).  Consideration of these results through the lens of Allport's theory lends support and builds upon this framework in interprofessional education (IPE) research.  Results of research questions two and four indicated that experiences with team training and in IPE simulation positively influenced teamwork attitude.  This aligns with Social Identity Theory which recognizes the value of time spent with those considered in the "out-group" for overcoming negative attitudes toward them.  Results of research question one related to effectiveness of an immersive one-time exposure to IPE provides evidence that this time spent in the presence of the "out-group" does not need to be extensive.  Research question three results that identified affective feelings of preparation and anxiety as predictors of teamwork skills recognizes the impact of pre-existing attitude states on the ability to work effectively as a team, an alignment with the Social Identity Theory which recognizes the pre-existing attitudes as an important consideration in achieving a harmonious integration of team members (Allport, 1954).

## Summary

This study sought to describe the differences and predictability of teamwork skills and attitude outcomes when healthcare students are trained in teamwork using simulation, with two different time-delivery models. Findings of this study support the use of a single day immersive type of team training, low anxiety levels, and higher feelings of preparation to influence higher team skill performance. For teamwork attitude, team training with simulation, and a positive attitude in the pre-simulation period, is the best way to lead to a positive attitude toward teamwork after training and simulation.

The World Health Organization emphasized the importance of developing learning opportunities in interprofessional groups to develop team competencies for the ultimate outcome of the collaborative-practice ready graduate (Interprofessional Education Collaborative Expert Panel, 2011). The underlying outcome construct of these models was teamwork competency, divided into the domains of team structure, leadership, situation monitoring, mutual support, and communication. Results of this study demonstrated effective options for building student team competency in a critical care context.

## Limitations Related to Sample and Methods

The most significant limitation of this study was the sample size. The individual sample was 161 students reduced to the team unit of measure of 19, which limited statistical power. Another limitation that related to sample was the single site sampling during a time period of one and a half semesters. Recruitment was limited to one school of nursing, one respiratory therapy program from the same institution, and one nearby healthcare center's emergency department with a medical education program. Findings can only be applied to this population.

Lack of a control group may be considered another limitation of this study. It would be beneficial to compare outcomes of teamwork skills and attitudes to teams that were from a single profession who received the same training methods. Based on experience and literature review, a control group was not used in this study because it is clear that students require team training to develop teamwork skills, therefor evaluation of students without training was not incorporated into the design. An alternative would be to include a comparison to another program that does not currently offer team training in a replication of this study with a different cohort for comparison. Additionally, limited availability of students who met the requirements of this study, as well as limited resources to expand the program to more students, prevented recruiting enough to serve as a control group. A reviewer of interprofessional education literature identified comparison to single profession education programs as a research priority that would help differentiate the benefit of IPE compared to traditional methods (Hammick, Freeth, Koppel, Reeves, & Barr, 2007).

A methodologic limitation of this study was the variation of training for the nursing students, and the non-nursing students, medical and respiratory therapy (RT). The ability to deliver the immersive training design was easily accomplished logistically for all students, but the time-distributed design was more challenging for non-nursing students who were unable to participate in training before the week preceding the simulations. Because these students were not jointly enrolled in a common course, contact with these students began electronically the week before the live event. Therefore, only the nursing students received a different training method that was time-distributed over seven weeks, while medical and RT students received training in the immersive method in the week before simulation for both training groups. Because the large majority of students was made of nursing students, with one medical and one RT student with 4-6 nursing students per team, I felt the different training method for nurses only could impact team competency measures. Although statistical testing evaluated this influence as described in Chapter 4, this design would be strengthened by working out a way to include the medical and respiratory therapy students in the weeks leading up to the face to face simulations.

A limitation of this study relates to the use of observational research. Evaluation of teamwork skills via observation limits assessment to only what is seen, or heard, as opposed to higher level thought processes. Behaviors don't always convey what has been learned. Observable team behaviors are valuable for evaluation, but they are fairly insensitive to other domains that include cognitive understanding, self-confidence, self-efficacy, or critical thinking. Implications of and recommendations from this study are based on findings taking these limitations into consideration.

**Implications of Findings**

The findings of this study have implications for health profession students, educators, and healthcare consumers. The results of this study applies to students of healthcare professions who are preparing to enter the workforce expected to perform in interprofessional collaborative teams. As they are presented with the challenge of acquiring knowledge, skills, and attitudes that are associated with good teamwork, it is the role of their educators to design ways to help them with this goal. This study attempts to fill some of the gaps regarding what we as educators know about teaching models, or student characteristics that make a difference in achieving teamwork competency. And finally, this study relates to healthcare consumers who are the ultimate beneficiaries of effective healthcare teamwork through higher quality and safer healthcare practices.

Effective teamwork in healthcare is driven by the overarching goal of improving patient safety. Safety has been associated with better teamwork, and simulation-based education is an effective way to achieve clinical goals related to safety (McGaghie, Issenberg, Cohen, Barsuk, & Wayne, 2011). The Institute of Medicine (2011) released a statement and list of recommendations regarding, "The Future of Nursing: Leading change, advancing health." Among the eight recommendations, four mention nursing in association with teamwork and collaborative practice in education, and long range competency. Recommendation 4 asserts that a joint classroom and clinical become the standard for shared interprofessional learning. Recommendation 6 suggests repeated opportunities to maintain ongoing competency become the standard. Recommendation 8 suggests building an infrastructure for collection and analysis of interprofessional healthcare data collection.

In regards to team training, for those who have not yet implemented a program, I recommend a good place to start is to determine if and how students are learning about teamwork in each individual program, and then seek out collaborating faculty to discuss ways that interprofessional teams can be brought together for shared learning. Curricular mapping is an effective way to determine how teamwork is addressed in an entire curriculum, after which gaps can be identified where opportunities to infuse teamwork would best fit. If there is lack of faculty buy-in for collaborative teaching and learning, it may be necessary to begin with networking among faculty of different professions to learn about what programs have in common, what the literature reveals about teamwork and patient safety. Without faculty champions leading a change, new innovations will not be realized such as collaboration for interprofessional education (Conrad, Guhde, Brown, Chronister, & Ross-Alaolmolki, 2011).

Recommendations from the 2012 healthcare simulation symposium were released from the National League for Nurses who joined forces with the Society for Simulation in Healthcare. Together they proposed several strategies for educators who want to integrate interprofessional education (IPE) for the purpose of developing teamwork competencies based on the Interprofessional Education Collaborative (IPEC) Core Competencies. These recommendations are to link IPE to safety and quality initiatives, dissemination of information about the core competencies and domains to students and faculty, use of simulation evaluation tools to measure outcomes, and incorporation of IPEC Core Competencies into simulations (HEADLINES from the NLN, 2011).

I recommend that more healthcare education programs and healthcare facilities consider implementing TeamSTEPPS team training. By training for teamwork with one common curricular standard, a shared language and approach to teamwork can make collaborative practice more achievable. According to Clapper and Kong (2012), TeamSTEPPS training can lead to decreased error and increased safety by combining the concepts of crew resource management that transformed aviation into a highly respected team safety example, and human factors concepts that accounts for inevitable human error.  Making a difference in patient safety and medical error is something within our grasp, and team training can be one step toward saving lives of those who seek healthcare.

## Recommendations for Future Research

Future research is needed that builds on the recommendations of the newest set of IPEC Core Competencies (2016) that expand the focus to the Triple Aim (improved patient experience in healthcare, improve health of populations, and reduce the cost of health care) that was brought into focus with the Affordable Care Act in 2010.  To meet these goals of the Triple Aim, team simulations should be expanded to settings outside of acute care, and include those providing community and population health.  Cost benefit and patient satisfaction measures related to team training and team based care would also fall in line with working toward the Triple Aim goal (Interprofessional Education Collaborative, 2016)

It is also important to continue research that includes acute care as in this study. As demonstrated by ongoing medical error rates, inpatient settings have not met their goal in safety either.  Expanding this research model to a broader population of healthcare disciplines, and clinical scenarios where teamwork and safety risks are common in practice settings could strengthen evidence of best team training practice. Quality research methods using valid instruments and larger, multi-site samples would also add to the available evidence related to the effects of team training.  Larger samples, or when one is not possible, repeating of research models to allow meta-analysis for larger effect size analysis is a good goal.

This study measured proximal outcomes of team skills and teamwork attitude. Studies that include evaluation that goes beyond the immediate period following training would be welcome along with those that show transition of training into practice. There needs to be a shift from the culture of viewing IPE as an "add-on" activity to one that is an expectation to lay the foundation for positive attitudes of students for IP learning (Curran, Sharpe, Flynn, & Button, 2010).

This study was set in a critical care acute care setting. Research with team training and teamwork competency are needed that includes other settings. Tools and strategies are available for different team settings for team training, and can serve as a standard curriculum that requires less preparation by educators (Agency for Healthcare Research and Quality, 2012). Further studies regarding best methods in team-training, and outcome measures are still needed to guide educators, prepare students for practice, and protect patients from medical error.

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APPENDICES

APPENDIX A

EVENT BASED APPROACH TO TRAINING (EBAT) MAP: MOCK CODE

| Trigger | Expected behavior | Debriefing points |
|---|---|---|
| Patient verbalizes c/o pain | Communication:<br>• Call outs of information gathered.<br>Situation Monitoring (core competency)<br>• Distribute responsibilities:<br>○ Focused assessments: subjective pain descriptors, objective vital signs and physical exam.<br>○ Chart review regarding available orders for pain medication. | • How do you (group) feel it went? What emotions were you experiencing during this event?<br>• What are your thoughts about how the team performed together?<br>• Communication: Were call outs used to inform all members of patient assessment?<br>• Situation Monitoring:<br>○ Was there a shared mental model?<br>○ Were all members engaged and filling a needed role? |
| Heart rhythm converts to pulseless VT/VF | Leadership (core competency)<br>• Call a code: Assembles team<br>• Assign roles if needed<br>• Advocate plan<br>Situation Monitoring (core competency)<br>• Team members recognize need and fulfill roles for resuscitation<br>• Coordination of efforts, all members engaged<br>Communication (core competency)<br>• Call outs, check backs, and SBAR used to communicate patient information to the team. | Was nursing leadership established? Code called? SBAR to MD?<br>Roles assigned as needed.<br>Situation Monitoring: Was there coordination of team members?<br>Communication:<br>• Was SBAR used to report info to the bedside MD (may discuss earlier)?<br>• Were call outs used r/t pt. assessment?<br>• Check backs (closed loop communication) used r/t interventions? |
| Heart rhythm changes to | Leadership<br>• Advocate plan | Does leader share change in rhythm? |

| | | |
|---|---|---|
| VF or VT (or VT to VF) | • Seek input from other team members<br>Situation Monitoring<br>• Team members coordinate changes in roles as needed<br>Communication<br>• Call outs, check backs used to inform team.<br>Mutual Support<br>• CUS used to advocate for change if needed. | Does leader seek input from members?<br>Situation Monitoring<br>• Do team member roles change (CPR rotation )?<br>Communication:<br>• Are call outs and check backs used (closed loop) for interventions?<br>Mutual Support<br>• Are members cross monitoring each other? (Checking pulses w/CPR, monitoring bagging, medication doses & compatibility issues).<br>• CUS used if needed? |
| Heart rhythm changes to bradycardia with pulse and low BP | Communication<br>• Call outs, check backs, to inform team members of actions<br>Leadership<br>• Advocate plan<br>• Request information about patient<br>Situation Monitoring<br>• Coordination of efforts to assess the patient for significant symptoms<br>Mutual Support<br>• CUS used to advocate change if needed | Were changes to a perfusing rhythm noticed and communicated to team?<br>Leadership<br>• Did the leader advocate a clear plan? (Shared mental model)<br>• Request pt. assessments.<br>Situation Monitoring<br>• Was the treatment plan (Giving of Atropine) coordinated?<br>Mutual Support<br>• Were members cross monitoring the decisions (drug choice, compatibility choice). |
| Patient condition improves | Leadership<br>• Advocate for reassessment<br>Situation Monitoring<br>• Coordinate care of reassessment needs among members.<br>Communication<br>• Call outs, check backs to inform team members of actions | Did the leader request reassessment of patient response to Atropine?<br><br>Did members make assessments as needed?<br><br>Was communication shared regarding patient response? |

APPENDIX B

TEAMSTEPPS-TEAMWORK ATTITUDE QUESTIONNAIRE

TeamSTEPPS® 2.0

## TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ)

**Instructions:** Please respond to the questions below by placing a check mark (√) in the box that corresponds to your level of agreement from *Strongly Disagree* to *Strongly Agree*. Please select only one response for each question.

| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| **Team Structure** | | | | | | |
| 1. | It is important to ask patients and their families for feedback regarding patient care. | | | | | |
| 2. | Patients are a critical component of the care team. | | | | | |
| 3. | This facility's administration influences the success of direct care teams. | | | | | |
| 4. | A team's mission is of greater value than the goals of individual team members. | | | | | |
| 5. | Effective team members can anticipate the needs of other team members. | | | | | |
| 6. | High performing teams in health care share common characteristics with high performing teams in other industries. | | | | | |
| **Leadership** | | | | | | |
| 7. | It is important for leaders to share information with team members. | | | | | |
| 8. | Leaders should create informal opportunities for team members to share information. | | | | | |
| 9. | Effective leaders view honest mistakes as meaningful learning opportunities. | | | | | |
| 10. | It is a leader's responsibility to model appropriate team behavior. | | | | | |
| 11. | It is important for leaders to take time to discuss with their team members plans for each patient. | | | | | |
| 12. | Team leaders should ensure that team members help each other out when necessary. | | | | | |

**PLEASE CONTINUE TO THE NEXT PAGE**

| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| **Situation Monitoring** | | | | | | |
| 13. | Individuals can be taught how to scan the environment for important situational cues. | | | | | |
| 14. | Monitoring patients provides an important contribution to effective team performance. | | | | | |
| 15. | Even individuals who are not part of the direct care team should be encouraged to scan for and report changes in patient status. | | | | | |
| 16. | It is important to monitor the emotional and physical status of other team members. | | | | | |
| 17. | It is appropriate for one team member to offer assistance to another who may be too tired or stressed to perform a task. | | | | | |
| 18. | Team members who monitor their emotional and physical status on the job are more effective. | | | | | |
| **Mutual Support** | | | | | | |
| 19. | To be effective, team members should understand the work of their fellow team members. | | | | | |
| 20. | Asking for assistance from a team member is a sign that an individual does not know how to do his/her job effectively. | | | | | |
| 21. | Providing assistance to team members is a sign that an individual does not have enough work to do. | | | | | |
| 22. | Offering to help a fellow team member with his/her individual work tasks is an effective tool for improving team performance. | | | | | |
| 23. | It is appropriate to continue to assert a patient safety concern until you are certain that it has been heard. | | | | | |
| 24. | Personal conflicts between team members do not affect patient safety. | | | | | |

PLEASE CONTINUE TO THE NEXT PAGE

| | Communication | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 25. | Teams that do not communicate effectively significantly increase their risk of committing errors. | | | | | |
| 26. | Poor communication is the most common cause of reported errors. | | | | | |
| 27. | Adverse events may be reduced by maintaining an information exchange with patients and their families. | | | | | |
| 28. | I prefer to work with team members who ask questions about information I provide. | | | | | |
| 29. | It is important to have a standardized method for sharing information when handing off patients. | | | | | |
| 30. | It is nearly impossible to train individuals how to be better communicators. | | | | | |

Please provide any additional comments in the space below.

**Thank you for your participation!**

APPENDIX C

TEAM PERFORMANCE OBSERVATION TOOL

TeamSTEPPS® 2.0

## Team Performance Observation Tool

Date: ____________________
Unit/Department: ____________________
Team: ____________________
Shift: ____________________

**Rating Scale**
*Please comment if 1 or 2.*

1 = Very Poor
2 = Poor
3 = Acceptable
4 = Good
5 = Excellent

| **1. Team Structure** | **Rating** |
|---|---|
| a. Assembles a team | |
| b. Assigns or identifies team members' roles and responsibilities | |
| c. Holds team members accountable | |
| d. Includes patients and families as part of the team | |
| Comments: **Overall Rating – Team Structure** | |
| **2. Communication** | **Rating** |
| a. Provides brief, clear, specific, and timely information to team members | |
| b. Seeks information from all available sources | |
| c. Uses check-backs to verify information that is communicated | |
| d. Uses SBAR, call-outs, and handoff techniques to communicate effectively with team members | |
| Comments: **Overall Rating – Communication** | |
| **3. Leadership** | **Rating** |
| a. Identifies team goals and vision | |
| b. Uses resources efficiently to maximize team performance | |
| c. Balances workload within the team | |
| d. Delegates tasks or assignments, as appropriate | |
| e. Conducts briefs, huddles, and debriefs | |
| f. Role models teamwork behaviors | |
| Comments: **Overall Rating – Leadership** | |
| **4. Situation Monitoring** | **Rating** |
| a. Monitors the status of the patient | |
| b. Monitors fellow team members to ensure safety and prevent errors | |
| c. Monitors the environment for safety and availability of resources (e.g., equipment) | |
| d. Monitors progress toward the goal and identifies changes that could alter the plan of care | |
| e. Fosters communication to ensure that team members have a shared mental model | |
| Comments: **Overall Rating – Situation Monitoring** | |
| **5. Mutual Support** | **Rating** |
| a. Provides task-related support and assistance | |
| b. Provides timely and constructive feedback to team members | |
| c. Effectively advocates for patient safety using the Assertive Statement, Two-Challenge Rule, or CUS | |
| d. Uses the Two-Challenge Rule or DESC Script to resolve conflict | |
| Comments: **Overall Rating – Mutual Support** | |
| **TEAM PERFORMANCE RATING** | |

## APPENDIX D

## RECRUITMENT SCRIPT

Your participation in a research study is being requested as part of the interprofessional simulation event planned at the Austen Simulation Center on ___(date and time)____________________. Participation in the study is voluntary and will not be required to attend and participate in the simulations. By agreeing to participate, you will be asked to complete an 8-item demographic/background survey and a 30 item attitude teamwork questionnaire before and after the simulations. The faculty who have organized the event are conducting the study and would appreciate your participation so that information regarding students engaged in interprofessional learning can be evaluated. A description of the study is included on the informed consent form that you are being asked to sign. Your decision to participate or not will not affect your grades or evaluation in any way.

APPENDIX E

INFORMED CONSENT

**Informed Consent Document for Interprofessional Education with Simulation for Team Training**

Please read the information outlined below.

Title of Study: Interprofessional education with simulation for team training.

Introduction: You are invited to participate in a research project being conducted by Diane Brown, PhDc, RN, CCRN, faculty member in the School of Nursing, at The University of Akron.

Purpose: The purpose of this study is to determine the effect of educational design of interprofessional education (IPE) using simulation, on healthcare students' teamwork attitude and team performance competency skills. Research questions are: 1. Are there differences in teamwork attitudes among interprofessional healthcare student groups following team training? 2. Are there differences in teamwork attitudes of student groups according to profession, gender, or reported anxiety? 3. Are there differences in teamwork competency skill scores of student groups made up of one discipline compared to multiple disciplines when engaged in simulated clinical experiences?

Procedures: Students from nursing, respiratory therapy, and medicine will be asked to participate in a two hour interprofessional education activity with two different simulated clinical experiences (SCE), one cardiac arrest, and one postoperative head injury. Each simulation will last approximately 30 minutes with additional time used for debriefing in groups.

Pre-simulation, all student participants will be asked to prepare by viewing a 15 minute audio-video recorded PowerPoint presentation focused on the Situation Monitoring competency, as described by TeamSTEPPS® team training curriculum. This recording was made by the principle investigator and posted on YouTube as a secure recording that is accessible only with the specific web link. Students will also be instructed to review the care of a patient in a cardiac arrest and postoperative head injury.

On the day of the event, participants will be asked to first complete an 8 item demographic and background survey, and a 30 item teamwork attitude questionnaire (TAQ). Following the team simulations, participants will be asked to complete the same 30 item teamwork attitude questionnaire as a post-education measure.

Risks and Discomforts: Students may experience mild anxiety associated with performing simulated patient care under simulated acute conditions. These feelings would be similar to those experienced when in actual clinical practice, but to a lesser degree considering any mistakes will only affect manikins rather than actual patients. Data collected from the surveys and the simulation ratings will be kept confidential.

Benefits: The results of this project may help educators and students to learn about their teamwork attitudes and skills when involved in an interprofessional education event. Participation may result in the student's ability to transfer learned skills to the clinical practice setting which can result in higher quality and safer patient care delivery.

Payments to Participants: No compensation will be provided for participation in this study.

Right to refuse or withdraw: Participation in this study is voluntary.

Anonymous and Confidential Data Collection: No identifying information will link you to the questionnaires or simulation scoring. Study ID numbers will be used in lieu of names to further protect anonymity.

Who to contact with questions: If you have any questions about this study, you may call Mrs. Diane Brown at 330-972-7863. This project has been reviewed and approved by The University of Akron Institutional Review Board. If you have any questions about your rights as a research participant, you may call the IRB at (330) 972-7666.

Acceptance: I have read the information provided above and all of my questions have been answered. **By signing**, I voluntarily agree to participate in this study.

Signature________________________________________Date__________________

APPENDIX F

PHOTOGRAPHY CONSENT

I authorize The University of Akron to broadcast my appearance and/or voice and to record my picture and/or voice (on photographs, film and/or tape), to edit these recordings at its discretion, to incorporate these recordings into a broadcast medium, to use such recordings for publicity and advertising, and to use my name, photograph, likeness, voice, biographic and other information concerning me in connection thereto. I know that The University of Akron owns all rights to the aforementioned recordings, photographs and biographical materials.

I release The University of Akron from any loss, damage and liability arising out of my appearance on photographs, film, printed materials and/or tape.

__________________________________________________

Print name

__________________________________________________

Signature

____________________ __________________________

Date Telephone Number (Area Code)

__________________________________________________

Address

__________________________________________________

City State Zip

__________________________________________________

Signature of Parent or Guardian if Subject is a Minor

APPENDIX G

DEMOGRAPHICS SURVEY

**Participant Demographic Data**:

Please respond by answering the question or placing an X next to the answer that applies.

(1) Which healthcare discipline education program you are currently enrolled?

______(1) medicine

_____ (2) nursing

_____ (3) respiratory therapy

(2). Gender: ______(1) Male

______(2) Female

(3). Age: ________ (nearest year)

Section II: Background

Please complete the following questions.

(4) Have you ever before engaged in a *learning activity* with one or more other healthcare disciplines different than your own?

______(1) Yes

______(2) No

(5) Did you view the "TeamSTEPPS: Situation Monitoring" recorded PowerPoint recording assigned for pre-event preparation?

______(1) Yes

______(2) No

(6) Rate how knowledgeable and prepared you feel to respond to a patient with a *cardiac arrest* in your professional role.

______(1) Very unprepared

______(2) Somewhat unprepared

______(3) Somewhat prepared

______(4) Very prepared

(7) Rate how knowledgeable and prepared you feel to respond to a patient *following surgery for a head injury* in your professional role.

______(1) Very unprepared

______(2) Somewhat unprepared

______(3) Somewhat prepared

______(4) Very prepared

(8) Rate your anxiety or stress level in regards to participating in a learning activity with one or more other healthcare disciplines different than your own.

______(1) Very stressed/anxious

______(2) Somewhat stressed/anxious

_____(3) A little stressed/anxious

_____(4) Not stressed/anxious at all

## APPENDIX H

## INTERPROFESSIONAL LEARNING OBJECTIVES

Overall learning outcomes for this event: The student will

1. Use team performance tools and strategies to achieve common goal of safe, quality patient care (e.g. team huddle to establish shared mental model, advocacy and assertion as part of situation monitoring and mutual support of team members).
2. Use effective communication strategies with team members to ensure patient safety and quality care delivery (e.g. team huddle, closed loop communication, SBAR, verbalizing what is being done to inform team members).
3. Indicate knowledge of roles and responsibilities of team members (delegates to or asks for consultation or support from the appropriate professional).
4. Show appreciation and respect for each team member (e.g. asks for input from other team members, respectful communication).
5. Actively participate in guided debriefing to provide and accept feedback on team performance.

Mock Code simulation learning objectives:

1. Perform accurate and targeted physical assessment related to patient symptoms.
2. Respond to a rapidly changing patient situation by utilizing all team member roles.
3. Perform resuscitation interventions according to ACLS guidelines following safety and quality strategies.
4. Integrate teamwork concepts of situation monitoring and effective interprofessional communication during team resuscitation.

Traumatic Brain injury simulation learning objectives

1. Identify patient care priorities during transition of care from OR to an ICU setting for a critical neurotrauma patient.
2. Implement priority interventions using team collaboration and appropriate delegation of actions to team members.
3. Demonstrate critical decision-making during changes in patient condition, using appropriate rationale for independent actions and consulting experts on the health care team.
4. Evaluate diagnostic results considering implications for TBI patient.

Respiratory therapy Performance Objectives:

1. Initiate mechanical ventilation for a neurological patient being admitted to the ICU from the OR following craniotomy surgery and s/p TBI.
2. Recognize and apply appropriate settings given physician’s goals for maintaining appropriate ICP/CPP of critical neurological patient.
3. Utilize SBAR communication technique with nursing and physician team to obtain goals for respiratory care of the patient.