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Exploring Healthcare Simulation as a Platform for Interprofessional Education

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Exploring Healthcare Simulation as a Platform for Interprofessional Education

by

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Each person whose signature appears below certifies that this dissertation in his/her opinion is adequate, in scope and quality, as a dissertation for the degree Doctor of Philosophy.

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TERMS OF REFERENCE

PLEASE NOTE: Although there are clear concepts in interprofessional education (IPE) and healthcare simulation (HCS), terminology often varies across professions, geographical boundaries, and institutions. The following constructs are threaded within this study, and a standardized language is essential. These terms of reference and abbreviations were not created to define these words and concepts, but rather to create working definitions for the purposes of this dissertation. This reference guide is meant to be used as a starting point to develop the terms used in the fields so frequently and fluidly and to facilitate discussions with reduced miscommunications. Further concept analyses and studies beyond this dissertation specifically designed to explore and define these terms are encouraged and it is accepted that the definitions listed here will likely change as the fields mature.

A **Clinical Scenario** is the plan of an expected and potential course of events for a simulated clinical experience. The clinical scenario provides the context for the simulation and can vary in length and complexity, depending on the objectives. Designing the clinical scenario may include the following:

- Participant preparation.
- Prebriefing: objectives, questions, and/or material.
- Patient information describing the situation to be managed.
- Student learning objectives.
- Environmental conditions, including mannequin or standardized patient preparation.
- Related equipment, props, tools and/or resources for assessing and managing the

simulated experience to increase the realism.

- Roles, expectations, and/or limitations of each role to be played by participants.
- A progression outline including a beginning and an ending.
- Debriefing process.
- Evaluation criteria (Jeffries, 2007; Lyon & Lyon, 1980).

Collaboration is “an active and continuing partnership based on sharing, cooperation and coordination in order to solve problems and provide a service, often between people from diverse backgrounds” (Howkins & Bray, 2008, p. xviii).

Confederate—see **Simulated Actor**

Crisis Resource Management (CRM) is an approach to managing critical situations in a healthcare setting. CRM training develops communication skills. Originally developed in aviation and, as a result, also called **crew resource management**, CRM emphasizes the role of "human factors"-the effects of fatigue, expected or predictable perceptual errors, as well as the effects of different management styles and organizational cultures in high-stress, high-risk environments (Helreich, Merritt, & Willhelm, 1999; Gaba, Howard, Fish, Smith, & Sowb, 2001).

Debriefing is a formal, reflective stage in the simulation learning process. Debriefing is a process whereby educators and learners review or re-examine a real or simulation event and fosters the development of clinical judgment and critical thinking skills (Johnson-Russell & Bailey, 2010). It is designed to guide learners through a reflective process about their learning, where participants explain, analyze, and synthesize information and emotional states to improve performance in similar situations and assist in processing any psychological effect from the event or memories triggered by the event (National League for Nursing Simulation Innovation Resource Center [NLNSIRC], 2010). "Participant reflective thinking is encouraged, and feedback is provided regarding the participants' performance while various aspects of the completed simulation are discussed. Participants are encouraged to explore emotions, question, reflect, and provide feedback to each other. The purpose of debriefing is to move toward assimilation and accommodation in order to transfer learning to future situations" (International Nursing Association for Clinical Simulation and Learning [INACSL], 2011, p. S4).

Embedded Simulated Person (or Simulated Person) is when a person portrays a patient (**simulated patient**), family member (**simulated family**), or healthcare provider (**simulation healthcare provider**) in order to meet the objectives of the simulation. Also referred to as "**Embedded Actor"** (INACSL, 2011, p. S5). A simulated person may also be called a **Standardized Patient/Family/Healthcare Provider** if they "have been trained to act as a real patient to simulate a set of symptoms or problems used for healthcare education, evaluation, and research" (INACSL, 2011, p. S6). There is continuing debate around the use of the word "actor" because standardized patients often engage in assessment by providing feedback to the learner.

Experiential Learning posits a cyclical model of learning: Do (concrete experience), Observe (reflective observation), Think (abstract conceptualization), and Plan (active experimentation). Experiential Learning is learning through the development of meaning from direct experiences (Kolb, 1984).

For the purposes of this study, **the "Field"** refers to the overlapping combined science of the fields of Interprofessional Education and Healthcare Simulation.

Haptic “relates to or is based on the sense of touch” (Merriam-Webster, 2012). “A haptic simulation uses haptic devices that provides tactile feedback technology and that interacts with a user’s motions or applications during a simulation” (Robles-De la Torre, 2011, “What is a haptic?” para. 1).

Healthcare Simulation is “a technique that uses a situation or environment created to allow persons to experience a representation of a real healthcare event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions. Simulation is the application of a simulator to training, assessment, research, or systems integration toward patient safety” (Council for the Accreditation of Healthcare Simulation Programs [CAHSP], 2012, p. 45).

High-fidelity healthcare simulation is the use of simulation modalities or mechanisms to create a realistic patient model or healthcare situation. See **realism** or **high-technology healthcare simulation** or **mannequin-based simulation.** High-fidelity simulation has been used synonymously in the literature for mannequin-based simulation; however, recent discussions have argued that low-technology modalities may have more fidelity than a mannequin, depending on learning objectives.

High-technology healthcare simulation, also referred to as **high-technology simulation,** is the use of computerized simulation modalities that are controlled or programmed by a person external to the learner. These functions may be altered by a simulation facilitator/technician/educator as an interactive result of learner actions.

High-Stakes Assessment “is one that:

- is a single, defined assessment (perhaps with component subunits)
- has clear distinction between those who pass and those who fail

- has direct consequences for passing or failing (something "at stake")" (Gaba et al., 2001).

Hybrid Simulation Methodologies "integrates multiple modalities of simulation (e.g., simulators and standardized patients to achieve learning objectives in a simulation)" (CAHSP, 2012, p. 44).

A **huddle** is a technique encouraged by TeamSTEPPS. According to TeamSTEPPS, a huddle is "when a team is brought together to gain situational awareness of the patient by discussing critical issues and emerging events, anticipate outcomes and likely contingencies, assign resources, and express concerns" (Agency for Healthcare Research and Quality [AHRQ], 2006, p. 112).

Interdisciplinary learning (IL) "involves integrating the perspective of professionals from two or more professions, by organizing the education around a specific discipline, where each discipline examines the basis of their knowledge" (Howkins & Bray, 2008, p. xviii).

Interprofessional education/training (IPE) "describes those occasions when two or more professions learn with, from and about each other to improve collaboration and the quality of care" (CAIPE, 2005, "What is Interprofessional Education?" para. 1). "It is an initiative to secure *interprofessional learning* and promote gains through interprofessional collaboration in professional practice" (Freeth, Hammick, Reeves, Koppel, & Barr, 2005, p. xv). "**Formal interprofessional education** aims to promote collaboration and enhance the quality of care; therefore it is an educational or practice development initiative that brings people from different professions together to engage in activities that promote interprofessional learning. The intention for formal interprofessional education is for curricula to achieve this aim" (Freeth et al., 2005, p. xiv). **"Informal" (or "serendipitous") interprofessional education** is unplanned learning between professional practitioners, or between students on *uniprofessional* or *multi-professional* programs, which improves interprofessional practice. At its inception, it lacks the intention of interprofessional education. At any point in time after that it may be acknowledged that learning with, from and about each other is happening between participants. However, in many such initiatives, this remains unacknowledged or is only recognized on reflection in and on the learning practice" (Freeth et al., 2005, p.xiv).

Interprofessional learning (IPL) is "learning arising from interaction between members (or students) of two or more professions. This may be a product of *interprofessional education* or happen spontaneously in the workplace or in education settings (e.g., from *serendipitous interprofessional education)"* (Freeth et al., 2005, p. xv).

Interprofessionality is the development of a cohesive and integrated healthcare practice among professionals in response to clients' needs through (a) the development of a cohesive practice between professionals from different disciplines, (b) the process of self-reflection and development of practice methods that provides an integrated and cohesive answer to the needs of their patient(s), (c) a derivation from the preoccupation of professionals to reconcile their differences and their sometimes opposing views, and (d) continuous interaction and knowledge sharing between professionals organized to solve and compare patient care issues (D'Amour & Oandasan, 2005).

Interprofessionalism is "the effective integration of professionals through mutual respect, trust, and support, from various professions who share a common purpose to mold their separate skills and knowledge into collective responsibility and awareness that can be achieved through learned processes for communication, problem solving, conflict resolution, and conducting evaluation" (Palaganas & Jones, 2012).

Intraprofessional involves activity between or among individuals within the same profession with similar or different specialties or levels of practice (e.g. Surgeon and Emergency Physician; Clinical Nurse and Nurse Practitioner, Resident and Physician).

Low-technology healthcare simulation, also referred to as **low-technology simulation,** is the use of simulation modalities that are not computerized or electronic and may not be controlled or programmed by a person external to the learner.

Mannequin vs. Manikin. A mannequin (French origin) is "a form representing the human figure, whereas a manikin (Dutch origin) is a life-sized anatomical human model used in education" (Merriam-Webster, 2012, "Definition," para. 1). Both terms have been used interchangeably for human-like simulators with a majority of simulation literature using "mannequin" and a majority of resuscitation literature using "manikin." After much debate and research, in the summer of 2006, "**mannequin"** was the term recommended by Simulation in Healthcare (Gaba, 2006). Some authors have also used the term **human patient simulator**; however, Human Patient Simulator is the trade name of a METI (CAE) product and appending "human" to patient is thought to be a pleonasm (Gaba, 2006).

Mannequin-based simulation or **manikin-based simulation** is the use of human-like mannequins to create a patient case/scenario/situation via heart and lung sounds, palpable pulses, voice interaction, vital signs monitor, movement (e.g. seizures, eye blinking), bleeding, blood flashback with intravenous insertion, and other human capabilities that may be controlled by a simulation specialist using computers and paralleled software.

Moulage is "the art of applying mock injuries or manifestations to a person or simulator for the purposes of training, education, and assessment" (CAHSP, 2012, p. 45).

Multidisciplinary (MD) involves bringing professionals with different perspectives together to provide a wider understanding of a particular problem (Howkins & Bray, 2008, p. xviii).

Multiprofessional education (MPE) is "when members (or students) of two or more professions learn alongside one another: in other words, parallel rather than interactive learning. Also referred to as **common or shared learning**" (Freeth et al., 2005, p .xv).

In HCS, there are frequently **Observing and Active Participants** due to limited resources and because a typical clinical event has fewer providers than the number of students. Observing participants learn by observing the simulation with active participants actively undergoing the scenario. The debriefings included both observing and active participants.

Prebriefing is "an information session held prior to the start of a simulation activity and in which instructions or preparatory information is given to participants. The purpose of the prebriefing is to set the stage for a scenario and assist participants in achieving scenario objectives. Suggested activities in a prebriefing include an orientation to the equipment, environment, mannequin, roles, time allotment, objectives, and patient situation" (INACSL, 2011, p. S5).

Primary Simulation Research describes research that studies simulation as a method for an educational aim, whereas **Secondary Simulation Research** describes research that studies an educational research aim by using simulation as an intervention or evaluation instrument.

Realism is the quality of the simulation perceived by the participants that enables them to engage "as if" the situation or problem were real. External factors that influence realism include simulation equipment, environment, simulated patient, and activities of the educators, assessors, and/or facilitators (CAHSP, 2012; INACSL, 2011). **Simulation Fidelity** is the physical, semantic (Dieckmann, 2009) or conceptual (Rudolph et al., 2007), and phenomenal (Dieckmann, 2009) or emotional and experiential (Rudolph et al., 2007) accuracy that allows persons to experience a simulation as if they were operating in an actual activity (CAHSP, 2012; Dieckmann, 2009). It is the believability, or the degree to which a simulated experience approaches reality; as fidelity increases, realism increases. The level of fidelity is determined by the environment, the tools and resources used, and many factors associated with the participants. Fidelity can involve a variety of dimensions, including (a) physical factors such as environment, equipment, and related tools; (b) psychological factors such as emotions, beliefs, and self-awareness of participants; (c) social factors such as participant and instructor motivation and goals; (d) culture of the group; and (e) degree of openness and trust, as well as participants' modes of thinking (Dieckman, Gaba, & Rall, 2007; Rudolph, Simon, & Raemer, 2007; Dieckmann, 2009; Kolb, 1984). **Simulation Validity** is the quality of a simulation or simulation program that demonstrates that the relationship between the process and its intended purpose is specific, sensitive, reliable, and reproducible (Dieckmann, 2009; CAHSP, 2012).

Simulation-enhanced Interprofessional Education is the use of healthcare simulation modalities for interprofessional education. **Simulation-based Interprofessional Education (SimBIE)** describes simulations that were created using interprofessional learning objectives and students from two or more professions learn with, from, and about each other during the simulation; whereas **Interprofessional simulations (IPsim)** describe simulations that were created using clinical, diagnosis-centered, or task-focused learning objectives and students from two or more professions participate in the simulation.

Simulator is "any object or representation used during training or assessment that behaves or operates like a given system and responds to the user's actions" (CAHSP, 2012, p. 46).

Simulation is "a technique that uses a situation or environment created to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions. Simulation is the application of a simulator to training and/or assessment" (CAHSP, 2012, p. 46).

Simulation Program in Healthcare is "an organization or group with dedicated resources whose mission is specifically targeted towards improving patient safety and outcomes through assessment, research, advocacy, and/or education using simulation technologies and methodologies including formal workshops, courses, classes, or other activity that uses a substantial component of simulation as a technique. A **Simulation Center** is an entity with dedicated infrastructure and personnel where simulation courses are conducted. A center may support several Simulation Programs” (CAHSP, 2012, p. 46).

A **simulationist** is a person “who is involved, full-time or part-time, with at least one of the following activities:

- collects and/or specifies data to be used for/by simulation models (in analysis problems, by designing experiments, by performing instrumentation, calibration… In design problems, by providing explicit assumptions, by allowing implicit assumptions, and by formulating and certifying specifications);
- develops models to be used for simulation purposes;
- engages in validation, verification, and accreditation studies;
- performs simulation studies, [that is], specifies simulation problems, causes generation of model behavior and performs analysis/interpretation of the generated model behavior;
- formulates (specific or policy) solutions to problems based on simulation;
- develops simulation software, simulation software generators, or simulation tools;
- manages simulation projects (engineering or administrative management);
- advertises and/or markets simulation products and/or services;
- maintains simulation products and/or services;
- advises other simulationists;
- promotes simulation-based solutions to important problems;
- advances simulation technology; and

• advances simulation methodology and/or theory" (Ören, 2000, p.167).

Standardized (Human) Patient Simulation is a simulation using a person or persons trained to portray a patient scenario or actual patient(s) for healthcare education in both skills and communication and healthcare assessment. Also see "**simulated actor**" (CAHSP, 2012).

In the theory of **Situated Learning,** Lave and Wenger (2008) posit that learning is situated. This is in contrast to most classroom learning activities that involve abstract knowledge not within the context of the activity. Lave and Wenger argue that learning occurs as it normally occurs and is embedded within activity, context and culture.

Systems Engineering is "an interdisciplinary engineering dealing with how complex projects should be designed and managed. Because issues such as logistics, coordination of different teams, modeling, automatic control of machinery, and human factors become more difficult when dealing with large, complex organizations (and components therein), this field deals with work-processes and tools (including simulation) to handle such projects, and overlaps with both technical and human-centered disciplines, such as control engineering, mechatronics engineering, industrial engineering, organizational studies, and project management" (CAHSP, 2012, p. 47).

Task-Trainer or **skills trainer** is "a training model utilized to teach or practice a specific skill. Examples include intravenous line arms, intra-osseous line legs, intubation heads, and central venous line chests" (CAHSP, 2012, p. 47).

Team-based learning refers to "small groups of students with diverse skill sets learning together after preliminary individual accountability. This approach provides incentive to work together through an activity and experiential exercises" (Michaelsen, Parmelee, McMahon, Levine, 2008).

Teamwork is "the process whereby a group of people, with a common goal, work together to achieve that goal" (Freeth et al., 2005, p. xvi).

Transdisciplinary is a strategy that crosses many disciplinary boundaries to create a holistic approach to development and attempts to overcome the confines of individual disciplines to form a team that crosses and recrosses disciplinary boundaries and thereby maximizes communication, interaction, and cooperation among team members (Freeth et al., 2005).

Uniprofessional education is members (or students) of a single profession learning together (Freeth et al., 2005; Howkins & Bray, 2008).

Virtual simulations are recreations of reality depicted on a computer screen (McGovern, 1994). Virtual simulations may be **virtual environment simulations** where a participant may engage via avatars. Virtual simulations may also include **surgical simulators** that are used for on-screen procedural training and are usually integrated with **haptic device(s)** (McGovern, 1994; Robles-De La Torre, 2011).

Note: See Appendix A: Sources for Terms of Reference

ABBREVIATIONS

ESP	Embedded Simulation Person (Provider, Family, Patient)
HC	Healthcare
HCP	Healthcare Provider
HCS	Healthcare Simulation
IPE	Interprofessional Education
IPL	Interprofessional Learning
IPP	Interprofessional Practice
IPsim	Interprofessional Simulation
qual	Qualitative Methods (see Terms of Reference)
quant	Quantitative Methods (see Terms of Reference)
R/V	Reliability/Validity
Sim	Healthcare Simulation
SimBIE	Simulation-based Interprofessional Education
SP	Standardized Patient
TeamSTEPPS	Team Strategies and Tools to Enhance Performance and Patient Safety (AHRQ and DoD)
Th	Theory
USA	United States of America

CREDENTIALS

BA	Bachelor of Arts
BS	Bachelor of Science
BSN	Bachelor of Science in Nursing
DNP	Doctor of Nursing Practice
DNS	Doctor of Nursing Science
DPT	Doctor of Physical Therapy
EdD	Doctor of Education
EMS	Emergency Medical Service [Personnel: Technicians or Paramedics]
MA	Master of Arts
MD	Medical Doctor
MSc	Master of Science
MSN (MN)	Master of Science in Nursing
MSW	Master of Social Work
NP	Nurse Practitioner
OT	Occupational Therapist
PharmD	Doctor of Pharmacy
PhD	Doctor of Philosophy
PT	Physical Therapist
RN	Registered Nurse
SW	Social Work

ORGANIZATIONS

AACN	American Association of Colleges of Nursing
AACP	American Association of Colleges of Pharmacy
AAMC	Association of American Medical Colleges
ACGME	Accreditation Committee on Graduate Medical Education
AHRQ	Agency for Healthcare Research and Quality
ANCC	American Nurses Credentialing Center
AONE	American Organization of Nurse Executives
ASPE	Association of Standardized Patient Educators
BEME	Best Evidence in Medical Education Collaborative
CAIPE	Centre for the Advancement of Interprofessional Education
CAHSP	Council for Accreditation of Healthcare Simulation Programs
CCNE	Commission on Collegiate Nursing Education
IOM	Institute of Medicine
IPEC	Interprofessional Education Collaborative
JC	Joint Commission
NLNAC	National League for Nursing Accrediting Commission
QSEN	Quality and Safety Education for Nurses
SSH	Society for Simulation in Healthcare
WHO	World Health Organization

JOURNALS

Am J Pharm Edu	American Journal of Pharmaceutical Education
Clin Sim in Nurs	Clinical Simulation in Nursing
Inter J Ev Based HC	International Journal of Evidence Based Healthcare
J Adv Nurs	Journal of Advanced Nursing
J Allied Health	Journal of Allied Health
JIC	Journal of Interprofessional Care
Med Edu	Medical Education
Med Teacher	Medical Teacher
Nurs Edu Persp	Nursing Education Perspectives
Nurs Ed Res	Nursing Education Research
Nurs Edu Today	Nurse Education Today
SiH	Simulation in Healthcare

ABSTRACT OF THE DISSERTATION

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by

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Dr. Betty J. Winslow, Chairperson

Interprofessional education (IPE) is gradually recognized as essential to patient safety and implemented as a standard for healthcare education through professional organization recommendations and accrediting bodies. Given the increasing adoption of experiential and team-based learning, healthcare simulation (HCS) has become a preferred vehicle for IPE. As healthcare professional educators explore simulation as a platform for IPE, a need to better understand the state of the science has become apparent.

This descriptive comparative study examines how the most commonly used simulation modalities and IPE teaching methods (low-technology versus high-technology; multiprofessional versus collaborative team-based activities; observational versus active methods; standardized patients versus mannequins) affect participants' post-test scores in perceived teamwork and collaboration in pre-licensure students while controlling for factors shown previously to affect these perceptions. A total of 716 medical, nursing, pharmacy, and physician assistant students completed a survey on teamwork and collaboration perceived before and after a HCS enhanced IPE lab. Stratified by profession, the students were randomly allocated into small interprofessional teams that underwent one of six simulation modalities. A secondary analysis of data

from an evaluation of an interprofessional lab was used in this exploration of HCS as a platform for IPE.

Using mixed between-within repeated measures ANOVA, perceptions of teamwork and collaboration did not improve significantly for high-technology methods ($p > .05$) over low-technology methods, however, the difference in means between post-test surveys differed significantly, suggesting that there was an intervention effect. There was no significant difference in perceptions of teamwork and collaboration in team-based methods and multiprofessional methods ($p > .05$), as well as active and observing participants. Enhanced mannequin-based simulation significantly increased ($p < .05$) students' perceptions of teamwork and collaboration compared to enhanced standardized-patient based simulation.

From the findings for initiatives in simulation-enhanced IPE, a framework has been proposed for the development of simulation-enhanced IPE and a format for the reporting of research. Deficiencies were identified both in the existing literature (e.g. gaps in knowledge and reporting, low rigor in research design, variability between studies, multiple confounding variables) and in the study (e.g. retrospective analysis, organization of lab, limitations of equipment and simulators, time and ceiling bias). Acknowledgement of these issues may strengthen future research. By exploring a number of proposed modalities for simulation-enhanced IPE and students' perceptions of teamwork, the findings of this study support a better understanding of IPE using HCS, inform recommendations for use, and identify areas to further join the HCS and IPE fields.

CHAPTER ONE

INTRODUCTION TO INTERPROFESSIONAL EDUCATION

A single professional does not have the expertise to adequately and effectively meet the complexity of patients' and patient's families' healthcare needs (Centre for the Advancement of Interprofessional Education [CAIPE], 2007; Interprofessional Education Conference Expert Panel [IPECEP], 2011a, 2011b; Barr, Koppel, Reeves, Hammick, & Freeth, 2005; MacDonald, Stodel, & Chambers, 2008). Despite the knowledge that 80% of medical errors are attributed to poor communication among healthcare providers (Joint Commission, 2008), professional education continues to occur in silos (Benner, 2010), expecting graduates to know and understand how to communicate effectively with other professionals to provide safe patient care. Interprofessional education (IPE) is one way to overcome the issues present in healthcare as a result of poor teamwork and communication. IPE describes those occasions when "two or more professions learn about, from, and with each other to improve collaboration and the quality of care" (World Health Organization [WHO], 2010, p. 13). IPE is "an initiative to secure interprofessional learning (IPL) and promote gains through interprofessional collaboration in professional practice" (Freeth, Hammick, Reeves, Koppel, & Barr, 2005, p. xv). Formal IPE aims to promote such collaboration and enhance the quality of care; thus, it is an educational or practice development initiative that brings people from different professions together to engage in activities that promote interprofessional learning. IPE recognizes the need for continuous, coordinated care by teams of healthcare providers working collaboratively to ensure that care is safe, seamless, and conforms to the highest possible standards (IPECEP, 2011a, 2011b; Oandasan & Reeves, 2005; Clark, 2009). By introducing shared concepts, skills, language, and perspectives, IPE establishes a common ground for interprofessional practice (Morey et al., 2002). The interactive nature of IPE may provide a foundation for practice and reflection on issues of accountability, responsibility, respect for roles (e.g., skills, knowledge, duties, scopes of practice, value systems, codes of conduct), communication, and teamwork. IPE participants use their distinctive experiences and expertise to contribute to patient care (WHO, 2010). IPE allows each profession to gain a deeper understanding of its own practice and how it can complement and reinforce that of others (IPECEP, 2011a, 2011b). These skills may be taught, learned, and practiced by healthcare professionals prior to hospital employment or patient care (Interprofessional Education and Healthcare Simulation Collaborative [IPEHCS-C], 2012).

Introduction to Healthcare Simulation

Healthcare Simulation (HCS) is a technique that uses a situation or environment engineered to allow persons to experience a representation of a real healthcare event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions. HCS is the application of a simulator to training, assessment, research, or systems integration toward patient safety (Council for the Accreditation of Healthcare Simulation Programs [CAHSP], 2012). HCS takes multiple forms including embedded simulated persons, low-technology or high-technology simulation, or a hybrid of embedded simulated persons, and low- and high-technology simulations.

Embedded Simulated Person (ESP; also referred to as “Simulated Actor,” “Embedded Actor,” or “Confederate”) is when a person portrays a patient (simulated patient), family member (simulated family), or healthcare provider (simulated healthcare provider) to meet the objectives of the simulation. Simulated persons may also be called "Standardized Patient," "Standardized Family," or "Standardized Healthcare Provider" if they have been trained to act as a real patient to simulate a set of symptoms or problems used for healthcare education, evaluation, and research (International Nursing Association for Clinical Simulation and Learning [INACSL], 2011). Standardized Patients often engage in assessment by providing feedback to the learner. Examples of embedded simulated persons include a patient with a psychiatric disorder, a distraught family member, a team member that makes a medical error, or an angry team member. When technology (equipment or a live clinical environment) is used to enhance the ESP simulation, it may be considered a high-technology hybrid simulation.

Low-technology simulation is the use of simulation modalities that are not computerized or electronic and may not be controlled or programmed by a person external to the learner. Common uses of low-technology simulation include standardized patients, case studies, team-based activities, non-computerized task trainers (e.g., a suturing skin model for suture training), and role play (students playing patients or other healthcare providers). Depending on the course objectives, low-technology simulation may be more appropriate than high-technology simulation and may require more time, resources, and planning than high-technology simulation.

High-technology simulation is the use of computerized simulation modalities that are controlled or programmed by a person external to the learner. These high-technology functions may be altered by a simulation facilitator as an interactive result of learner actions. Common uses of high-technology simulation include mannequin-based simulation, computerized task trainers (e.g., surgical laparoscopy simulator), and virtual worlds (e.g., SecondLife™).

Mannequin-based simulation is the use of human mannequins to create a patient event via human capabilities (e.g., heart and lung sounds, palpable pulses, voice interaction, vital signs monitor, movement, bleeding, blood flashback with intravenous insertion) that are controlled by a technical specialist or simulationist (Ören, 2000) using computers and paralleled software. The specialist may interact with learner actions using these functions. Like the clinical environment, a scenario may be predictable or unpredictable; however, unlike the clinical environment, it can be set to specific common, procedure-oriented, or rare scenarios and repeated with multiple groups of students. Learners are typically immersed in a real or simulated clinical environment as an active participant followed by a debriefing for guided reflections.

Simulation may integrate the use of multiple modalities. Common hybrid simulations include the use of a standardized patient supplemented with a computerized task model or the use of a mannequin with an ESP at the bedside portraying a family member or healthcare provider. Hybrid simulations are created to overcome the limitations of simulated persons, low, or high technologies.

Introduction to the Study

The Research Problem

Amid the flourishing adoption of IPE and HCS, there is a need to study the simulation mechanisms that underpin positive and negative learning outcomes. Excerpted from his Keynote Address at the 2012 Interprofessional Education and Healthcare Simulation Symposium (2012, January), “Interprofessional Education: The need is great; the time is ripe," Dr. Stephen C. Schoenbaum, Special Advisor to the President for the Josiah Macy Jr. Foundation, stated:

> Interprofessional education is a tool for achieving a set of competencies needed for collaboration, excellent care, and ultimately better outcomes. Simulation is a tool for structuring and standardizing the educational process. It also helps learners acquire essential skills and competencies without imposing that learning process on patients … the challenge is to use these tools as effectively and efficiently as possible (Schoenbaum, 2012, January).

Interprofessional education is gradually being recognized as essential to patient safety and is becoming a standard for healthcare education through professional organization recommendations and accrediting bodies. Given the increasing adoption of experiential and team-based learning, healthcare simulation has become a preferred vehicle for IPE. Healthcare professionals are not guaranteed exposure to relevant interprofessional practice opportunities that are needed to prepare them for the transition from individual provider to team member. These encounters may be engineered through simulation-enhanced IPE through which healthcare students and practicing providers have the opportunity to experience team issues, interactions, communication, and an opportunity to learn and practice team skills. The efforts to further the field of IPE toward improving patient safety are moving toward a focus on enhancing the science of HCS. As healthcare professional educators explore simulation as a platform for IPE, there is an apparent need to better understand the state of the science (IPEHCS-C, 2012). Although current activities in both the HCS and IPE fields attempt to demonstrate that HCS can be an effective platform for IPE, existing literature lacks the research evidence needed to guide educators on how to best structure simulation-enhanced IPE. The simulation mechanisms that underpin positive and negative outcomes in IPE have not yet been adequately studied. Rigorous research that evaluates the state of the science can assist in determining the needs of students, faculty, and organizations, as well as inform recommendations for ways to achieve desired learning outcomes that may be advocated for and carried out by professional organizations.

Purpose and Aims of the Study

The purpose of the study was to examine how the most commonly used simulation modalities affect participants' post-test scores in perceived teamwork and collaboration in pre-licensure medical, nursing, pharmacy, and physician assistant students while controlling for factors believed to affect these perceptions. The specific aims and hypotheses of the study were:

Aim 1. To compare teamwork and collaboration after high or low-technology simulations while adjusting for potential confounders.

From this first aim, the following research hypothesis was tested:

H_1: Pre-licensure students receiving high-technology simulation-enhanced IPE will report higher teamwork and collaboration on completion of the lab than will students who receive low-technology IPE.

Aim 2. To compare teamwork and collaboration after multi-professional and team-based methods used for low-technology simulation-enhanced IPE through self-reported perceptions of teamwork and collaboration while adjusting for potential confounders. These two methods compared were low-technology methods.

From this second aim, the following research hypothesis was tested:

H_2: On completion of the lab, perceptions of teamwork and collaboration scores will be higher in students who participated in a team-based lab than in students who participated in a multiprofessional lab.

Aim 3. To compare teamwork and collaboration after observational and active participation methods used for high-technology simulation-enhanced IPE through self-reported perceptions of teamwork and collaboration while adjusting for potential confounders. The active participation group was composed of three active groups: huddle, immersed, and mannequin-based. From this third aim, the following research hypothesis was tested:

H_3: Upon completion of the lab, there will be no difference in perceived teamwork and collaboration between students who actively engaged in simulation and debriefing versus students who observed the simulation and engaged in the debriefing.

Aim 4. To compare teamwork and collaboration after methods using mannequins and standardized patients in high-technology simulations through self-reported perceptions of teamwork and collaboration while adjusting for potential confounders. Both of these groups were high-technology, active participation simulations with no team planning prior to the simulation. From this fourth aim, the following research hypothesis was tested:

H_4: Upon completion of the lab, there will be no difference in perceived teamwork and collaboration between students who actively engaged in simulation using mannequins versus standardized patients.

Assumptions

According to Parker (2000), scientific knowledge is best created and advanced when the assumptions of the researcher are recognized. The following assumptions have been identified by the researcher:

1. Safe quality healthcare begins with a thorough assessment of health needs and depends heavily on the ability of the healthcare team to cooperate and communicate. Good teamwork requires education on working as a team and the opportunity to practice the learned concepts. Health professions education currently offers only limited opportunities for practiced interaction with students of other disciplines.
2. IPE is necessary to improve patient safety and healthcare.
3. IPE promotes personal and professional growth.
4. HCS is a valuable and best practice method used to educate healthcare students and providers. It is growing in use and development to meet educational needs in healthcare.
5. HCS provides a vehicle for achieving the requirements for effective IPP.
6. Realism is a critical feature of HCS that meaningfully contributes to the quality of learning.
7. Many established learning theories, including Adult Learning Theory (Knowles, 1980), Experiential Learning (Kolb, 1984), and Situational Learning (Lave & Wenger, 2008), can be applied effectively through HCS (Billings & Halstead, 2009).
8. Findings from the literature are an effective framework for exploring the current state, opportunities, barriers/challenges, and strategies of simulation-enhanced IPE.

9. Studying specific simulation modalities in IPE is an effective way to inform and initiate simulation-enhanced IPE endeavors.
10. Healthcare education is in need of guidelines for creating simulation-enhanced IPE.
11. Guidelines created for simulation-enhanced IPE require rigorous research, evaluation, and reporting.
12. HCS, when used appropriately, promotes the development of team skills and collaboration.

Significance of the Study

Simulation is increasingly recognized as an effective and advanced method that transcends limitations identified in traditional education (Billings & Halstead, 2009) and allows healthcare students to acquire skills needed for interprofessional practice. This recognition has created proponents within academic and healthcare professional and accrediting bodies, promoting and requiring the use of HCS and the integration of IPE (see Appendix C). Educational institutions and programs desire to provide best-quality healthcare education, graduate competent healthcare providers, and maintain patient safety, while meeting the standards of professional and accrediting bodies. This desire provokes a pressing need for understanding factors in the use of this technology that contribute to positive and negative outcomes.

IPE can occur using a wide selection of methods, including simulation. Furthermore, simulation activities can occur in a wide array of settings (e.g., simulation centers, in situ, virtual worlds) using varied modalities including mannequin-based simulations, standardized patients, embedded simulated persons, task training, team-based games and serious games. This study compares multiple commonly used simulation modalities. These modalities have shown positive outcomes in single-profession use and, in this study, were examined in a multiple-profession team context. The findings from this study may inform other educational organizations given the growth in HCS utilization, the increasing adoption of IPE initiatives, and the continual restructuring of health education and hospitals with patient safety as a major concern. This study has potential significance for nursing, as the largest group of healthcare professionals. It also has a potential significance for theory. Situated as a bridge from learning to practice, HCS in IPE is fertile ground for exploration of the relationship between theory and practice.

Significance for Nursing

The popularity of IPE and HCS has prompted new aspirations in the field of nursing. Standards that have been set and the ambitions to reach these standards can be viewed at the macro-, meso-, and micro- levels of nursing. For the purposes of this dissertation, the macro-level refers to the entire profession. Individual organizations (schools of nursing or hospitals) compose the mesa-level. The micro-level refers to those educators intimately involved in either HCS or IPE and who are attempting to use HCS for IPE (see Figure 1).

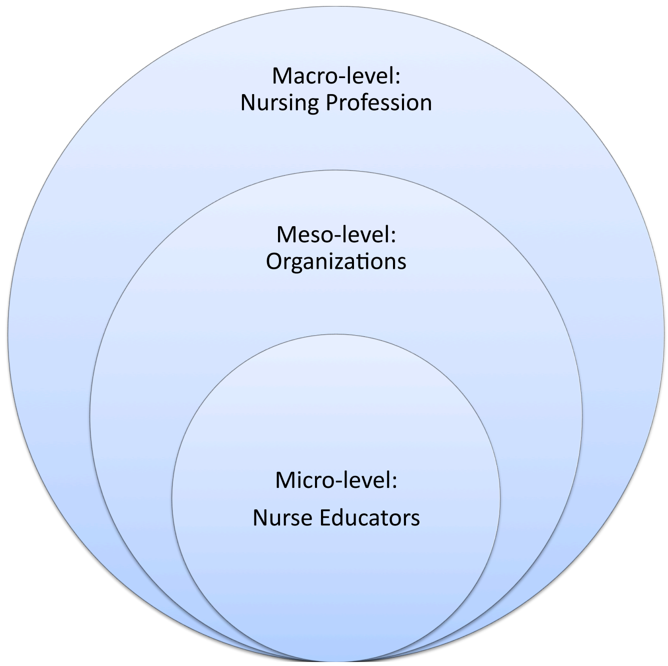

Figure 1. The micro-, meso-, and macro- levels of simulation in nursing.

Significance at the Macro-level

As a result of increasing recognition of IPE and HCS by educators, organizations, societies, and accreditors, many driving forces exist in nursing that impose IPE and HCS activities or elicit discussions regarding the adoption of such activities. The IOM reports on patient safety and health professions education (1999, 2001, 2003, 2006) and the future of nursing report (2010) identified the need for the integration of IPP into education and called for health professionals to develop interprofessional curricula. The National League for Nursing Education Competency Model describes "teamwork" as an integrating concept necessary for interprofessional practice (National League for Nursing [NLN], 2010). The American Association of Colleges of Nursing (AACN) identifies "interprofessional learning" as an expected competency for baccalaureate (2008), masters

(2011) and doctoral preparation (2006). Both accrediting bodies for nursing education programs, National League for Nursing Accrediting Commission (NLNAC) and Commission on Collegiate Nursing Education (CCNE), seek evidence of interprofessional education (NLNAC, 2011; CCNE, 2009). The Quality and Safety Education for Nurses (QSEN) initiative supported by Robert Woods Johnson Foundation (RWJF) also lists teamwork and collaboration as one of its six core competencies for both pre-licensure and graduate knowledge, skills, and attitudes necessary for continuous improvement of quality and safety in the healthcare system (Cronenwett, Sherwood, Barnsteiner, Mitchell, & Sullivan, 2007). Joint Commission (2008) also recognizes and recommends HCS and IPE as accepted educational tools toward patient safety and quality hospital environments. Hence, the findings of this study may suggest or support ways in which organizations can meet current and future standards.

Significance at the Meso-level

Organizations struggle to meet the standards set by professional and accrediting bodies, often "reinventing the wheel" when using innovative solutions uninformed of external, and often internal, activities and findings. Dissemination of the details of this study and its findings may provide a framework for organizations that can be used to meet these standards. The findings from this study can inform the development of simulation-enhanced IPE toolkits that can be shared beyond the meso-level.

In a recent Think Tank summit held by the National League for Nursing (2012), six organizations representing a diverse group of nurses in practice, education and administration (the National League for Nursing [NLN], American Association of Colleges of Nursing [AACN], American Nurses Association [ANA], American

Organization of Nurse Executives [AONE], International Nurses Association for Clinical Simulation and Learning [INACSL] and the Quality and Safety in Nursing [QSEN]) collaborated to share their perspective and experience of simulation-enhanced IPE in nursing. Attendees felt that there are too few IPE learning activities and that simulated learning environments are uniquely positioned to provide interactive IPE and IPP both prior to and following graduation.

> Think tank participants believed that opportunities for interprofessional interactions can uncover new dimensions of communication among health professions students. This is particularly true for scenario-based IPE experiences. Although each profession must educate students in preparation for their expected roles, it was considered essential that team members understand the roles of the others on the team. Simulated healthcare practice allows students to question the perceptions about these roles brought from culture and environment (NLN, 2012).

The findings from this dissertation may provide tangible solutions for these organizations.

Significance at the Micro-level

Nursing educators strive to understand how to identify approaches that assist in establishing effective education. To achieve quality patient care, educators seek to find methods that are reflective of nursing practice in teams. As Bradshaw and Lowenstein (2007, p. 5) highlight, "Rapid changes in technology require that teachers recognize the valuable principles behind the use of specific technologies, rather than focusing on the technology itself." Findings that inform the use of HCS in IPE may help nurse educators more fully understand the relationships between education, learning, and practice in hopes of discovering approaches to support nurses and all other professionals in effective communication and collaboration. Nursing educators can learn if interprofessional education is a necessary stage for professional learning and, if so, what purpose it has in providing best patient care. This study sought to increase the awareness of HC educators in the technology, methods, and benefits of HCS, including the benefit of bridging IPE curriculum, theory, and practice.

Significance for Theory

Many funders, organizational leaders, and educators looking to invest time, human resources, and money into either healthcare simulation or interprofessional education often pursue “proof of concept” in the use of either or both. While there are occasional studies with strong findings (McGaghie, Issenberg, Petrusa, & Scalese, 2010; Thistlethwaite, 2012), there are many studies that support the positive benefits of IPE or HCS that need to be treated with caution because of a lack in rigor or attention to evaluation. Collectively, the existing gray and peer-reviewed literature provide good foundational research that indicates that IPE or HCS are sound, if not best practice, educational methods. This existing foundation of knowledge needs further study, development, and refinement. Research quality, evaluation, reporting, and a standardization of language and knowledge has increased as the HCS and IPE fields advance and the “proof” is slowly strengthening; meanwhile, still with many “unknowns,” the fields continue to progress under many theoretical assumptions (see Chapter Two: Conceptual and Theoretical Background). Combining the fields and their individual assumptions creates a heavier reliance on theory and a vital need for theory-based research and curricula. Simulation modalities are often chosen because of theoretical perspectives and less because of strong evidence. By exploring a number of proposed modalities and students’ perceptions of teamwork, the findings of this study promote better theoretical understanding of IPE using HCS and identify areas and venues to further join the fields of IPE and HCS.

Overview of Remaining Chapters

This dissertation is structured into five chapters: Chapter One: Introduction, Chapter Two: Review of the Literature and Major Concepts, Chapter Three: Methodology, Chapter Four: Methods, Analysis, and Findings, and Chapter Five: Discussion and Conclusion. In Chapter One, the stage was set for the research undertaken in this dissertation. A review of the historical, theoretical, and current research literature is presented in Chapter Two, which synthesizes the state of the science. Details regarding the philosophical underpinnings and methods of the dissertation study, as well as the measures used and identified limitations are discussed in Chapter Three. A discussion of the findings of the study forms Chapter Four. The concepts and explorations presented are woven together in Chapter Five. Additionally, there is one circumscribed and embedded manuscript within this dissertation. The manuscript entitled, "Healthcare Simulation and Interprofessional Education: A Review of the Research Literature" is found in Chapter Two. Methods related to this embedded manuscript are included within the manuscript.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

As the need for interprofessional education (IPE) becomes increasingly evident, educators are looking toward healthcare simulation (HCS) as a platform for IPE. Healthcare professionals are not guaranteed exposure to relevant interprofessional practice (IPP) opportunities that are needed to prepare them for the transition from individual provider to team member. These encounters may be engineered through simulation-enhanced IPE where healthcare students and practicing providers have the opportunity to experience team scenarios, interactions, communication and to learn and practice team skills. Although current activities in both the HCS and IPE fields attempt to demonstrate that HCS can be an effective method that serves as a vehicle (or "platform") for IPE, existing literature lacks the research evidence needed to guide educators on how to best structure simulation-enhanced IPE.

Although both fields (IPE and HCS) have been in existence for over 40 years, research in the separate fields is relatively new, with publications increasing over the last decade. It is not a surprise that authors of literature reviews in both fields have also identified the need for enhancing the evaluation process and scientific rigor of the studies (Reeves, Abramovich, Rice, & Goldman, 2012; Zhang, Thompson, & Miller, 2011; McGaghie et al., 2010; Hammick, Freeth, Koppel, Reeves, & Barr, 2008; Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2004; Cooper, Carlisle, Gibbs & Watkins, 2001). A comprehensive approach to reviewing the literature is needed to capture a more accurate picture of the state of the merged sciences (see Figure 2).

This review of literature is organized into five sections: background of the study, a historical review of the literature, a review of the research literature, conceptual and theoretical background, and a conclusion of the current state of the combined fields (IPE and HCS are herein referred to as "the field") (see Figure 2). As an expansion of Chapter One, section one (Background) of this chapter introduces the sciences (IPE and HCS) separately. The successive sections of this chapter: two (A Historical Perspective), three (A Review of Research Literature), four (Conceptual and Theoretical Background), and five (Conclusion) primarily cover the field (see Figure 2).

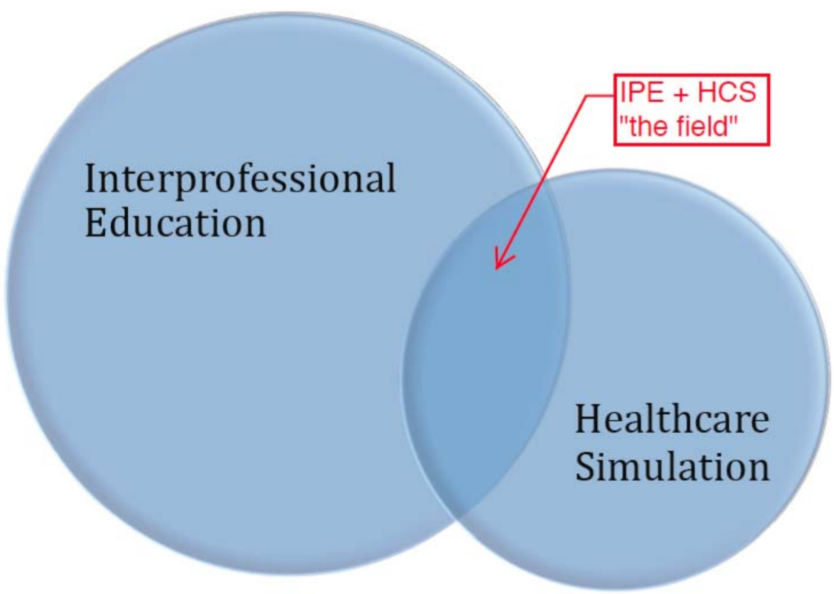

Figure 2. Interprofessional Education and Healthcare Simulation

Background of the Study

Pre-licensure IPE and Methods

IPE is not a standard requirement in the curriculum of pre-licensure or graduate healthcare students (Benner et al., 2010) but is increasingly recommended by accreditors and educational experts (IPECEP, 2011a, 2011b). Interprofessional learning may be limited by the educational methods used in an IPE program (Greenfield, Nugus, Travaglia, & Braithwaite, 2010). As researchers continue to find supportive and effective forms of IPE, some forms have been found to produce negative rather than positive outcomes in pre-licensure students usually due to poor planning or poor matching to course level or objectives (Freeth et al., 2005). Depending on the method used, IPE can be more beneficial for some professions than others. IPE may also be more beneficial for females (Curran, Sharpe, Forristall, & Flynn, 2008), which may affect the data of gender-centric professions (Freshman, Rubino, & Chassiakos, 2010; Benner et al., 2010). As IPE increases in pre-licensure healthcare education to meet the recommendations of accreditors and experts, it is imperative that appropriate IPE be developed to meet the needs of pre-licensure students.

Pre-licensure Students' Perceptions and Attitudes in IPE

Effective interprofessional learning is achieved through effective IPE (Hean, Craddock, & Hammick, 2012) and has been measured by perceived overall effectiveness of the education (Freeth et al., 2005). Individual learning is affected by the attitudes of the other team members (Curran, Sharpe, Flynn, & Button, 2010). Negative attitudes may be the most difficult to change (Pollard, Miers, & Gilchrist, 2005). For an IPE program to be effective, perception of overall effectiveness should be positive regardless of professional group or gender (Barr et al., 2005).

Systematic literature reviews on IPE studies of pre-licensure students have found that most studies measured student reactions, changes in attitudes, and changes in knowledge and skills (Reeves, Abramovich, Rice, & Goldman, 2012; Hammick, Freeth, Koppel, Reeves, & Barr, 2008). Student reactions were typically positive and indicated appreciation of interaction with the students from other professions (Thistlethwaite, 2012). Whereas courses allowed individuals to gain skills necessary for collaboration, they tended to have no effect on attitudes (Hammick, Freeth, Koppel, Reeves, & Barr, 2008). Pirrie, Wilson, Harden, and Elsegood (1999) challenge the value of IPE in pre-licensure students who do not yet fully understand their own professional role. Takahashi, Brissette, and Thorstad (2010) challenged Pirrie et al.'s position with findings from their studies in pre-licensure students which showed enhanced uniprofessional understanding of their role, as well as the understanding of the roles of other professions as a result of IPE. Takahashi et al. (2010) found that the acquisition of team skills increased within their sample. A common perspective in the literature is that IPE should be introduced early in pre-licensure curriculum (Horsburgh, Lamdin, & Williamson, 2001).

Individual learning during IPE has been found to be affected by the attitudes of the other team members, with negative attitudes the most difficult to change (Horsburgh et al., 2001). Cooper, Carlisle, Gibbs, and Watkins (2001) found that IPE was most effective when the students were at similar academic levels; however, similar academic levels continued to be difficult to achieve for IPE. Other difficulties included: sample size difference, need for faculty champions, and scheduling (Freeth et al., 2005).

Interprofessional Competencies

To create a coordinated effort across health professions and provide strategies toward collaborative learning, interprofessional competencies have been developed by the Institute of Medicine, Canadian Interprofessional Health Collaborative, and individual universities (Institute of Medicine [IOM], 2003; Canadian Interprofessional Health Collaborative [CIHC], 2010; IPECEP, 2011a, 2011b). In 2011, efforts in the United States brought together an Interprofessional Educational Collaborative Expert Panel (IPECEP, 2011a) that developed interprofessional competency domains. The group came to consensus on four domains:

1. Values/Ethics for Interprofessional Practice
2. Roles/Responsibilities
3. Interprofessional Communication
4. Teams and Teamwork

The IPECEP met again to develop specific competencies under these domains (IPECEP, 2011b). The purpose, aims, and methodology of this dissertation have been attuned to these competencies regarding teams and teamwork and were addressed throughout the study (see Appendix B).

The Benefits of IPE

Healthcare organizations including the World Health Organization (2010), the Institute of Medicine (1999, 2001, 2003, 2006), and the Agency for Healthcare Research and Quality ([AHRQ] 2008) established the need for IPP based on twenty years of findings that indicate approximately 80% of all sentinel events or unusual occurrences are a product of poor interprofessional communication (Joint Commission, 2008). As a result of these findings, healthcare education organizations and hospitals continue to seek methods for effective IPE and IPL (IPECEP, 2011b). Despite these efforts, positive outcomes remain hypothetical because there is a lack of evidence confirming effective change (WHO, 2010).

The Benefits of HCS

Healthcare simulation has acquired features that are advantageous over other educational tools. These attractive features include:

- a close resemblance to actual clinical practice;
- less subjective simulator scores;
- the ability to assess psychomotor skills;
- more relevant feedback;
- learner identification of educational needs;
- the ability to vary conditions; and
- student motivation to practice specific tasks (Pugh, 2008).

The safety net established by HCS not only protects the true patient but allows for an environment in which learners can safely make and learn from their mistakes with decreased fear, thus increasing the learning threshold.

According to the 2004 literature review by Issenberg, McGaghie, Petrusa, Gordon, and Scalese under the Best Evidence Medical Education (BEME) Collaboration, a filtered set of 109 studies from 1969 to 2003 identified ten consistent features and uses of high-technology simulators that lead to effective learning. These features and uses include:

- immediate provision of feedback during the learning experience;
- ability for learners to engage in repetitive practice;
- ability for a simulation to fully integrate the overall curriculum;
- ability to practice increasing levels of difficulty;
- adaptability to use multiple learning strategies;
- capacity for clinical variation (exposure to rare events, number and variety of patient encounters);
- controlled environment without injurious patient consequences;
- individualization of learning (ability to reproduce standardized experiences);
- clear outcomes definition; and
- realistic, relevant practice (Issenberg et al., 2004).

The 2010 literature synthesis by McGaghie, Issenberg, Petrusa, and Scalese found clear evidence that simulation technology produces substantial educational benefits. They provide a caveat that effective use of simulation requires, "knowledge of best practices, perseverance and attention to the values and priorities at play in one's local setting" (McGaghie et al., 2010, p. 60).

A Historical Perspective

Simulation has a long formal history, but potentially has an even longer undocumented history as a natural human behavior from imitative play and gaming to war tactic training. These types of activities often include more than one person with different roles, knowledge, skills, and attitudes. These natural human behaviors, often seen through child's play, imply a natural human tendency to practice being part of a team through simulation.

The first documented IPE and HCS initiative found by the researcher was published in 1947 and focused on inter- and trans-disciplinary education. The manuscript by Jantsch (1947) did not use the specific words "simulation" or "interprofessional education," but suggested IPE because the students learned with, from, and about each other. The description infers standardized healthcare providers because it used role-play activities between disciplines via trained actors.

Interprofessional simulations emerged in the 1950s as computerized simulations for behavioral sciences, psychology, sociology, and organization theory. The literature expanded in the 1960s, possibly as a result of an emergence of human factors studies (Gilmer, 1960; IOM, 1972). As early as the 1960s, teamwork and collaboration were commonly referred to as the "future of healthcare delivery" (Henry, 1974, p. 11)—a phrase still used today when describing IPE. A steep incline of interprofessional simulations (see Figure 3) began in the early 1990s and continues today.

The year 2000 began a new wave of what Eduardo Salas refers to as a "national obsession" with team training (Salas, Burke, & Cannon-Bowers, 2000, p. 339). In 1999, "To Err is Human" was published by the Institute of Medicine (1999). There was an increased focus on team training, with the use of MedTeams (McConaughey, 2008) in the early 2000s and the release of TeamSTEPPS (AHRQ, 2008) in 2006. In 2010, the World Health Organization published a framework for action on IPE, and the Interprofessional

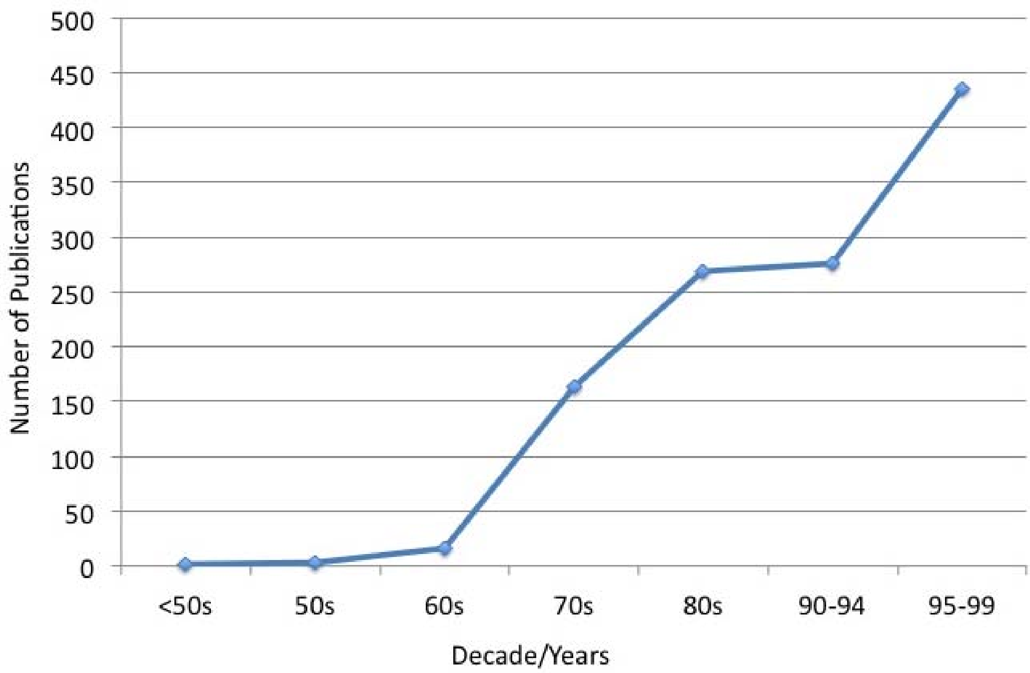

Figure 3. Number of interprofessional simulation articles published between the years 1947-1999.

Education Collaborative Expert Panel met twice to come to consensus on: 1) the domains for competencies, and then 2) more detailed competencies under the domains. Sponsored by the Josiah Macy Jr. Foundation, a third effort occurred during the Interprofessional Education and Healthcare Simulation Symposium (2012) where representatives from 22 professional healthcare organizations (see Appendix C) built upon the work of IPECEP's domains and competencies by coming to consensus on how healthcare simulation can further the field of IPE.

To understand simulation methods and modalities that support positive IPE and the promotion of these factors, a review of the research literature is fundamental. A synthesis of existing research may result in evidence-based suggestions for the development of effective simulation-enhanced IPE. An exploration of themes in the field may also contribute to the educational science.

Publishable Paper

Interprofessional Education: A Review of the Research Literature

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Abstract

Purpose: To explore the state of pre-licensure interprofessional education (IPE) using healthcare simulation (HCS) by examining studies that use HCS for pre-licensure IPE through a review of the research literature.

Methods: Research literature from the years 1800 to 2012 were reviewed and filtered through inclusion and exclusion criteria. This review covers research that included: experiential healthcare simulation with reported measures and formal interprofessional education with pre-licensure participants from at least two professions.

Results: Most of IPE and HCS literature was found to be descriptive without reported or measured outcomes. Twenty-two pre-licensure IPE and HCS studies met the inclusion criteria and were included in this review. Fifty percent (n = 11) of studies used mannequin-based HCS. Fifty-four percent (n = 12) of studies used a theoretical framework. Themes that emerged from the review include: focus of objectives (IPE or clinical objectives), level of technology, focus of measures, challenges, faculty descriptions, and areas for future study. Overall, the research designs included small sample sizes and low-rigor quantitative or qualitative analysis, resulting in findings that appear to be suggestive rather than evidence-based.

Conclusion: The quality and rigor of the existing literature is inadequate to determine factors that lead to positive or negative interprofessional learning through HCS. The authors conclude this review by suggesting research criteria and reporting items for future researchers to include in their studies and publications that could enhance future knowledge development.

Introduction

With the increasing recognition, adoption, and promotion of healthcare simulation (HCS), interprofessional education (IPE), and the use of HCS for IPE, programs are simultaneously creating IPE activities using HCS, seemingly duplicating efforts that other researchers have already begun exploring. The need for shared and compared knowledge is apparent.

The simulation-enhanced IPE research literature appears to be lacking rigorous approaches (Zhang, Thompson, & Miller, 2011). The factors that influence positive and negative outcomes when using HCS for IPE have not yet been defined. The recent rapid growth in HCS and IPE activities demands a need for reviewing existing literature with the aim of building knowledge around these unknown factors. Educators, institutions, and professional societies are in search of recommendations that can inform ways to effectively develop and evaluate IPE using HCS.

Purpose

This review seeks to explore the state of pre-licensure IPE using HCS by examining research studies that use healthcare simulation for pre-licensure healthcare IPE. The review addresses the following questions:

- What demographics arise from the existing literature (e.g. geographic distribution, professions, professions of authors)?
- What research methods are used?
- What subjects were studied?
- What theories and frameworks are used in HCS IPE?
- What simulation modalities are used in HCS IPE?

- What measurements are used? Are the measures reliable and valid?
- What characteristics have been found to influence positive and negative outcomes in IPE?
- What are the common challenges that researchers encounter?

This review is an exploration of simulation methods used for IPE from a variety of study perspectives, offering new information and raising many areas for future research. In this review, complex factors in this methodology are clarified in an attempt to assist educators and researchers to further understand their simulation practice, and to build their own curriculum and research for interprofessional education and learning.

Background

Interprofessional education/training (IPE) occurs when "two or more professions learn with, from and about each other to improve collaboration and the quality of care" (Center for Advancement of Interprofessional Education [CAIPE], 2005, "What is Interprofessional Education?" para. 1). Formal IPE is developed as an educational event or program that aims to achieve interprofessional learning by bringing learners from different professions together and fostering collaboration in practice (Freeth, Hammick, Reeves, Koppel, & Barr, 2005). The intent for formal IPE is for learning to be applied in the practice setting through interprofessional practice (IPP) and ultimately enhance the quality of patient care.

Simulation is "a technique that uses a situation or created environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions. Simulation is the application of a simulator to training and/or assessment" (Council for the Accreditation of Healthcare Simulation Programs [CAHSP], 2012, p. 46). A simulator is "any object or representation used during training or assessment that behaves or operates like a given system and responds to the user's actions" (CAHSP, 2012, p. 46).

Methods

Standard literature review procedures (Polit & Beck, 2012) were applied for reading abstracts, scrutinizing full papers and abstracting data. Due to poorly written abstracts, the authors evaluated all publications, filtering according to the inclusion criteria. Because the literature generally lacked adequate methodological strength, strength of findings, and similarity in research question, variables, populations, or measures, a meta-analysis was not appropriate (Polit & Beck, 2012). Development of a literature database was initiated using a synthesis of literature review management items (Cochrane Collaboration, 2012; Best Evidence in Medical Education [BEME], 2012; Garrard, 2010) (see Appendix D).

There were 5,547 hits that resulted from a general search of nine literature databases (CINAHL, PubMed, MEDLINE, EBSCO Academic Search Premier, Social Sciences Citation Index, PsychINFO, JSTOR, Cochrane Collaborative Review, Google Scholar) searching from the earliest date available in each data base ranging from 1800 to 2012 using 33 single search terms including "health*" and "simulat*, standardized, experiential, case-based, or virtual" and "interprofession*, educ*, team*, collaborat*, profession*, communicat*, staff development, physician, medic* + nurs*, or TeamSTEPPS" and multiple Boolean combinations. Of the initial 5,547 articles found for IPE and HCS, the inclusion and exclusion criteria were narrowed to include at least two professions, formal pre-licensure educational initiatives, experiential HCS that involved direct experience (Kolb, 1984), and measured and reportable results (see Figure 4). This resulted in 22 articles (see Table 1). Articles that met the inclusion criteria were logged using Microsoft Office Access® 2010 (Microsoft, Inc., Redmond, WA, USA) according to selected items that included researcher(s) professional background, purpose, sample and faculty composition, duration, research design, theory, interventions, simulation characteristics, evaluation methods, findings, strengths, limitations, challenges, and areas for further study (see Appendix D).

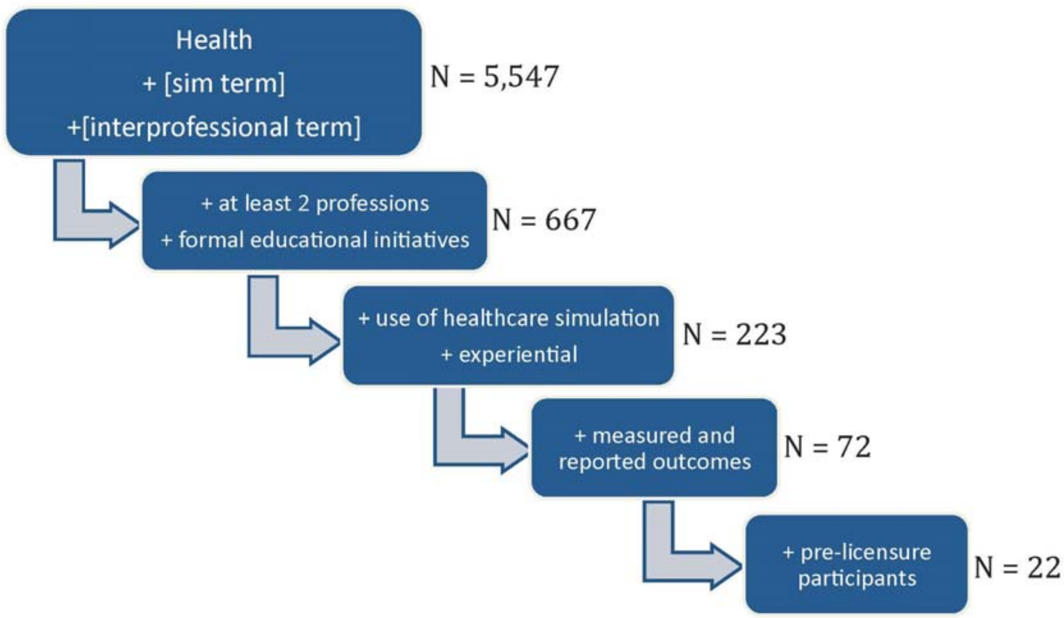

Figure 4. Literature inclusion and exclusion criteria.

Table 1

Table of Pre-licensure Interprofessional Education and Healthcare Simulation Published Research Studies

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
Baker et al., 2008	To report preliminary evaluations of an IPE simulation through learner and teacher reactions Th: Investigator developed, Competency framework merging multiple frameworks	quant→QUAL Action research (Kemmis & McTaggart), descriptive statistic comparisons	Non-probability *N* = 301 154 RN St 70 MD St 77 MD JrRes 5 learners per group 2 hours	Mannequin-based with debriefing and task-model Resuscitation scenarios with focus on leadership and communication	Post-evaluation open-ended questions: perceptions and value of learning; Interdisciplinary Education Perception Scale R/V: Cronbach's alpha = 0.87; reference for validity testing provided	Attitudinal scores and responses were consistently positive regarding evaluation of the course among all students.
Bandali et al., 2012	To assess the impact of a New Curriculum Model intervention on student preparedness for clinical practicum Th: Michener New Curriculum Model (NCM, investigator-developed)	QUANT-qual Post-survey and focus groups	Non-probability *N* = 195 118 Students from Medical Laboratory Science, RT, Diagnostic Cytology and Genetics Technology, Medical Radiation Sciences 77 Clinical Educators Team composition not reported. Summer semester	Task-specific trainers, mannequins, anthropomorphic phantoms, discipline-specific case scenarios, computer exercises, SPs and ESPs. Clinical Preparation for Allied Health Professions: scenarios with common technical, IP, and "core" skills	Clinical educator survey, pre- and during student course evaluations, focus groups (separate for student and faculty) R/V not reported	41% survey response rate, 66% of educators participated in focus groups; educators rated 61% NCM students as better than non-NCM; graduates reported significant (p<0.05) preparation through simulation; technical skills the most significant improvement; core skills also improved; IP collaboration decreased.

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
Cavanaugh & Konrad, 2012	To describe the implementation of a shared learning model designed to promote the development of person-centered healthcare communication skills Th: shared learning model (Investigator developed)	qual Descriptive, narrative feedback	Non-probability *N* =73 39 MSW St 34 DPT St Team composition not reported. 4 hours over 2 days	Case-study, video-replay simulated role-modeling (good and bad example), simulated family and patient; reflective learning, communication skill practice Person-centered communication scenarios	Transcripts/notes	Students valued opportunities to learn directly from each other and from patients; model shows promise as an effective method for person-centered communication skills.
Dagnone et al., 2008	To describe the development and implementation of a series of interprofessional resuscitation rounds promoting team roles Th: not reported	quant Post-test	Non-probability *N* = 222 101 RN St 42 MD St 79 JrRes 5 per team 2-hour sessions, nurses once, medical students 1-8 times	Mannequin (no debrief) ACLS simulations, blended learning levels	Perception of learning using Likert-type scale R/V not reported	Encounter was valuable for understanding team roles, desire more IPE, positive attitude toward sim, and identified lack of similar educational initiatives.
Dillon et al., 2009	To analyze student perceptions of collaboration following an interdisciplinary simulation exercise	QUANT— qual Pre- and post-test and open ended questions	Non-probability *N* = 82 68 RN St 14 MD St	Mannequin followed by debriefing Mock code scenarios	Jefferson Scale of Attitudes Toward Physician-Nurse Collaboration; open-ended questions re:	Nursing with higher pre-test scores, $p<.05$ seen in MD students post-test scores for collaboration and nursing autonomy.

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	Th: not reported		10 per group 2 sims, one observe/one active		perceptions of learning R/V: Cronbach's alpha, 0.70 to 0.96; validity not reported	
Jankouskas et al., 2011	To detect relevant training effects after Crisis Resource Management training during sim Th: Team Effectiveness Conceptual Model (Kozlowski and Ilgen, 2006)	QUANT Experimental; pre- and post-test	Random sampling *N* = 96 50 RN St 46 MD St 4/team (2RN, 2MD) 1 session, 3hr	Mannequin followed by debriefing BLS and CRM scenarios	ANTS (teamwork, task management, situation awareness), response time, error rate R/V: Cronbach's alpha = 0.79 to 0.86; inter-rater reliability 0.83 for task management, 0.79 for teamworking, and 0.66 for situation awareness	Experimental teams demonstrated significant improvement in team process measures compared with control teams; team effectiveness improved with both groups; RN and MD students with same IP attitude.
Ker et al., 2003	To describe simulated ward for junior medical and nursing students Th: not reported	qual Semi-structured evaluation questionnaire	Non-probability *N* = 151 92 MD St 160 RN St 20 students per session 8 sessions for 2hrs over 2wks	12 SPs Acute medical condition scenarios	Investigator-developed assessment reflecting learning objectives	94% survey return rate, 4 themes: 1. Educational environment (positive comments—realism and equipment), 2. Organizational issues (processes), 3. IP issues (most positive—team experience), 4. Communication
Kyrkjebo et al., 2006	To test and evaluate program Th: BEST principles (Wisborg, 2006,	qual Focus group method (Krueger &	Non-probability *N* = 12 MD St, RN St	Mannequin followed by debriefing 4 settings: blood	Uniprofessional structured focus groups	Students didn't consciously use Crisis Resource Management during sim exercises; videos not helpful and

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	2005)	Casey, 2000)	4 teams: 1 profession/team 2 sims twice (re-run)	transfusion, BLS, cvc, drug administration; videos; no videos; debriefing		nursing-focused—although video review and discussions were very helpful.
Lewis, 2011	To evaluate a pre-registration program Th: SMART program, national competencies and guidelines	QUANT - qual Pre- and post-test (Featherstone, 2005)–descriptive statistical tests and open text analysis	Non-probability *N* = 88 16 MD St 72 RN St 16 nurses and 4 med students/cohort Duration/Frequency not reported.	CD-ROM and mannequins with workshops Acute illness scenarios	Questionnaire for ALERT program (Featherstone) - knowledge, confidence, perceptions of IPP and free text R/V not reported for revised questionnaire	Levels of knowledge, confidence, and comfort with IPP increased after the program (comfort: 3.5 to 6.6 mean; confidence 3.1 to 5.6 mean; knowledge 5.5 MDs and 2.4 RNs).
Luctkar-Flude et al., 2012	To evaluate an interprofessional pediatric educational module using HCS Th: not reported	QUANT-qual Mixed, quasi-experimental action research (Kemmis & McTaggert, 1990)	Non-probability *N* = 96 79 RN St 17 MD St Team composition not reported. One session: 30 min sim 30 min debrief	Mannequins and ESP-family Asthma exacerbation and sepsis	Likert and qualitative survey Communication and Teamwork Scale of the University of W. England, Bristol Entry Level IP Questionnaire (Pollard, 2004); confidence survey—investigator developed R/V: Cronbach's alpha = 0.79 for Communication and Teamwork scale; 0.83 for asthma; 0.87 for	Team skills improved significantly for the IP groups, but not for non-IP groups; pediatric skills lower than team scores for all; lower confidence after sim; assessments better in IP groups; documentation was better in non-IP group.

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
					sepsis; peer review validation	
MacRae, 2012	To refine professional parameters, learn to collaborate, and design community interventions Th: Interprofessional Geriatric Education Program (IGEP) model Rudenberg's (2004) Turf, Team and Town (Investigator-developed)	qual Descriptive, qualitative reflective feedback	Non-probability *N* = not reported Team composition: 10 PA, 2 OT, 2 DDS, 5 PT students 4hr twice/wk during fall and spring semesters	SPs, feedback followed by debriefing (more patient visits than sim) Interprofessional Geriatric Education Program (IGEP) scenarios	Qualitative reflective feedback. Formative: faculty observation, student written plan of care; Summative: paper and OSCE	Perceptions of other professions became clearer and generated more respect; exposure better prepared them for challenges and advocating collaboration and holistic patient care.
Marken et al., 2010	To design an IP project to teach IP teams how to recognize and engage in difficult conversations with patients Th: Conscious Competence Learning Model and Matrix	quant-qual Post-survey, behavioral assessment, text analysis; Compared statements with performance	Non-probability *N* = 12 4 RN St 1 Pharm St 6 Residents 1 Fellow Team composition not reported. Two 4 hour sessions 3 weeks apart	Hybrid sim with SP mom and mannequin child followed by debriefing Sick child visit with mother indicating intimate partner violence and suicidal thinking	IP Teams in Difficult Conversations Self-Assessment; sim assessment rubric by faculty; satisfaction survey; 3 statements R/V: reliability was not tested and was not used for reporting; rubric was not validated	Positive participant satisfaction. Participants demonstrated knowledge and skill enhancement using the assessment told and were satisfied with the program.
McIlwaine et al., 2007	To explore personal, uniprofessional, and interprofessional	quant Post-test eight	Non-probability *N* = 25	Mannequin with simulated MD, and simulated RN, case	Likert-type questions on personal, uniprofessional, and	Mainly females chose this course. All students felt workshop

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	roles in the dying and death process; program evaluation Th: Social Constructivism	weeks post workshop	14 MD St 11 SW St Team composition not mentioned. 2.5 hours	studies, document review, followed by debriefing (mannequin sim was mainly documentation, reporting findings)	interprofessional death and dying; open-ended questions on knowledge gained and perception of training R/V not reported	was worthwhile, seven students believed the workshop should remain voluntary. SW students attended workshop because they were most interested in grief process. MD students attended to further their knowledge. Sim rated most useful element.
Reese et al., 2010	To investigate the use of sim to support collaboration between nursing and medical students Th: Nursing Education Simulation Framework (NESF)	QUANT-qual Pre-/post-test, factor analysis	Non-probability *N* = 28 15 MD St 13 RN St 4 per group, 2 active, 2 observing 40 minutes	Mannequin Surgical patient with dysrhythmias	Simulation Design Scale (SDS) 20 items; Collaboration scale 12 item, validity through experts 3 open-ended questions R/V: Cronbach's alpha reported for new collaboration scale = .95	Positive responses on collaboration scale, no significant differences between nursing and medical student groups in perceptions of educational practices of the sim, self-confidence to care with patient with complications, and satisfaction with collaborative aspects.
Reising et al., 2010	To understand IP communication (between nursing and medical students) within the context of traditional versus simulated educational environment	QUANT-qual Prospective, descriptive and comparative survey	Non-probability *N* = 60 41 RN St 19 MD St 2 med students and 3-4 nurs students per team	Mannequin and case study (no debriefing) ACLS Scenarios	Survey (possibly investigator developed) R/V not reported	Students with better sense of clinical role; experience changed view of the role of the team. The descriptive survey suggested trust and respect as a result. Most students expected medical student to be

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	Th: Jeffries Sim Model		One year course, duration/frequency of sim not reported.			leader. The difference bet RN and MD St: MD students used term, “leader,” RN students often used, “autonomous” and “independence.”
Robertson et al., 2010	To describe an adaptation of TeamSTEPPS for med/nurs students Th: educational framework (Investigator-developed)	QUANT Pre- and post-test	Non-probability *N* = 213 RN and MD St Teams of 10 4 hr team training half day for all nurse/med students	Mannequin and video review followed by debriefing	12-item pre/post knowledge and 14-item CHIRP attitudes assessment; recognition of team skills through video review: team skills 24-item checklist video rating (yes/no and Likert) R/V: Cronbach’s alpha = .587 and .674 for video rating, .86 for survey	Significant change in knowledge and attitude around team skills. Nursing significant increase in teamwork perceptions, however, nurses had higher pre scores. Significant increase in attitudes for those who did sim first.
Shoemaker et al., 2011	To describe the design, planning, cost, and support staff time required for IP sim for 64 PT and OT students Th: not reported, “Beasley Method” used for schedule.	qual Qualitative analysis of student experiences	Non-probability *N* = 64 PT and OT St Team composition not reported 4 hours	SP, video obs, followed by debriefing Clinical Status Recognition, range of motion, and safe mobilization scenarios	Observation	Sim is highly valued and well-liked, requires staff and financial resources and varies by fidelity of type of scenario.
Shrader et al., 2011	To describe a sim IP rounding with	quant	Non-probability	Mannequin followed by	Pre- and post-survey, university grading tool	Better appreciation of value of IP

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	mannequins for Pharm, MD, and PA students; determine effect on attitudes toward IP collaboration Th: not reported	Pre- and post-survey	*N* = 99 72 Pharm St 27 MD and PA St 5 per team (3 pharm, 2 either MD or PA) 1hr 15 minutes	debriefing Interprofessional Rounding Scenarios	for clinical performance R/V: reliability not reported, not validated	collaboration, increased knowledge about other professions, increased knowledge about role, and self-perceived improvement in teamwork skills.
Titzer et al., 2011	To describe an IP sim in four professional programs Th: Benner's Novice to Expert	quant-qual Post-test	Non-probability *N* = 131 79 RN St 15 Rad Tech St 10 RT St 27 OT St 7 per sim team: 2 RNs, 2 rad techs, 2 OTs, 1 RT were active; remaining observed Duration/frequency not reported.	Mannequin followed by debriefing COPD Scenario	Educational Practices in Simulation Scale (EPSS) (NLN and Laerdal). Healthcare Provider Priority Survey (HPPS) perceptions of importance of sim for collaboration and of each other R/V: Cronbach's alpha = 0.86 for simulation practice and 0.91 for the importance of the items	Sim provided relevant experience, increased understanding of OT role, discussed differences in terminology and procedures; higher education level felt more important than those at a lower level.
Van Soeren et al., 2011	To provide insight into the nature of IPE in sim, particularly the teaching and learning processes. Th: not specifically	QUAL Collective case study (Stake, 1994)	Non-probability *N* = 253 152 clinicians 101 students (Pharm tech, paramedics, RN assistants, OT and PT assistants)	SPs, video-recorded role play followed by debriefing and later focus groups Meeting-based scenarios	Video coding structure Validity established, triangulation for reliability	5 key themes: 1. Enthusiasm and motivation —students more enthusiastic, 2. Professional role assignment—clinicians had disconnection from

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	reported, mentioned role-play theory in literature review (van Ments, 1983)		5-8 learners per team 8 hours			role they were playing 3. Scenario realism—could not engage at times when it wasn't real 4. Facilitator style and background—2 types: facilitator role and teacher role 5. Team facilitation—two or more debriefers provided balance
Wamsley et al., 2012	To describe IP standardized patient exercise Th: ISPE framework	QUANT—qual Pre/post-test; focus group	Non-probability *N* = 101 Dental, MD, NP, Pharm, and PT St Teams of 4-5 4 hours	SP followed by debrief Transient ischemic attach scenario	Attitudes Toward Healthcare Teams (ATHCT) R/V: Cronbach's alpha = 0.83 for team value, 0.74 for team efficiency, and 0.61 for physicians shared role; consistent with other studies	Attitudes toward team-based care improved significantly on team value and team efficiency subscales; significant differences in attitudes toward team-based care by profession–physicians and dentistry with less favorable attitudes.
Whelan et al., 2008	To develop and evaluate a rural interprofessional learning module Th: not reported, used RIPPER	QUANT-QUAL Mixed methods, Pre-/post-test over 2 years	Non-probability *N* = 60 MD, RN, and Pharm St Team composition	3 types: Mannequin, low-tech sim, and role-playing; each followed by debriefing Confused patient,	13-item Likert-type scale: perceptions of roles, responsibilities, communication, teamwork; focus groups; 8 open-ended	Positive shift in students' understanding of IPP and teamwork as a way of problem solving and improving patient outcomes; pharm students

Reference	Purpose and Theory	Design	Sample, Team Composition and Duration	Simulation Modality and Scenario	Outcome Measures	Findings
	framework	quasi experimental, thematic analysis of 8 open items and focus groups	not reported. 2 weekends	acute diabetic episode, cardiac arrest	questions: perceptions of learning R/V: Not reported	uncomfortable with role-play.

Note. Th = Theory; RN St = Nursing Students; MD St = Medical Students; MD JrRes = Junior Residents; R/V = Reliability and Validity; MSW St = Social Work Students; DPT St = Doctor of Physical Therapy Students; PT St = Physical Therapy Students; ESP = Embedded Simulated Person; SP = Standardized Patient; sim = simulation; HCS = Healthcare Simulation; Pharm St = Pharmacy Students; PA St = Physician Assistant Students; OT = Occupational Students; NP = Nurse Practitioner; IP = Interprofessional

Results

Demographics

When determining the state of a science, demographic data are essential to identify needs and habits in the field, providing parameters that suggest areas of focus for researchers. From a geographic perspective, the 22 studies were undertaken in six countries including the United States (n = 12), Canada (n = 4), Canada and Israel (n = 1), United Kingdom (n = 3), Australia (n = 1), and Norway (n = 1). Fifty-two percent of the publications were from the United States. This was of particular interest to the authors because IPE activities in the United States were strong in the early 1960s and dropped substantially over the following four decades with a strong refocus in the 2000s. Over those four decades, educators and researchers in the United Kingdom, Canada, and Australia made strides in advancing the field. Because there is a long-standing international history and development in IPE, international studies were included in this review.

Like all experiential learning curricula, HCS and IPE require a great deal of preliminary planning (Billings & Halstead, 2009) due to the highly complex and interactive nature of HCS. To achieve simulations appropriate for each learner, the planning team should include a member for each involved learner profession (Freeth et al., 2005) to promote equal and realistic learning opportunities for all involved learners. Faculty composition in the development, research, and implementation of simulated IPE may influence the outcomes of the activities. Author credentials indicate experience while affiliations indicate target students. Of the 22 publications, 25% did not note author's credentials and affiliations (Kyrkjebo, Brattebo, & Smith-Strom, 2006; Lewis, 2011; Van Soeren et al., 2011; Wamsley et al., 2012; Whelan, Spencer, & Rooney, 2008). Of those noted, 36% were nurses. Over half of the included studies involved only medicine and nursing participants (Baker et al., 2008; Dagnone, McGraw, Pulling, & Patteson, 2008; Dillon, Noble, & Kaplan, 2009; Jankouskas, Haidet, Hupcey, Kolanowski, & Murray, 2011; Ker, Mole, & Bradley, 2003; Kyrkjebo et al., 2006; Lewis, 2011; Luctkar-Flude et al., 2012; Marken, Zimmerman, Kennedy, Schremmer, & Smith, 2010; Reese, Jeffries, & Engum, 2010; Reising, Carr, Shea, & King, 2010; Robertson et al., 2010). One study included both pre-licensure students and practicing providers as participants (Van Soeren et al., 2011).

Samples

The studies generally had very small sample sizes. Quantitative studies ranged from 12 to 301 participants. Although most studies sampled medical and nursing students, 36% did not report the professional composition of the learning groups. Most studies also did not report the process of matching learner levels from one profession with other professions included in the IPE. Some studies noted the similarities or differences between knowledge, skill, and experience levels of the group members. The duration of exposure to the intervention or other confounding variables was reported by all but two of the studies and ranged from 30 minutes to one year; however, the duration of exposure experienced by each sample population (e.g. was the exposure equivalent between each professional group) was generally not mentioned.

Research Methods

Most studies were conducted to describe and report the development and implementation of simulation-enhanced IPE through learner evaluations and surveys.

Nine quantitative studies used pre- and post-test designs. Four studies used post-test only. Of the survey designs, most studies did not have a between group comparison. There was one experimental design and one quasi-experimental design. Other quantitative designs include descriptive statistics comparison (*n* = 3), action research with pre- and post-tests (*n* = 1), and behavioral assessment through video coding with behavioral items (*n* = 1). Six of the studies used qualitative methods with open-text questionnaires and focus group analysis as the most frequent methods. Other qualitative methods included descriptive, narrative feedback (*n* = 2), observation (*n* = 1), case study (*n* = 1), and thematic analysis (*n* = 1). Ten studies used a mixed method approach, most frequently using descriptive statistics comparisons and debriefing discussion and anecdotal transcripts.

As shown in Table 1, positive effects of HCS for IPE were suggested in the literature; however, it was apparent that there was a lack of focus on evaluation when using simulation for IPE. The studies that evaluated an educational intervention can be categorized using Kirkpatrick's evaluation model (Kirkpatrick, 1967). Kirkpatrick's evaluation model is an accepted evaluation methodology for assessing learning processes (1967). Kirkpatrick (1967) provided four distinct levels (or "steps") for assessing the effect of an educational course: 1) Reaction, 2) Learning, 3) Behavior, and 4) Results. Levels two and four were modified by Barr, Koppel, Reeves, Hammick, and Freeth (2005) and used in both IPE and HCS literature reviews. Barr et al.'s (2005) modified Kirkpatrick levels are: 1) Learners' Reaction, 2a) Modification of Attitudes and Perceptions, 2b) Acquisition of Knowledge/Skill, 3) Change in Behavior, 4a) Change in Organizational Practice, and 4b) Benefits to patients/clients. Business groups have since added a level five: 5) Impact. This fifth level embraces any effect on the field toward healthcare improvement. In the IPE and HCS pre-licensure literature, attitudes and perceptions were most frequently studied (see Figure 5) with an identified need for more research around clinical outcomes.

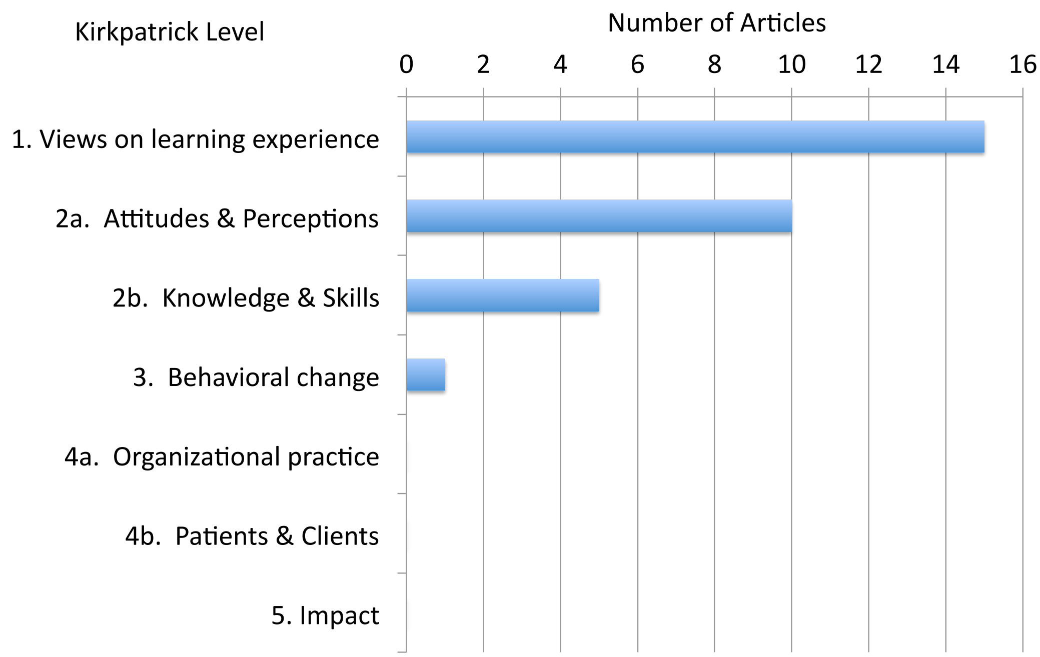

Figure 5. Kirkpatrick levels of studies.

Theories and Frameworks

Ten of the articles included in this review did not report a theory or framework. Of the twelve studies reporting the use of a framework, half used investigator-developed frameworks to guide the development of the HCS for IPE. The frameworks commonly used in the studies were curricular maps and competencies established by the educator's institution. The Nursing Education Simulation Framework (Jeffries, 2007), a theory specific for HCS, was referenced in two studies.

Interprofessional competencies developed by either the Canadian Interprofessional Health Collaborative (Canadian Interprofessional Health Collaborative [CIHC], 2010) or the Interprofessional Education Collaborative Expert Panel (IPECEP, 2011b) were not used by any of the studies. One study included TeamSTEPPS, a previously published team-based framework (Agency for Healthcare Research and Quality [AHRQ], 2008). Studies that used a theory or framework detailed rigorous approaches to the research in comparison to studies that did not use a framework (see Table 1). Because assessment instruments for these frameworks are still being developed and refined, critique of the effects of frameworks on outcomes will not be addressed at this time but is suggested for future study. Particular relationships in these models or specific team skill tools (e.g. TeamSTEPPS) were not comparatively studied.

Simulation Modalities

All studies using simulation modalities generally showed positive effects on learner outcomes (see Table 1). The most common experiential simulation modalities used for IPE are mannequin-based simulations (36%), standardized patients (19%) and embedded simulated persons (10%). The studies that examined these modalities did not compare these particular modalities with each other. Similarly, in a 2012 survey of educators that use HCS for IPE, Palaganas and Andersen (2012) report that 79% of respondents used mannequin-based simulation and felt that mannequin-based IPE was most effective at achieving the IPE objectives for their courses, whereas 35% used a simulated family member and 31% used a standardized patient (some in conjunction with mannequins) (Palaganas & Andersen, 2012).

In healthcare simulation, frequently there are both observing and active participants. This usually occurs for two reasons: 1) the simulation emulates a typical hospital event where there are usually only a few providers at the bedside (Van Soeren et al., 2011) and 2) simulation programs have limited resources (Shoemaker et al., 2011). Twenty studies used debriefing, most commonly immediately following a simulation. All studies reported positive findings regardless of no debriefing, debriefing immediately following simulation, or debriefing at the end of the course. There were no studies that comparatively studied the use of debriefing. There were no studies evaluating the use of reflecting teams.

The frequency and duration of simulations ranged from one session to a year-long course and thirty minutes to eight hours. Team composition also varied in range from two to twenty learners per simulation group. Of the studies that reported frequency, duration, and composition, the most commonly used study was one 2-hour session with five learners per group.

Low-technology or High-technology Modalities

There was an apparent delineation in the literature regarding the use of technology, particularly equipment used to facilitate the simulation. Researchers used low-technology simulation and high-technology simulation. Low-technology simulations minimally involved equipment or computer-controlled models, including: paper activities, case study discussions, team building activities, and role-playing. High-technology often referred to “high-fidelity” or “human patient simulation,” involved mannequin-based simulation. The use of hybrid simulation has gradually increased over the last decade with mannequin-based simulations integrating “embedded simulated persons," or simulated healthcare providers or family. Hybrid simulations also appear as technology-enhanced standardized patients and may be structured as actors using simulated models as adjuncts to their clinical event or their physical structure. Another modality widely used by practicing provider learners includes virtual simulation that builds interactions through the use of avatars. Virtual simulations were not used in any of the reviewed studies.

Simulation Objectives

A synthesis of the teaching methods used in HCS and IPE suggested two main classification structures when examining simulation facilitation methods: simulation-based interprofessional education (SimBIE) and interprofessional simulations (IPsim). This SimBIE versus IPsim classification focuses on the objectives used to structure the simulation.

SimBIE or IPsim

A distinction that has been made in IPE literature is interprofessional education and multiprofessional education (MPE). IPE describes those occasions when two or more professionals learn with, from and about each other to improve collaboration and the quality of care (CAIPE, 2005). MPE is when members (or students) of two or more professions learn alongside one another: in other words, parallel rather than interactive learning (Freeth et al., 2005). There is evidence in IPE literature that learning is better achieved through IPE versus MPE (CIHC, 2010).

This distinction can also be made in HCS and appears in two forms with which the authors refer to as, "SimBIE" and "IPsim." These methods depend on the objectives specified for the simulation. SimBIE refers to a simulation that was structured according to IPE objectives where two or more professionals learn with, from, and about each other to improve collaboration and the quality of care. IPsim corresponds with MPE and involves learners from two or more professions learning alongside one another in the simulation. In IPsim, the simulation is structured around a patient condition or situation that requires coordination and demonstration of skills specific to the individual professions. In this study, eighty percent of high-technology simulations used IPsim. By nature, debriefing as a separate modality fosters SimBIE. The authors found that 90% of high-technology simulations coupled debriefing with the IPsim and, therefore, provided a hybrid approach of IPsim to SimBIE.

Outcome Measures

Most simulation-enhanced IPE activities were developed to increase awareness for IPE, assess perceptions and attitudes around interprofessional practice, and provide a venue to practice team skills. Many studies appeared to have a mismatch in measurement instruments as paired with the reported purposes of the study and activity (e.g. intent is program evaluation with measurement instrument focused on role perception). Most studies also used two or more measurement methods. Fifty percent of the studies reviewed used investigator developed measures. Qualitative methods included transcribed focus group discussions and open-ended investigator-developed questionnaires. Thirty-six percent reported validation of measures through expert development, review, or revision; however, 59% of the studies did not report psychometric testing. Measurement of student performance included skills checklists (n = 6), behaviorally anchored instruments (n = 3), and video review (n = 1). The lack of psychometric testing is identified broadly from literature reviews within HCS and IPE separately (Hammick, Freeth, Koppel, Reeves, & Barr, 2008; Reeves, Abramovich, Rice, & Goldman, 2012; Reeves, Tassone, Parker, Wagner, & Simmons, 2012; Thistlewaite, 2012; Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005; McGaghie, Issenberg, Petrusa, & Scalese, 2010; Zhang et al., 2011), and is substantiated in this literature review of the field.

Characteristics That Influence Outcomes

Exploring potential characteristics or isolated factors that influence positive or negative IPL outcomes has proven difficult. Although this review of published literature finds positive outcomes through anecdotal evidence or data from untested or psychometrically tested instruments, a report of outcomes is not adequate when factors that can influence those outcomes are not fully disclosed or reported. In several studies, potential confounding variables were not reported or controlled in the analysis. In addition to faculty composition, other potential confounders included faculty perceptions and enthusiasm, faculty development, simulation facilitation, debriefing methods, and instrument development.

Acknowledging that the strengths of findings in the current studies are ambiguous with no clear conclusions, there appeared to be a trend where conclusions may be based on what is reported. Themes identified by the investigators to influence positive outcomes included: realism, opportunity to expose students to patient events, practice, and acculturation; whereas themes identified by investigators to influence negative outcomes included: additional training of faculty or simulated actors, equipment limitations, and a focus on the overall program versus specific modalities.

Those who believed that simulation is more effective than traditional approaches attributed this perception to:

- realism;
- practice;
- debriefing and reflection;
- increased student engagement;
- relevance of the experience;
- fostered interaction;
- safe environment;
- opportunity for feedback;
- immediacy of feedback;
- immersive experience;
- framework for learning communication; and
- the emotional experience.

There were no reports that students believed simulation was not an effective method. In the 2012 survey by Palaganas and Andersen (2012), those respondents that believed simulation was less effective highlighted the importance of protecting the psychological safety of learners during the simulation and how simulation, if not done "right," may be more detrimental to positive interprofessional learning (Palaganas & Andersen, 2012).

Challenges Found in Studies

The challenges reported in the 22 studies during implementation of the simulation-based IPE reflected common challenges found in simulation and in IPE in general. Of the common challenges found in simulation, costs and resources were a barrier for interprofessional HCS (McGaghie et al., 2010). Of the common challenges found in IPE, scheduling, logistics, and organizing the different programs or professions was a barrier for interprofessional HCS (Freeth et al., 2008). Simulation-specific challenges during implementation included:

- equipment issues (e.g., problems with audio recording or live streaming, mannequin electronic failure, no technology support, not having enough time);
- difficulty meeting needs of all disciplines (e.g., scenario development that engages all disciplines and learning levels, lab scheduling and schedule conflicts, interprofessional debriefing);
- lack of simulation knowledge (e.g., simulator operator training, lack of faculty expertise in technology, simulation, and debriefing; lack of pre-briefing, fidelity (accurate reflection of the phenomenon);
- difference in personal objectives of the involved faculty (e.g. one profession is looking for team training, the other is looking for skills training); and
- difficulty with assessing team performance.

Discussion

This literature review outlines the existing research for pre-licensure IPE using HCS across demographics, methods, modalities, measures, factors, strengths, and limitations. Positive outcomes were reported by all investigators in regards to participant satisfaction. The studies generally reported enthusiastic verbal feedback from participants and faculty. Despite positive reports, a synthesis of these studies showed low rigor in research design (e.g. lack of focus on evaluation and small sample size). A common theme throughout the literature considered for future directions included studying patient outcomes; however, no studies in this review engaged in this type of patient outcome-based research.

The studies examined reflected the complexities of HCS and IPE including: the use of multiple teaching methods, the lack of valid and reliable measures, multiple confounding variables (reported and not reported, with many variables yet to be identified in the field), differences in student learning levels, and differences in sample sizes of the involved professions. Hence, characteristics that influence outcomes must be further studied. Furthermore, studies that explore characteristics must be rigorous in design (e.g. randomized controlled trials) to understand and control potential variables.

The authors found that there is a need for researchers to mention the generalizability and transferability of their study findings in publication. Current practices for publishing are limited to journal guidelines, as well as criteria and formatting accepted for the method used. The problem that ensues is that the science has not yet identified variables that influence IPE outcomes and, because these variables have not yet been identified as areas for reporting, a thorough and detailed view of each study is necessary for any future synthesis study. Frequently, the details of the simulation scenario (i.e. the protocol or intervention) are summarized in one to two paragraphs. This does not allow for future replication of the study. It is, therefore, necessary to develop studies with rigorous processes, find new reporting mechanisms and formats including video supplements and scenario details, as well as explore community activities and gray (not published or peer-reviewed) literature in conjunction with published literature. From the findings of this review, a checklist of suggested reporting points is presented in Table 2. A pool of reliable knowledge may be created from synthesis and research of future publications that address these reporting points.

Conclusion

With a global call to improve patient safety through better communication and teamwork, many institutions have invested financial and human resources to develop effective healthcare education using HCS for IPE. Reviews of the research literature often result in evidence-based recommendations for research, development, methods, and measures. However, for this maturing and complex field, there are preliminary steps needed to improve this science: 1) studying potential characteristics that influence positive and negative outcomes, and 2) establishing new frameworks or mechanisms for reporting. Once potential characteristics are identified, more detailed frameworks for reporting or supplemental mechanisms (e.g. online video addendums) would allow further evidence to study these characteristics.

Table 2

Checklist of Suggested Reporting Points for IPE and HCS Research

Suggested Reporting Items for Future IPE and HCS Studies
☐ Objectives o Aims and Purpose of Study (Manuscript) o Objectives of Educational Activity o Objectives of Simulation Activity ☐ Background o Terminology and definitions used by author o Current existing literature ☐ Learners o Sample sizes (total and per professional group) o Profession or Program o Grade Level o Team composition in simulation ☐ Educators/Researchers o Backgrounds/credentials o Composition for development of study and educational activity o Composition for implementation of study and educational activity ☐ Method o Design o Theoretical Framework o Interventions ☐ Simulation Modality o Type, model, and version o Details of scenario (consider video supplement and scenario appendix) o Structure of debriefing if incorporated (consider video supplement and appendix if structured or semi-structured) ☐ Measures o Why chosen o Validity o Reliability ☐ Results ☐ Discussion o Simulation factors that may have led to positive outcomes o Simulation factors that may have led to negative outcomes o Challenges encountered o Strengths of study design o Limitations of study design o Areas for future study

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Conceptual and Theoretical Background

Advances in technology foster new scientific fields such as HCS. Appropriate to HCS's stage in maturation, the data provided in the literature have been inadequate, although with marked improvement over the last five years as a result of the expansion in scientific rigor, increasingly experienced educators, and recommendations for further study. According to Tekian, McGuire, and McGaghie (1999), expert opinion is the best and most logical source when there is an absence of clear data. The fields of IPE and HCS have advanced logically with thoughtful due processes within individual simulation programs, professional societies, and interest groups focused on IPE and HCS.

Traditionally, theory has been defined as, "an abstract generalization that offers a systematic explanation about how phenomena are interrelated" (Polit & Beck, 2012, p. 126). Rather than using theoretically-based methods, IPE or HCS educators are basing their methods on opinions, suggestions, and recommendations. IPE and HCS apply to a wide variety of professions. Fortunately, this interprofessional nature amalgamates various professions that bring applicable theoretical frameworks and knowledge from their separate disciplines. Success in professional diversity requires a central goal that can unify efforts, skills, and knowledge. For IPE and HCS, the central goal is quality education with the long-term outcome-based goal of patient safety. Because education is the focus, it is reasonable to centralize approaches around educational theories that have been developed and provided structure and guidance to instructional strategies and learning activities over the last century (Billings & Halstead, 2009).

Situated Learning Theory

In the theory of situated learning, Lave and Wenger (2008) posit that learning is situated. This is in contrast with most classroom learning activities that involve abstract knowledge that is not within the context of the activity. Lave and Wagner (2008) also challenge the observation that educational achievement often fails to translate into effective use of knowledge. They argue that learning occurs normally and is embedded within activity, context, and culture.

Lave and Wenger (2008) describe the teaching method to achieve effective learning. The theory suggests that knowledge needs to be presented in authentic contexts, including settings and situations that would normally involve that knowledge. Social interaction and collaboration are essential components of situated learning. Lave and Wenger (2008, pp. 27-42) refer to this learning through engagement in social practice as, “legitimate peripheral participation,” suggesting multiple, varied ways of participation with changing perspectives, in which location is relational to learning and indicates processes of social transformation (see Figure 6). It is through this interaction that learners become involved in a “community of practice” (p. 29), which embodies desired beliefs and behaviors. As the beginner or novice moves from the periphery of a community to its center, he or she becomes more active and engaged within the culture and eventually assumes the role of an expert (Lave & Wenger, 2008).

Situated learning is based on the philosophy of Constructivism (Vygotsky, 1978). Constructivism is the worldview that learning is an active process constructed by the learner. During this construction, people create their own subjective representations of objective reality where prior knowledge is linked to new information (Fosnot, 2005).

Situated learning methods include scaffolding and fading (see Figure 6). Scaffolding refers to the facilitation the educator provides to assist the learner in achieving tasks, while fading refers to gradual elimination of assistive facilitation as the learner gradually achieves expertise (McLellan, 1996).

Situated learning theory defines learning as a social process where knowledge is co-created within a context of how that skill or knowledge is applied (Lave & Wenger, 2008). Methods that derive from experiential learning theory (Kolb, 1983) and situated learning theory have been shown to be effective in the application of knowledge to practice (Galbraith, 2005; Arthur, Tubre, Paul, & Edens, 2003; Fosnot, 2005; Kolb, 1983; Lave & Wenger, 1991). Situated simulation fosters an opportunity for experiential learning (Mahlmeister, 2009; Pugh, 2008; CAIPE, 2007). The flexibility of simulation allows for the inclusion of multiple learning objectives specific to professions, as well as overall interprofessional objectives (see Figure 6).

Lave and Wenger (2008) state that the teaching method must achieve effective learning. Because learning, from a constructivist view is an active process constructed by the learner, learning is highly subjective. In keeping with this theory, students' perceived overall benefits indicate effective learning.

Situated learning theory has a concrete experience and reflective observation. Simulation would then appear to be an ideal medium for situated learning since the key structures of simulation include the concrete experience (the simulation) and reflective observation (the debriefing). In alignment with situated learning, the simulation occurs within a constructed context and culture to be authentic to the activity being learned. Rather than focusing on cognitive processes and conceptual structures, situated

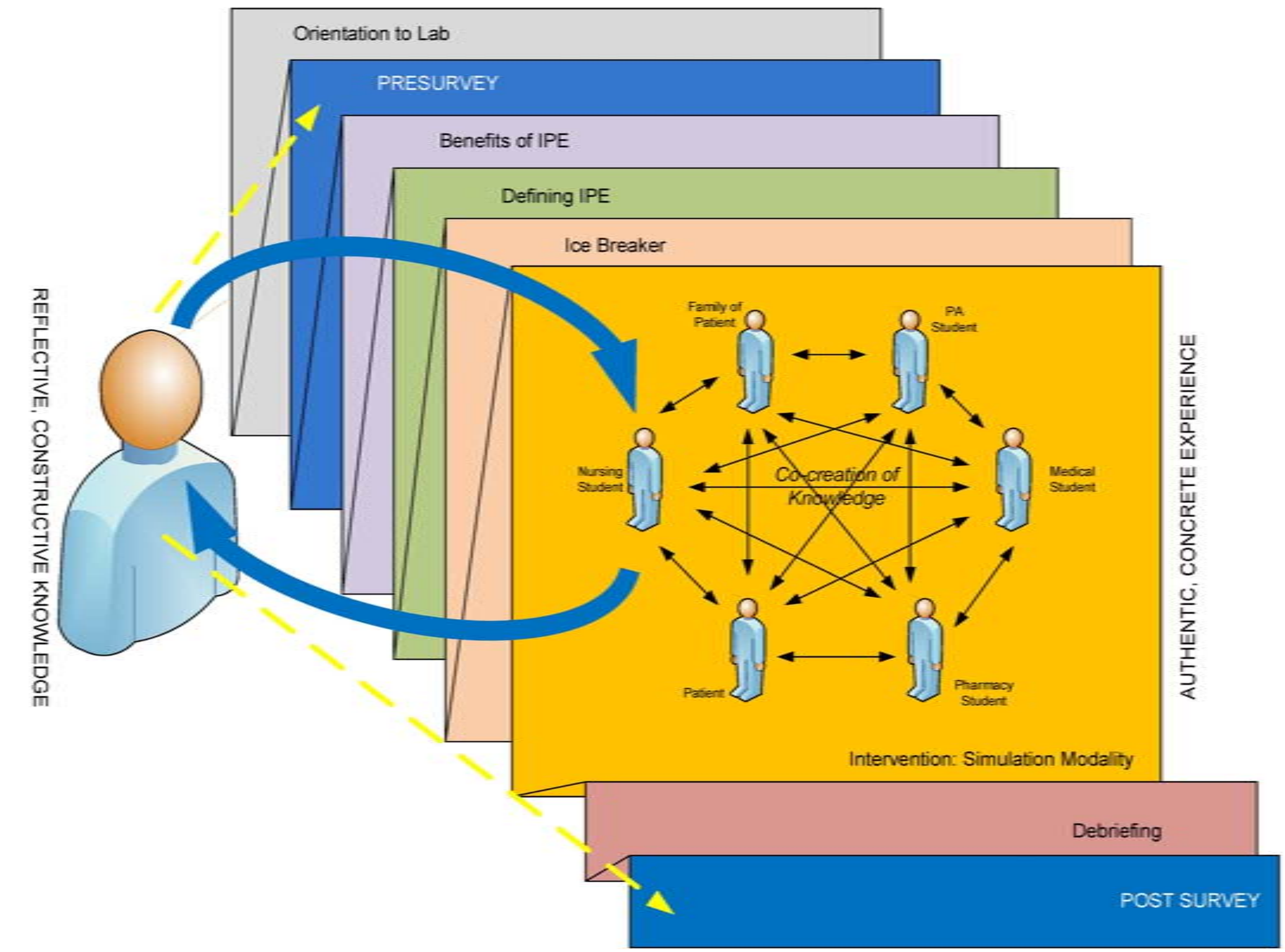

Figure 6. Situated learning theory application to study.

learning questions what kind of social contexts or social learning environments allow learning to take place.

Situated learning requires collaboration. The theory suggests that knowledge be presented in situations that would normally involve that knowledge. For the healthcare student, this would be in the patient care setting within interprofessional teams. Social interaction and collaboration are essential components of situated learning. According to situated learning, students become involved in a "community of practice" that embodies certain beliefs and behaviors to be acquired and achieved through interaction. Understanding of individual roles, the roles of other professions, teamwork and collaboration are achieved through this "community of practice" (Lave & Wenger, 2008).

Conclusion

The literature remains inadequate in explaining what factors or modalities lead to positive, ineffective, or negative outcomes in learning. The literature suggests, however, that HCS is an effective platform for IPE. Interprofessional education and HCS provide a medium for creativity; educators and researchers continue to use multiple modalities without evidence of which modalities achieve positive, neutral, or negative learning outcomes. Many gaps in knowledge regarding HCS as a platform for IPE remain. Following a review of the literature, several questions remain: Is high-technology HCS really best practice for IPE? Is HCS better than multiprofessional methods in IPE? Is HCS better than team-based activities in IPE? Which methods are more appropriate for pre-licensure students? If high-technology HCS is the method of choice for an educator, what modalities are more effective? Standardized patient-based or mannequin-based? Should all students be active participants or would the learning in observing participants be tantamount to the learning of active participants? This study seeks to address the gaps identified in literature by comparing: 1) high-technology simulation with low-technology simulation, 2) multiprofessional simulation with team-based simulation, 3) observing participation with active participation, and 4) mannequin-based simulation with standardized patient-based simulation. Finding answers to such questions will inform the need for human or financial resources and influence the design of the simulations for IPE.

This study seeks to explore simulation as a platform for IPE by comparing the most common simulation modalities and exploring factors that influence positive and negative interprofessional learning. According to Situated Learning Theory (Lave & Wenger, 2008), knowledge must be co-created within a context of how that skill or knowledge is applied. Healthcare simulation is naturally situated learning. In this study, simulation modalities were developed to achieve IPE objectives using activities that promote constructive processes within the learner through situated learning.

CHAPTER THREE

DATA, DESIGN, AND METHODOLOGY

This study compared student (pre-licensure nursing, medical, pharmacy, and physician assistant students) outcomes of high and low-technology simulation for laboratory interprofessional education (IPE); also compared were two low-technology and three high-technology simulation methods. The Team Work and Communication Subscale (TWCS) of the Readiness for Interprofessional Learning Scale (RIPLS) was the outcome measure (Parsell & Bligh, 1999). Four repeated measures Analyses of Variance (ANOVA) using one within subject factor with time points and one between subject factor (while adjusting for confounding variables) were run. In each of the four analyses, total pre and post TWCS scores were the within subject factor, whereas the respective simulations being compared were the between subject factor. Covariates included program (or discipline), gender, race/ethnicity, and individual faculty member. Prior to making the various comparisons, data were screened and cleaned.

This study was part of a broader assessment program conducted to evaluate the interprofessional simulation lab at a health sciences university. This particular study was submitted to the Institutional Review Board (IRB) at Loma Linda University in Loma Linda, California. Because this study was a secondary analysis of de-identified archival data, the IRB determined that the research did not meet the definition of human subject research and was exempt from IRB review or approval (see Appendix G). The interprofessional lab was originally funded by an external grant that required program evaluation. A letter releasing the data for this extended analysis was also obtained from the Principal Investigator of the original program evaluation study.

Research Design

An IPE Lab development committee was formed by faculty members selected to represent the schools of nursing, medicine, pharmacy, and physician assistant program (school of allied health professions). The researcher was involved in the evaluation and development of this lab and committee, as well as the selection of research instruments and methodology with the intent to use the data for: 1) program evaluation and 2) doctoral projects of the researcher, including this dissertation. The lab evolved from a prior educational program funded by a community donor for a community clinic where the lab was previously located. The lab was integrated into a required course within each program and started in March 2008. In 2009, the IPE Lab Committee changed teaching modalities from multiprofessional to collaborative team-based activities (see Terms of Reference). Based on situated learning theory, the IPE Lab Committee, under the direction of the researcher, decided to revise the agenda to include high-technology interprofessional simulations. Four high-technology simulation modalities were used from the years 2010 to 2012. Three of these high-technology modalities are analyzed in this research. Because the aims in this research study were congealed after the collection of data, this study was a secondary analysis of data previously collected by the researcher.

The IPE Lab occurred monthly over each academic period (August to May) with non-repeating participants. The participants in this study are students within various academic programs; therefore, the terms "participants" and "students" are used interchangeably throughout this dissertation. Generally, when referring to the study and analysis, the participants are referred to as "participants;" in descriptive writing, more likely the word “students” is preferred. The IPE Lab can be divided into two sections for clarity. The first section, as explained in the next paragraph, was standard for all study groups. The educational interventions were structured in the second session and differed among all study groups; each group intervention is described below (see Figure 7). All lab materials can be found in Appendix E.

The first standard section of the lab began with a 10-minute review of the lab. The participants were then asked to complete the RIPLS baseline or pre-test. This was followed by a 20-minute lecture on the benefits of IPE and a review of IPE definitions. A panel of practicing professionals (nurse, physician, pharmacist, physician assistant, social worker, respiratory therapist, occupational therapist, and emergency medical technician) then shared their roles, educational background, encountered stereotypes, and professional experiences with the participants (see Figure 7). The remainder of the lab, the second (intervention) session, differed among the six groups (see Table 3). Over a four-year period, the activities embedded in this section of the lab went through three iterations (2008-2009, 2009-2010, and 2010-2012) forming six groups over time: multiprofessional, team-based, reflecting team, pre-simulation huddle, immersed, and mannequin-based (see Figure 7).

2008-2009: Multiprofessional Group

In the second session, the multiprofessional group (academic year 2008-2009) remained in a classroom lecture setting and entered into a case study presentation where the IPE Lab committee presented a chronic diabetes case scenario and discussed the progression of that patient, pharmaceutical management, and a team-based approach that

Min	Multiprofessional (2008-2009) *N*=195	Team-based (2009-2010) *N*=181	Reflecting Teams (2010-2011) *N*=106	Pre-Simulation Huddle Technology-Enhanced Standardized Patient (2010-2011) *N*=42	Immersed Group Technology-Enhanced Standardized Patient (2010-2012) *N*=90	Actor-Enhanced Mannequin (2010-2012) *N*=102
10	Introduction to Lab					
5	Pre-survey					
10	Benefits of IPE					
10	Defining IPE					
45	Defining Roles, Educational Curriculum, Stereotypes, and Experiences					
10	BREAK (into Rooms)					
15	Ice Breaker—4 facts, Stereotypes					
30	Case Study Presentation	Survival Activity	Observation	Huddle (Plan of Care)	Scenario 1 →Debrief	Scenario 1 →Debrief
30		Discussion	Observation	Scenario 1→Debriefing	Huddle (Plan of Care)	Huddle (Plan of Care)
5	BREAK					
30	Patient Presentation	Puzzle Activity	Observation	Plan of Care Delivery	Plan of Care Delivery	Plan of Care Delivery
			Develop Report	Debriefing		
30	Discussion	Discussion	Reflection Report			
5	Summary					
5	Post-survey					

Figure 7. Interprofessional Lab Agenda

Table 3

Description of Interventions

Intervention Details	Multiprofessional Learning	Team-based Learning	Reflecting Teams	Pre-simulation Huddle Technology-Enhanced Standardized Patient	Immersed Group Technology-Enhanced Standardized Patient*	ESP-Enhanced Mannequin*
Role of Student	Learning in parallel with other students, receiver of knowledge	Team-member needed to assist in problem solving	Observer, noting questions, strengths, opportunities for improvement, speculations, reactions and ideas	Clinical team member—post-licensure respective role, develop pre-plan of care, actively interview and assess patient and family situation	Clinical team member—post-licensure respective role, develop post-plan of care, actively interview and assess patient and family situation	Clinical team member—post-licensure respective role, actively assess and provide hands-on care to patient and family
Resources Used	Classroom with projection Faculty facilitators Powerpoint Case Study Real patient interview	Conference Room Faculty facilitator Non-clinical survival quiz Non-clinical Paper puzzle activity	Debriefing Room with live or video projection Faculty facilitator Reflecting Worksheet	Simulated Clinic + Debriefing Room Faculty facilitators A/V Technician SP Trainer StudioCode 4.5.0 SP Scenario Standardized Patient and Wife Plan of Care worksheet Debriefing Guide	Simulated Clinic + Debriefing Room Faculty facilitators A/V Technician SP Trainer StudioCode 4.5.0 SP Scenario Standardized Patient and Wife Plan of Care worksheet Debriefing Guide	Simulated Hospital Room + Debriefing Room Faculty facilitators A/V + Simulation Technician Simulation Educator Gaumard Hal S3000 StudioCode 4.5.0 Mannequin + ESP Scenario Simulated Wife Plan of Care worksheet Debriefing Guide
Description	Case study presentation about a chronic diabetes case in timeline format. Discussion included breakdowns in interprofessional communication. Guest patient with similar health experience discusses his experience. Faculty role play patient interview.	Survival quiz: Self-quiz, team discussion, then consensus quiz Puzzle: non-verbal cues to solve problem Debriefing after each activity re: how the learning from the activity could be applied to healthcare teams and practice.	Used reflecting worksheet for reflective training (Anderson, 1991). The group observed 2 active simulations, took notes on the above, and organized their thoughts in discussion. The active groups visualized and heard the discussion. This is thought to foster critical, affective, and reflective thinking, as well as formative and peer-review feedback.	Students were given a brief orientation and standardized nurse report and copies of the patient chart. The participants developed a plan of care BEFORE seeing the patient via the Plan of Care worksheet. The students then interviewed, assessed, and cared for the standardized patient and wife (embedded standardized person) as they would in a clinic setting. The scenario was a non-adherent chronic diabetic patient with worrisome labs whose wife provides most of his healthcare.	Students were given a brief orientation, standardized nurse report, and copies of the patient chart. The students then interviewed, assessed, and cared for the patient and wife as they would in a clinic setting. The scenario was a non-adherent chronic diabetic patient with worrisome labs whose wife (embedded standardized person) provides most of his healthcare. The participants developed a plan of care AFTER seeing the patient using the Plan of Care worksheet.	Students were given a brief orientation, standardized nurse report, and copies of the patient chart. The students then interviewed, assessed, and cared for the patient and wife as they would in a telemetry setting. The scenario was a non-adherent chronic diabetic patient whose wife (embedded standardized person) provides most of his healthcare and is at the bedside. The patient has a change in mental status. The participants developed a plan of care AFTER seeing the patient using the Plan of Care worksheet.

may have been used for the patient (see Appendix E). The case makes apparent the breakdowns in interprofessional communication. The case was presented in a time-line fashion where participants can clearly see where opportunities for teamwork and communication were missed. This case study was presented for an hour followed by a break. An invited guest patient whose health situation was similar to the case was then interviewed by the IPE Lab faculty about his experiences with healthcare and his perspectives around teamwork in healthcare. Participation by students occurred by hand-raising and inquiry.

2009-2010: Team-based Activities Group

In the second session, the team-based activities group (years 2009-2010) were divided into smaller groups of ten to fifteen participants. One faculty member facilitated each group through two non-clinical team-based problem-solving activities. This group underwent two 30-minute activities. Each activity was followed by a 30-minute discussion on teamwork factors discovered during the activity and how these factors are relevant to teams in clinical practice. The first activity focused on details of a non-clinical scenario that consecutively provides increasing information building into a bigger picture. The intent of this activity was to provide insight into assumptions and patient knowledge that can be segregated into individual professions. It allowed an opportunity for discussion on teamwork. The second activity promoted non-verbal cues to solve a problem. The intent of this activity was to provide insight into trust, gaining trust, and teamwork with a common goal (see Appendix E).

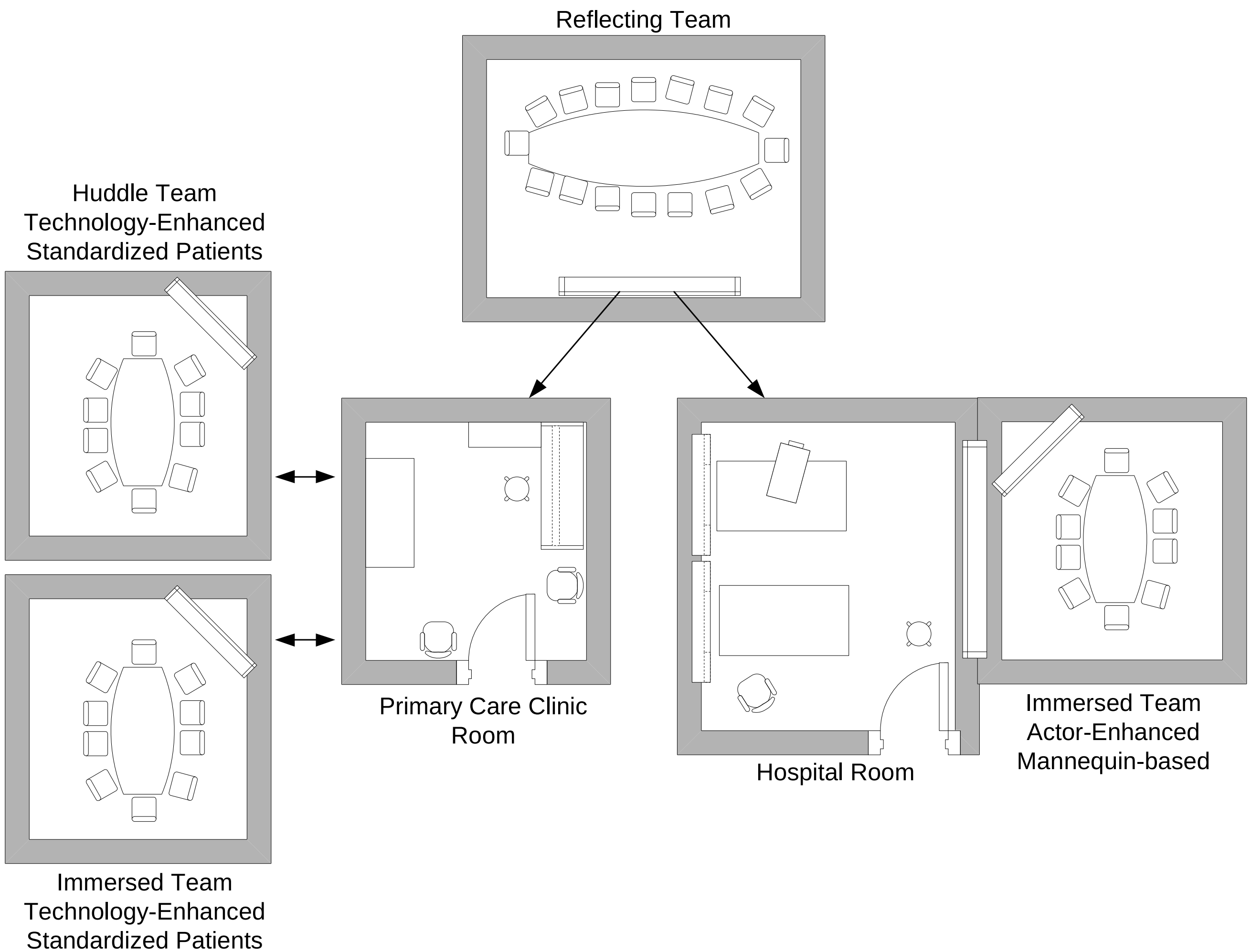

Figure 8. High-technology IPL environment.

2010-2012: High-technology Simulations

In 2010, the lab was transformed to include high-technology simulation and reflect an experimental design comparing four high-technology simulation methods. Like many limitations in HCS and IPE, this lab was influenced by limited faculty, the need for faculty development, inadequate simulation center resources, and a comparatively high number of participants. The IPE Lab Committee and simulation center used the limitations to guide discussions for future research. As a result, the participants were divided into four small interprofessional groups of eight to twelve participants. Participants were randomly assigned to groups according to profession; professions were evenly distributed as much as possible. Each group was briefly introduced to HCS, their group role and process for the lab. These labs were hosted at Loma Linda University Medical Simulation Center in four debriefing rooms and two simulation rooms emulating a clinical setting. Each group was based in a debriefing room that had capabilities for live-stream and playback of multiple views of their assigned patient-care simulation (see Figure 8).

Reflecting Team Group

Each reflecting team group (years 2010-2011) had ten to twelve participants. This group acted as observing participants and used the method of reflective training, which is a modification of the therapeutic method of reflective teams (Andersen, 1991). The group observed three active groups as described below. The reflecting group used a worksheet (see Appendix E) to take notes during observation and discussed the situation, while developing a plan of care. The group organized their thoughts and then re-entered a discussion while the active participants (in their separate debriefing rooms) visualized and heard the discussion. This was thought to foster critical, affective, and reflective thinking, as well as formative and peer-reviewed feedback (Gardner & Suplee, 2010).

Active Learner Groups

The active learner groups collectively refer to three groups: pre-simulation huddle technology-enhanced standardized patient (huddle), immersed technology-enhanced standardized patient (immersed), and immersed actor-enhanced mannequin-based simulation (mannequin) (see Figure 11). The huddle and immersed groups underwent the same simulation in the same simulated primary care room one after the other, while the mannequin group underwent a simulation with a mannequin patient and a simulated family member in a simulated double-bed hospital room. These simulation activities are referred to as the "simulation interventions" and are described below. After the active interventions, the three groups followed the same concluding processes, also described below.

Simulation Interventions

Pre-simulation huddle technology-enhanced standardized patient. Prior to the intervention, the participants were given a brief standardized nurse report and five copies of the patient chart (see Appendix E). The participants were instructed to develop a plan of care for the patient based on the nurse report, their experience, and findings within the chart. This was referred to as a "huddle." Each learner was given a Plan of Care form specific to their profession and developed from templates used by their profession in a clinical setting. There were minimal instructions given for this activity to allow an opportunity for teamwork and leadership. The participants were informed that following the care planning, they would enter the simulation to assess and care for the patient.

Following their huddle, the simulation facilitator gave a brief verbal orientation to the simulation. The facilitator suggested that the students engage in the simulation as they would in a clinic visit. The participants were advised to set times for assessment and access any member of their team as needed during the simulation via phone calls. The phone numbers between the debriefing room and the clinic room were noted to be visible on a sign by the phones. Blinded to the clinic room, the rest of the team awaited prompts and relied on reports from their team members.

Immersed technology-enhanced standardized patient. The immersed group was given a short orientation to the phone system and immediately given the brief verbal orientation to the simulation by the simulation facilitator. The group underwent the same simulation process as the huddle group and as described above; however, this group was immediately immersed in the simulation without time to review or discuss the patient's chart as a team. The difference between the huddle and this immersed group was that the huddle occurred after the simulation, rather than before the simulation. The group was informed that following the simulation, they would have time to develop a plan of care.

Next, the participants collaborated in their assigned debriefing room to develop a plan of care for the patients based on their experience and findings during the simulation. Every learner was given a Plan of Care form. There were minimal instructions given for this activity to allow an opportunity for teamwork and leadership.

Immersed actor-enhanced mannequin-based. Because the actor-enhanced mannequin-based simulation required equipment and assessment of equipment, these participants received a 5-minute brief orientation to the supply station and patient simulators where they were able to touch and feel the mannequin and listen to normal and abnormal lung and heart sounds (for that particular mannequin). Immersed in the new setting, the team then underwent a scenario-based mannequin simulation as direct providers. The scenario was purposely developed to stress the resourcefulness and communication skills of the participants and to have the greatest potential to address communication and coordination of personnel, equipment, and system resources during critical patient events. The scenario was a patient under observation for uncontrolled hypertension and was to be discharged in the evening. There was a simulated actor at the bedside as the patient's wife. The participants were asked to perform as they would in their post-licensure role and are given specific individual tasks for the patient, specific to their role. After ten minutes, the hypertensive patient became critically hypotensive and gradually unresponsive. The intent of this activity was to provide the opportunity to integrate student's individual work into a team and utilize available team resources.

Following the intervention, the participants collaborated in their assigned debriefing room to develop a plan of care for the patients based on their experience and findings. Every learner was given a Plan of Care form specific to their profession and developed from templates used by their profession in the hospital setting. There were minimal instructions given for this activity to allow an opportunity for teamwork and leadership.

Post-simulation Intervention

All high-technology scenarios were video and audio recorded for purposes of debriefings and future research. Following a short break, participants were able to re-enter the simulation to deliver their plan of care. This was followed by a 20-minute debriefing on collaboration, interprofessionalism, and TeamSTEPPS concepts (AHRQ, 2006). Following the debriefing, all three teams observed the audiovisual live-streaming of the Reflecting Team's 30-minute discussion. Debriefings occurred immediately following each simulation intervention for guided reflections within the three groups.

All groups ended with a five-minute summary discussion asking two questions: 1) "Following this lab, how would you define interprofessionalism?" and 2) "As a result of what you've learned today, what would you do differently in your clinical practice?" The participants were then asked to complete the post-test (i.e., the TWCS), using the same reference number used in the TWCS pre-test. The participants were also asked to complete a lab evaluation (see Appendix E). The surveys were then collected and linked by the researcher after all participants exited the lab.

Philosophical Assumptions

Constructivism is a philosophy and learning theory (Piaget, 1967; Vygotsky, 1978) that has provided a foundation for situated learning theory and the ensuing research for this dissertation. Constructivism posits that knowledge arises from actions and the learner's subsequent reflections. Hence, interaction does not imply a human interacting with objects as they really are, but rather a cognitive subject that is dealing with constructed perceptions. Educators and researchers assume a facilitator role under this philosophy with the task to dispense knowledge and provide participants with opportunities and incentives to construct meaning (Fosnot, 2005).

Research Questions

The purpose of the study was to examine how the most commonly used modalities (e.g. low-technology versus high-technology; multiprofessional versus collaborative team-based activities; observational versus active methods; standardized patients versus mannequins) affect participants' perceived teamwork and collaboration in pre-licensure medical, nursing, pharmacy, and physician assistant students while controlling for factors shown previously to affect these perceptions. Pre-simulation huddle versus post-simulation huddle is not included in this study as it would compare a change in simulation agenda versus actual simulation modalities (e.g., mannequin versus standardized patient). The specific aims and hypotheses of the study were:

Aim 1. To compare teamwork and collaboration (as measured by students' self-reported pre and post RIPLS TWCS scores) after high or low-technology simulations while adjusting for potential confounders (program/discipline, race/ethnicity, gender, and faculty) (see Figure 9). The low-technology group was composed of two low-technology methods: multiprofessional and team-based, and these methods were compared in Aim 2. The high-technology group was composed of four methods used in the lab. Three of these four methods also underwent additional comparisons in Aim 3.

From this first aim, the following research hypothesis was tested:

H_1: Pre-licensure students receiving high-technology simulation-enhanced IPE will report higher teamwork and collaboration on completion of the lab than will students who receive low-technology (non-simulated) IPE.

	Low-Technology		High-Technology			
Min	Multiprofessional (2008-2009)	Team-based (2009-2010)	Reflecting Teams (2010-2011)	Pre-Simulation Huddle Technology-Enhanced Standardized Patients (2010-2011)	Immersed Technology-Enhanced Standardized Patients (2010-2012)	Immersed Actor-Enhanced Mannequins (2010-2012)
10	Introduction to Lab					
5	Presurvey					
10	Benefits of IPE					
10	Defining IPE					
45	Defining Roles, Educational Curriculum, Stereotypes, and Experiences					
10			BREAK (into Rooms)			
15	Ice Breaker – 4 facts, Stereotypes					
30	Case Study Presentation	Survival Activity	Observation	Huddle (Plan of Care)	Scenario 1 →Debrief	Scenario 1 →Debrief
30		Discussion	Observation	Scenario 1→Debriefing	Huddle (Plan of Care)	Huddle (Plan of Care)
5			BREAK			
30	Patient Presentation	Puzzle Activity	Observation	Plan of Care Delivery	Plan of Care Delivery	Plan of Care Delivery
			Develop Report	Debriefing		
30	Discussion	Discussion	Reflection Report			
5	Summary					
5	Post Survey					

Figure 9. Comparing low-technology with high-technology interprofessional education.

Aim 2. To compare teamwork and collaboration (as measured by students' self-reported pre and post RIPLS TWCS scores) after multi-professional and teambuilding methods used for low-technology IPE through self-reported perceptions of teamwork and collaboration while adjusting for potential confounders (program/discipline, race/ethnicity, gender, and faculty) (see Figure 10). These two methods compared under this aim were low-technology methods.

From this second aim, the following research hypothesis was tested:

H_2: On completion of the lab, perceptions of teamwork and collaboration scores will be higher in students who participated in a team lab than in students who participated in a professional skills lab.

Min	Multiprofessional (2008-2009)	Team-based (2009-2010)	Reflecting Teams (2010-2011)	Pre-Simulation Huddle Technology-Enhanced Standardized Patients (2010-2011)	Immersed Technology-Enhanced Standardized Patients (2010-2012)	Immersed Actor-Enhanced Mannequins (2010-2012)
10	Introduction to Lab					
5	Presurvey					
10	Benefits of IPE					
10	Defining IPE					
45	Defining Roles, Educational Curriculum, Stereotypes, and Experiences					
10	BREAK (into Rooms)					
15	Ice Breaker – 4 facts, Stereotypes					
30	Case Study Presentation	Survival Activity	Observation	Huddle (Plan of Care)	Scenario 1 →Debrief	Scenario 1 →Debrief
30		Discussion	Observation	Scenario 1→Debriefing	Huddle (Plan of Care)	Huddle (Plan of Care)
5	BREAK					
30	Patient Presentation	Puzzle Activity	Observation Develop Report	Plan of Care Delivery Debriefing	Plan of Care Delivery	Plan of Care Delivery
30	Discussion	Discussion	Reflection Report			
5	Summary					
5	Post Survey					

Figure 10. Comparing multiprofessional and team-based interprofessional education.

Aim 3. To compare teamwork and collaboration (as measured by students' self-reported pre and post RIPLS TWCS scores) after observational and active participation methods used for high-technology simulation-enhanced IPE through self-reported perceptions of teamwork and collaboration while adjusting for potential confounders (program/discipline, race/ethnicity, gender, and faculty) (see Figure 11). These four methods were high-technology methods. The active participation group was composed of three active groups: huddle, immersed, and mannequin-based.

From this third aim, the following research hypothesis was tested:

H_3: Upon completion of the lab, there will be no difference in perceived teamwork and collaboration between students who actively engaged in simulation and debriefing versus students who observed the simulation and engaged in the debriefing.

			Observing	Active Participation		
Min	Multiprofessional (2008-2009)	Team-based (2009-2010)	Reflecting Teams (2010-2011)	Pre-Simulation Huddle Technology-Enhanced Standardized Patients (2010-2011)	Immersed Technology-Enhanced Standardized Patients (2010-2012)	Immersed Actor-Enhanced Mannequins (2010-2012)
10	Introduction to Lab					
5	Presurvey					
10	Benefits of IPE					
10	Defining IPE					
45	Defining Roles, Educational Curriculum, Stereotypes, and Experiences					
10				BREAK (into Rooms)		
15	Ice Breaker – 4 facts, Stereotypes					
30	Case Study Presentation	Survival Activity	Observation	Huddle (Plan of Care)	Scenario 1 → Debrief	Scenario 1 → Debrief
30		Discussion	Observation	Scenario 1 → Debriefing	Huddle (Plan of Care)	Huddle (Plan of Care)
5				BREAK		
30	Patient Presentation	Puzzle Activity	Observation Develop Report	Plan of Care Delivery Debriefing	Plan of Care Delivery	Plan of Care Delivery
30	Discussion	Discussion	Reflection Report			
5	Summary					
5	Post Survey					

Figure 11. Comparing observational participation and active participation in interprofessional education.

Aim 4. To compare teamwork and collaboration (as measured by students' self-reported pre and post RIPLS TWCS scores) after methods using mannequins and simulated patients in high-technology simulations through self-reported perceptions of teamwork and collaboration while adjusting for potential confounders (program/discipline, race/ethnicity, gender, and faculty) (see

Figure 12). Both of these groups were high-technology, active participation simulations with no huddles prior to the simulation.

From this fourth aim, the following research hypothesis was tested:

H_4: Upon completion of the lab, there will be no difference in perceived teamwork and collaboration between students who actively engaged in simulation using mannequins versus simulated patients.

Min	Multiprofessional (2008-2009)	Team-based (2009-2010)	Reflecting Teams (2010-2011)	Pre-Simulation Huddle Technology-Enhanced Standardized Patients (2010-2011)	Immersed Technology-Enhanced Standardized Patients (2010-2012)	Immersed Actor-Enhanced Mannequins (2010-2012)
10	Introduction to Lab					
5	Presurvey					
10	Benefits of IPE					
10	Defining IPE					
45	Defining Roles, Educational Curriculum, Stereotypes, and Experiences					
10	BREAK (into Rooms)					
15	Ice Breaker – 4 facts, Stereotypes					
30	Case Study Presentation	Survival Activity	Observation	Huddle (Plan of Care)	Scenario 1 →Debrief	Scenario 1 →Debrief
30		Discussion	Observation	Scenario 1→Debriefing	Huddle (Plan of Care)	Huddle (Plan of Care)
5	BREAK					
30	Patient Presentation	Puzzle Activity	Observation Develop Report	Plan of Care Delivery Debriefing	Plan of Care Delivery	Plan of Care Delivery
30	Discussion	Discussion	Reflection Report			
5	Summary					
5	Post Survey					

Figure 12. Comparing technology-enhanced SPs with ESP-enhanced mannequin simulation.

Sample

A convenience sample (N = 716 participants) was formed: 324 medical, 202 undergraduate nursing, 104 pharmacy, and 86 physician assistant students, representing four professions who frequently work together in both outpatient and inpatient clinical settings. The participants were in the lab as a requirement for an existing course. The lab was incorporated into the clinical curriculum of preventive medicine medical student clerkships (third or fourth year). The nursing students were from a health promotion or public health course (second, third, or fourth year), and the lab counted toward clinical hours. The lab was embedded into pharmacy student elective courses (third or fourth year). For the physician assistant program, the lab was required by the program director (either year of the 2-year program). Each IPE lab had six to 30 students randomly assigned to one of the six intervention groups. Whenever possible, each IPE lab group was comprised of professions evenly distributed. All participants met the additional eligibility requirements: English-speaking and the ability to perform without limitation in their clinical role.

The lab occurred monthly with no repeating participants. Additionally, a small percentage of social work, respiratory therapy, marriage and family therapy, occupational therapy, physical therapy, and business management participants completed the course. These professions were not included in the analysis due to the small number of participants, which would preclude meaningful analysis (see Figure 13).

Group assignment occurred by stratifying the groups according to profession. Each faculty member forwarded the lab director the names of the students participating. The students were then assigned a group solely based on profession by the lab director. The lab director attempted to distribute professions evenly between groups, with representation of each profession within one group.

The participants completed a demographic questionnaire with a pre- and post-RIPLS. Participants were also asked to complete a course evaluation with nine three-

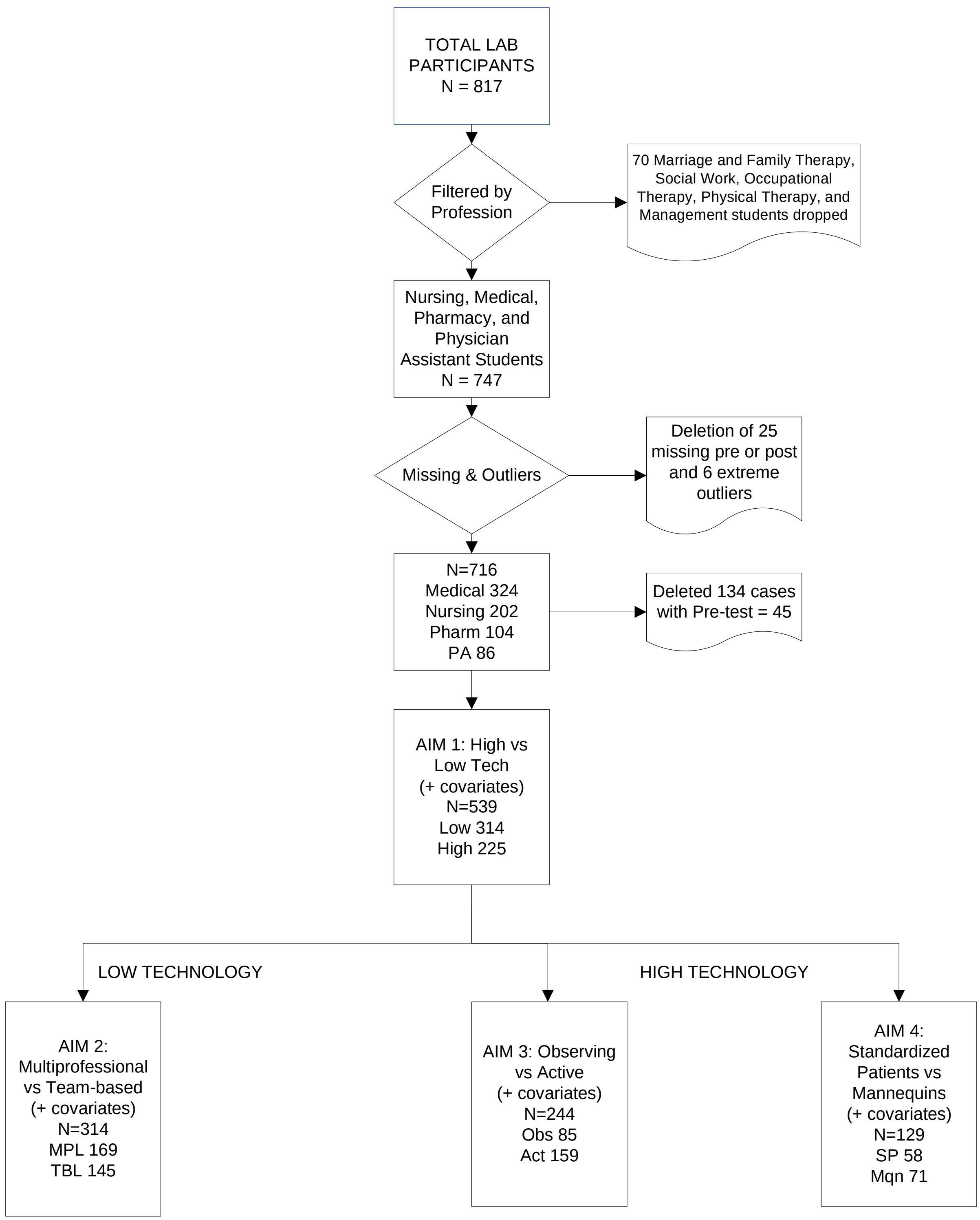

Figure 13. Study design with flow of participants through each stage of analysis.

point Likert questions on the objectives (see Appendix F). Additional demographic-related information is presented in the results section of Chapter Four.

Ethical Considerations

All students were provided with an informed consent document, orientation to the lab and informed of the program evaluation research and possible future research analysis prior to the collection of data. The data (RIPLS pre- and post-tests and lab evaluations) do not contain personal identifying information. These data are kept in a separate file from personal identifying (name of participant) information. Data were analyzed by the researcher and kept in a password protected computer file. No personal identifiers were included in this file. The de-identified stored data were used for the analysis. All researchers involved in the study supervised and reviewed the primary researcher's work and the analysis of the data.

Measures

Independent Variables

Demographic Independent Variables

The following measures were included in the demographic survey: educational program, grade level, gender, age, and race/ethnicity (see Table 4). Students were asked to provide this information for two reasons: to 1) capture the degree of diversity represented in the sample and 2) explore potential relationships among demographic data, RIPLS, and evaluation scores. Beyond describing the diversity of the sample, some demographic variables were used as potential confounders (i.e., covariates).

Non-demographic Independent Variables

Each intervention may have had a different faculty facilitator. This may be a confounder in the relationship between independent variables and dependent variables. Intervention faculty was included as a potential confounding independent variable in the data entry and analysis.

Treatment Variables

Each analysis involved one treatment variable as described below.

Technology. Depending upon assigned group, the type of technology used was recorded under two categories: low-technology and high-technology (see Figure 9). High-technology healthcare simulation is the use of computerized simulation modalities that are controlled or programmed by a person external to the learner. These functions may be altered by a simulation facilitator/technician/educator as an interactive result of learner actions. Low-technology methods use modalities that are not computerized or electronic and may not be controlled or programmed by a person external to the learner.

Low-technology method. There were two types of low-technology methods used in the IPE lab (see Figure 10). These included multiprofessional learning and team-based activities. Multiprofessional education is when members (or students) of two or more professions learn alongside one another; in other words, parallel rather than interactive learning. Collaborative learning occurs with team-based activities. The main purpose of team-based activities is to change the classroom experience from a unidirectional lecture format to understanding concepts in a team format. Team learning usually occurs in teams of five to seven students. Teams are formed such that each group contains a variety of students with different skills and backgrounds. The students spend

Table 4

Description of Variables

Variable Name	Range of Possible Responses	Variable Measurement
Pre_TWCS	1-5	The student's overall perceptions of teamwork and collaboration before undergoing IPE Lab: 1=not worthwhile at all 2=not very worthwhile 3=neutral 4=somewhat worthwhile 5=very worthwhile
Post_TWCS	1-5	The student's overall perceptions of teamwork and collaboration after undergoing IPE Lab: 1=not worthwhile at all 2=not very worthwhile 3=neutral 4=somewhat worthwhile 5=very worthwhile
Program	1-4	1=Medicine 2=Nursing 3=Pharmacy 4=Physician Assistant
Grade	0,1	0=Beginner, Advanced Beginner (years that comprise the first half the program, e.g. 1Y and 2Y out of 4Y Medical School, 1Y out of 2Y of PA Program) 1=Competent, Expert (Years that comprise the last half of the program)
Gender	0,1	0=Male 1=Female
Ethnicity	1-5	1=White 2=Asian 3=Hispanic 4=Black 5=Other
Professor	1-7	1-7=Anonymous, uniquely identified
Technology	0,1	0=Low 1=High
Participation	0,1	0=Observing Participants 1=Active Participants
Technology type	0,1	0=Standardized Patient 1=Mannequin
Low-technology method	0,1	0=Multiprofessional learning 1=Team-based activities

class time interacting with each other using team-based activities and discussing how the activity applies to the courses objectives. Team-based activities are often used in team-based learning; however the structure of this lab does not meet team-based learning criteria (e.g. pre-course reading and testing) (Michaelsen, Parmelee, McMahon, & Levine, 2008).

Participatory role. During the simulation, a participant was either an observer (via video live-stream located outside the simulated environment) or a direct provider (inside and actively participating in the simulated environment) (see Figure 11). Participants in the Reflecting Teams were observing participants. Each participant in an active group had the opportunity to be a direct provider in the simulation; however, participation was suggested and based on group and individual decisions. Despite the freedom to not participate, every medical, nursing, pharmacy, and physician assistant student in the active groups were active participants.

Huddle. Based on 20 years of research and lessons from the application of teamwork principles, the United States Department of Defense, in collaboration with the Agency for Healthcare Research and Quality (AHRQ), developed a training curriculum on integrating team skills for healthcare providers that was released in 2006 as "Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS)." TeamSTEPPS focuses on the key principle of team structure (AHRQ, 2006). "Huddle" is a technique encouraged by TeamSTEPPS. According to TeamSTEPPS, a huddle is "when a team is brought together to gain situational awareness of the patient by discussing critical issues and emerging events, anticipate outcomes and likely contingencies, assign resources, and express concerns" (AHRQ, 2006, p. 112). In this lab, the huddle may occur before or after seeing the patient. The pre-simulation huddle group performs a huddle prior to seeing the patient. The immersed groups do not huddle until after seeing the patient. Because the intervention in this group is extraneous to the aims of this study, the pre-simulation huddle group was not included in the analysis as a separate treatment variable.

High-technology simulation. This variable describes two modalities: technology-enhanced standardized patients and actor-enhanced mannequin-based simulations. Technology-enhanced standardized patients were structured around a standardized patient and standardized family member enhanced by a simulated environment, audiovisual capabilities, and controlled healthcare equipment (e.g., EKG monitor, glucometer). The actor-enhanced mannequin-based simulation was structured around the mannequin's capabilities, simulated environment and equipment, and enhanced with simulated healthcare providers and a standardized family member.

Pre-Test Teamwork and Collaboration Subscale. The participants were asked to complete the Readiness for Interprofessional Learning Scale (RIPLS) before and after the IPE Lab. The pre-test serves as a baseline measurement. This study specifically examines the TWCS of the RIPLS (Parsell & Bligh, 1999) as described below. Details about the scale and its use follow.

The Dependent Variable: Post-Test Teamwork and Collaboration Subscale

The dependent variable (teamwork and collaboration) was measured using the RIPLS instrument, specifically the TWCS (Parsell & Bligh, 1999). The RIPLS was developed in the United Kingdom by Parsell and Bligh (1999) to measure student readiness for interprofessional learning. The original RIPLS scale consists of 19 statements arranged in three subscales: teamwork and collaboration, professional identity, and roles and responsibilities. The items are scored on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument had a final internal consistency for all 19 items (alpha coefficient) of 0.90 (Parsell & Bligh, 1999). Large-scale validation of the instrument is continuing, drawing data from the United Kingdom and other countries, including the United States. It has been lengthened to include a fourth subscale. Use of the RIPLS by McFayden, Webster, and Maclaren (2006), Horsburgh et al. (2001), Hind, Norman, and Cooper (2003), and Morison, Boohan, Jenkins, and Moutray (2003) have shown this instrument to be a useful pre-initiative measure of student attitudes towards IPE. Although the instrument was developed to measure "readiness" for IPE, it has been validated for measurement of students' perceived benefits and perceptions of teamwork and collaboration (McFayden et al., 2006). This study uses the TWCS (one subscale) to measure students' perceived teamwork and collaboration.

In Parsell and Bligh's 1999 study, the TWCS had the highest coefficient alpha (.88) of the three RIPLS subscales. Six of the items in the TWCS assess the effectiveness of team working and the acquisition of team skills. The remaining three items tap the need for positive relationships between students from other professions.

Data Management and Preliminary Analysis

This study was a comparative study evaluating the potential effects noted above. The statistical method used was a repeated measures (pre- and post-test scores) ANOVA adjusted for several covariates. SPSS v. 20 (SPSS, IBM, Inc., Armonk, NY, USA) was used, and for all tests of statistical significance, alpha was set at .05. Data management, cleaning, screening and analyses were completed following approval of the proposal for this study. The following data management and preliminary analysis procedures were completed using Polit and Beck's (2012) Flow of Tasks Framework in Analyzing Quantitative Data. This framework details five phases: 1) preanalysis, 2) preliminary assessments, 3) preliminary actions, 4) principal analyses, and 5) interpretation. The first three phases (preanalysis, preliminary assessments, preliminary actions) are described herein, whereas the last two phases (principal analyses and interpretation) are presented in Chapter Four.

Preanalysis Phase

A data management log was created and all analyses were documented throughout each task. SPSS data, syntax and output files were saved by date. The data management log referred to outputs by date saved.

Data Collection

Once the consent was signed and possibilities for future research were discussed, the students experienced one of the simulation modalities described above. The data collection involved collecting participants' pre- and post- RIPLS ratings as raw data. The surveys were returned to the researcher for safe storage and data analysis. The team simulations and debriefings were video and audio recorded as explained to students for possible future analysis.

Data Entry

The survey data were entered manually into Excel by the researcher and separately by a research assistant with data points compared for accuracy. The data were then copied to an SPSS .sav file. The data were coded, and coding accuracy was checked as it was entered. For each matched case, the data were checked against the data sheets. There was one discrepancy; the data were subsequently rechecked. The data were reviewed a fourth time by the researcher for duplicate entries of which there were none. The data (*N* = 817) were then filtered to include only nursing, medical, pharmacy, and physician assistant students (*N* = 747) (see Figure 13).

Of the 79 variables, 33 were used in this study (refer to Appendix F). The range values were screened for miscoding. Using frequency statistics, data ranges were screened for each of the 33 variables entered to ensure that all data were entered within the prescribed ranges. Out of all cells examined, there were 73 cases with at least one data point outside the variable's possible range. Because these 73 items were identified to three particular labs, the original files for these cases were compared and examined for accuracy. The original files were examined and revealed the correct survey questions were used; however, the surveys provided by the facilitator of those two particular labs incorrectly used a 6-point Likert scale for the 5-point Likert RIPLS survey. Subsequently, the data were modified for each of these cases. Based on the Likert options (see Table 5), the researcher merged 3 and 4 to account for the neutral option

Table 5

Data Point Discrepancies

RIPLS 5-Point Likert Descriptions	Incorrect RIPLS 6-Point Likert Descriptions
1=Strongly Disagree	1=Strongly Disagree
2=Disagree	2=Moderately Disagree
3=Neither Agree nor Disagree	**3=Somewhat Disagree**
4=Agree	**4=Somewhat Agree**
5=Strongly Agree	5=Moderately Agree
	6=Strongly Agree

given in the published RIPLS instrument and change the 5 and 6 responses accordingly to fit the 5-point Likert scale.

During data entry, there were 33 entries found to have indicated two consecutive data points (e.g. for one survey item a participant marked 3 and 4). These data were coded the lower number plus .5 (e.g., 3 and 4 coded as 3.5). These data remained (e.g. coded as 3.5 stayed at 3.5). The data were rescreened for accuracy. All data were within the necessary parameters. For subscale (TWCS) scores, the range values were rescreened for miscoding through frequencies to identify any errors outside the possible range, and there were no miscoded data found.

Outliers

To perform the analysis without a large outlier influence, the data were screened for outliers. This was performed using boxplots, scatterplots, and residual plots of the pre- and post-test scores overall and the pre- and post-test scores with each intervention. There were five extreme outliers and one frequent outlier (appeared in both pre- and post-tests) that required further investigation. The entries did not appear to be in error but rather legitimate outlying values. The only commonalities found were the following: five out of the six were female and four of the six were from the low-technology, team-based group. Because the presence of outliers has the potential to distort results of a study and because the removal of these outliers would not materially affect the results, all six cases were deleted. There were additionally 41 outliers identified. These outliers were not deleted for two reasons: 1) because these outliers were not outliers in both pre- and post-tests for that participant, providing an important aspect that is paired to non-outlying data (pre- or post-test) and 2) a sensitivity test deleting the outliers did not show a significant difference in statistical results.

Preliminary Assessments and Actions

Missing Data

Further screening for missing data showed that there were 25 cases with a missing pre- or post-test. These cases were non-ignorable and dropped from the dataset. This deletion resulted in 716 remaining cases.

From a preliminary glance of the data, it appeared that approximately 25% of the cases were missing data for the variable "age." With such a large missing quantity, age was not used in the analyses. Ages generally ranged between 20 and 30 years. Although age is a typical variable in many surveys of this kind, removal of age in this study is not concerning because the variable, "grade level," generally reflects the participants' level in skill and knowledge specific to their profession and is more appropriate to the aims of this study.

Forty-six cases were found to have at least one independent variable item missing. The demographic missing variables were not replaced. For the survey items, if an item was missing from the pre-test, that item was replaced by the average of the other items provided in the pre-test for that participant. The same procedure was used for missing items in the post-test. There were no more than two missing survey items per participant found. There were very few (less than 100) items missing.

Once the data were screened and missing data issues were resolved, an overall TWCS score was determined from a sum of the 9 items in both the pre-test and post-test subscales. These overall scores were the pre- and post-tests described in each study aim.

Data Quality and Bias

Subscale Internal Consistency

The investigators reviewed the TWCS subscale to ensure the items reflected the desired outcome measure. Internal consistency is a measure that represents the extent to which different items of a scale measure the same characteristic. The reliability of the TWCS pre- and post-test instruments for this study was estimated. Reliability of this scale was acceptable with a Cronbach's alpha of 0.92 for the pre-test and 0.93 for the post-test.

Bias

Using histograms, all pre- and post-items were negatively skewed, suggesting a slight ceiling effect. This may be a result of pre-existing desires for teamwork in the clinical setting. This may also be due to bias regarding preferences in participating in a simulation lab versus clinical time in a clinical setting. This may also have occurred due to excitement working with students from other professions, as well as experiential learning with team activities or higher-technology that may be perceived as a better and more effective form of education. Scatterplots and frequencies revealed a significant ceiling effect, where 19% ($N = 134$) of the pre-test scores totaled 45—the highest possible score. This poses a ceiling bias on the data where the post-test of these participants, when compared to the pre-test, is limited to downward movement or no change. A sensitivity analysis was performed keeping the data and removing the data. The results differed substantially. As such, these cases were removed from the analyses.

Screening for Assumptions

A collection of data may have issues that violate the assumptions of ANOVA that must be resolved prior to analysis. The Assumptions of ANOVA include the Assumptions of Parametric Data and are the following: 1) normal distribution; 2) homogeneity of variances; and 3) Independence (Field, 2005). Each of these assumptions was evaluated prior to the main analyses. Moreover, the data were screened for adequate sample sizes prior to analysis. For descriptive statistics of variables in the study, refer to Table 6.

Table 6

Breakdown of Variables for Samples

Variable	AIM 1 (*N* = 539)		AIM 2 (*N* = 314)		AIM 3 (*N* = 244)		AIM 4 (*N* = 129)	
	N	%	*N*	%	*N*	%	*N*	%
Medical Students	259	48	161	51	109	45	49	38
Nursing Students	145	27	86	27	65	26	37	29
Pharmacy Students	73	13	34	11	39	16	24	19
PA Students	62	12	33	11	31	13	19	15
Male	256	44	138	44	111	45	60	47
Female	322	56	176	56	133	55	69	53
Novice	179	31	88	28	88	36	30	23
Competent	403	69	226	72	156	64	99	77
White	236	43	151	48	83	34	47	36
Asian	186	34	101	32	83	34	48	37
Hispanic	50	9	29	9	21	9	5	4
Black	35	7	19	6	15	6	3	2
Other	39	7	14	5	23	9	12	9
Low-technology	314	58						
High-technology	225	42						
Multiprofessional			169	54				
Team-based			145	46				
Observing					85	35		
Active					159	65		
Standardized Patient							58	45
Mannequin							71	55

**Novice refers to students that are mid-year in their program whereas Competent refers to those students who are in their graduating year.*

Normal Distribution

It is critical that the sample data meet the assumption of normality. Univariate normality was examined through histograms and normality plots of each variable. All variables should have a standard deviation between -1 and 1, which indicates normality. All histograms were normal or only slightly skewed.

Homogeneity of Variance

The homogeneity of variance assumption refers to equal variance within each of the populations studied. Screening for homogeneity was of particular importance given the potential bias for Type I errors (false positives) from a possible ceiling effect. Homogeneity of variances was screened using Levene's test. Analysis under equal variances was performed for the variables that revealed a significance value of above .05, for those variables that revealed a significant Levene's test (<.05), the analysis was performed as unequal variances. The variances of the dependent variable were the same for all subsamples.

Independence

The scores between each individual participant are not related; each case and treatment group was independent of one another. There were no repeating learners. The only dependency that existed among dependent variable scores (post-test) was the dependency on the pre-test scores by the same individuals. Because there are only two levels of within-subjects factor (pre-test and post-test), multivariate tests were not used to screen for assumptions.

Analysis

Demographic and Non-demographic Independent Variables

After univariate descriptive analysis, bivariate statistical analysis was conducted between both the demographic and non-demographic variables and the outcome variable—the post-test TWCS score—to determine whether any variable may be of predictive value in relation to perceived teamwork and collaboration. Variables revealing statistically significant relationships ($p < .05$) were considered for entry in the ANOVA analysis. This demonstrated how the demographic variable fared in relation to other independent variables. The pre-test TWCS was treated as an independent variable, whereas the post-test TWCS was the dependent variable.

Research Question Analysis

Analyses were conducted to determine whether each simulation method affected TWCS post-test scores, while controlling for potential confounders.

Limitations

Causation and Experimentation

Although the participants were chosen because of their involvement as students, the sample also served as a limitation. The clinical skill level of the students was a limit to the study because the students did not have comparable direct clinical experience. Because of this, some students were uncomfortable with progression of scenario events and equipment and were often unable to transcend procedural tasks to a more immersive patient care management scenario–a combined focus on technical, cognitive, and behavioral factors. The participants were also students of one institution. As a result, the participants' views may have been systematically biased. Issues that may be experienced by external students may not have been identified in this study.

Validity and Reliability

Each modality in simulation requires a complexity of potential confounders that are not yet understood. Some of these potential confounders that were not controlled in this study included difference in environment (e.g. primary care versus hospital setting) or intimacy of student orientation to the equipment (e.g. the mannequin-based group received orientation to touching the mannequin versus the standardized patient-based group received orientation to the phone system and equipment outside of the clinical environment). The treatment implementation also varied between active participants and observing participants, and this potentially decreases confidence in the observed findings. Although the participants were randomly assigned, the differences between the interventions may not alleviate interaction of factors. Every group had periods of discussion that may have, alone, served to support positive findings from this study. Because the study had general pre-testing and randomization, generalizability may be sufficient except for the treatment settings. In simulation, the learners have knowledge that they are being studied and/or observed. Given the smaller sample size of some professions, randomization was often impossible, specifically when there was only one student from a profession in the treatment group. The number of active participants limited those professions with larger numbers from having a percentage of participants active in the scenarios equal to the smaller professions. For the groups who did not undergo high-technology HCS, the lack of opportunity to undergo simulated IPE may not have been perceived to be worthwhile with a desired preference for experiential learning.

The lack of this experience may have been paradoxical to the overall objective of the lab which was to provide an interactive learning experience.

CHAPTER FOUR

RESULTS

To determine the effect of simulation type on TWCS scores, four repeated measures ANOVAs (mixed between-within design) with one within-subject factor (pre- and post-simulation TWCS scores) and one between subject factor (simulation type) adjusting for potential confounders (faculty, program, grade level, gender, and ethnicity) were run. See Table 6 for a summary of the demographics. Using SPSS v. 20 with alpha set at .05 for all tests of statistical significance, data were evaluated to ensure that the assumptions of repeated measures ANOVA were fulfilled. Sensitivity analyses were run (ANOVAs with and without potential confounding variables), and they revealed that it was necessary to control for the potential confounders.

Data management, cleaning, and univariate screening were completed resulting in the removal of extreme outliers and cases with missing pre- or post-tests, as well as replacing single missing items with the average of the other items provided in the pre- or post-test (see Figure 13) (at least five completed items were required). An overall TWCS score was determined from a sum of the 9 items in both the pre-test and the post-test, and these were used as the primary variables analyzed in each study aim. Reliability of this subscale was acceptable with a Cronbach's alpha of 0.92 for the pre-test and 0.93 for the post-test.

Aim 1: Low-technology versus High-technology

From the first aim, the following research hypothesis was tested:

> *Pre-licensure students receiving high-technology simulation-enhanced IPE will report higher teamwork and collaboration on completion of*

the lab than will students who receive low-technology (non-simulated) IPE.

A summary of results of the repeated measures ANOVA are presented in Tables 7 and 8 and Figure 14. The means and standard errors for TWCS scores are presented in Table 7. The results for the ANOVA showed a small, but statistically significant pre to post effect, $F(1, 522) = 5.10$, $p = .024$, favoring high versus low-technology. It should be noted that there was little difference in means from the pre-tests for both low- and high-technology and a small difference in means from the post-tests for both low- and high-technology, suggesting that the significant changes occurred after the pre-test from the interventions.

Aim 2: Multiprofessional versus Team-based Learning

In the second aim, the following research hypothesis was tested:

On completion of the lab, perceptions of teamwork and collaboration scores will be higher in students who participated in a team-based lab than in students who participated in a multiprofessional lab.

A summary of results of the repeated measures ANOVA for this analysis are also presented in Tables 7 and 8 and Figure 14 with the means and standard errors for TWCS scores presented in Table 7. The results for the ANOVA showed a non-significant pre to post effect, $F(1, 297) = .71$, $p = .339$. It should be noted, however, that the between groups (multiprofessional and team based) had adequate power, accounting for 95% of the overall (effect + error) variance. The results showed statistical significance between the multiprofessional learning group and the team-based learning group, there was

Table 7

Estimated Marginal Means (Least Square Means) for Each Teaching Modality Analysis

Aim/Comparison	Test	Modality	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Aim 1: Low vs. High-technology	Pre	Low Tech	36.78	.41	35.97	37.58
		High Tech	38.77	.45	37.87	39.66
	Post	Low Tech	37.09	.40	36.30	37.88
		High Tech	40.13	.45	39.25	41.02
Aim 2: Multiprofessional vs. Team-based Learning	Pre	Multiprofessional	36.42	.55	35.33	37.51
		Team-based	38.33	.60	37.14	39.51
	Post	Multiprofessional	36.88	.58	35.74	38.02
		Team-based	38.71	.63	37.48	39.95
Aim 3: Observing vs. Active Participation	Pre	Observing	37.87	.67	36.55	39.18
		Active	38.10	.65	36.82	39.38
	Post	Observing	38.11	.59	36.94	39.28
		Active	39.69	.58	38.55	40.82
Aim 4: Standardized Patient vs. Mannequin-based Simulation	Pre	SP	38.14	.74	36.68	39.60
		Mannequin	38.63	.96	36.71	40.54
	Post	SP	37.92	.77	36.39	39.45
		Mannequin	42.47	1.01	40.46	44.47

Table 8

ANOVA Summary Table Comparing Test Scores for Each Teaching Modality Comparison

Aim/Comparison	Source	*SS*	*df*	*MS*	*F*	*p*	*observed power*
Aim 1:	Within Pre-/Post-test	60.24	1	60.24	5.10	.024	.62
Low vs. High-technology	Between Low-High Tech	1419.47	1	1419.47	42.17	.000	1.00
	Technology x Pre-/Post-test	62.28	1	62.28	5.27	.022	.63
Aim 2:	Within Pre-/Post-test	8.09	1	8.09	.71	.399	.13
Multiprofessional vs.	Between MPL-TBL	447.00	1	447.00	12.73	.000	.95
Team-based Learning	Learning Method x Pre-/Post-test	.23	1	.23	.02	.886	.05
Aim 3:	Within Pre-/post-test	32.54	1	32.54	2.66	.104	.37
Observing vs. Active	Between Observing-Active Participation	70.72	1	70.72	2.41	.122	.34
Participation	Participation x Pre-/post-test	39.35	1	39.35	3.21	.074	.43
Aim 4:	Within Pre-/post-test	46.38	1	46.38	5.83	.018	.67
Standardized Patient vs.	Between SP-mannequin based simulation	179.81	1	179.81	8.47	.004	.82
Mannequin-based Simulation	Simulation x Pre-/post-test	116.78	1	116.78	14.67	.000	.97

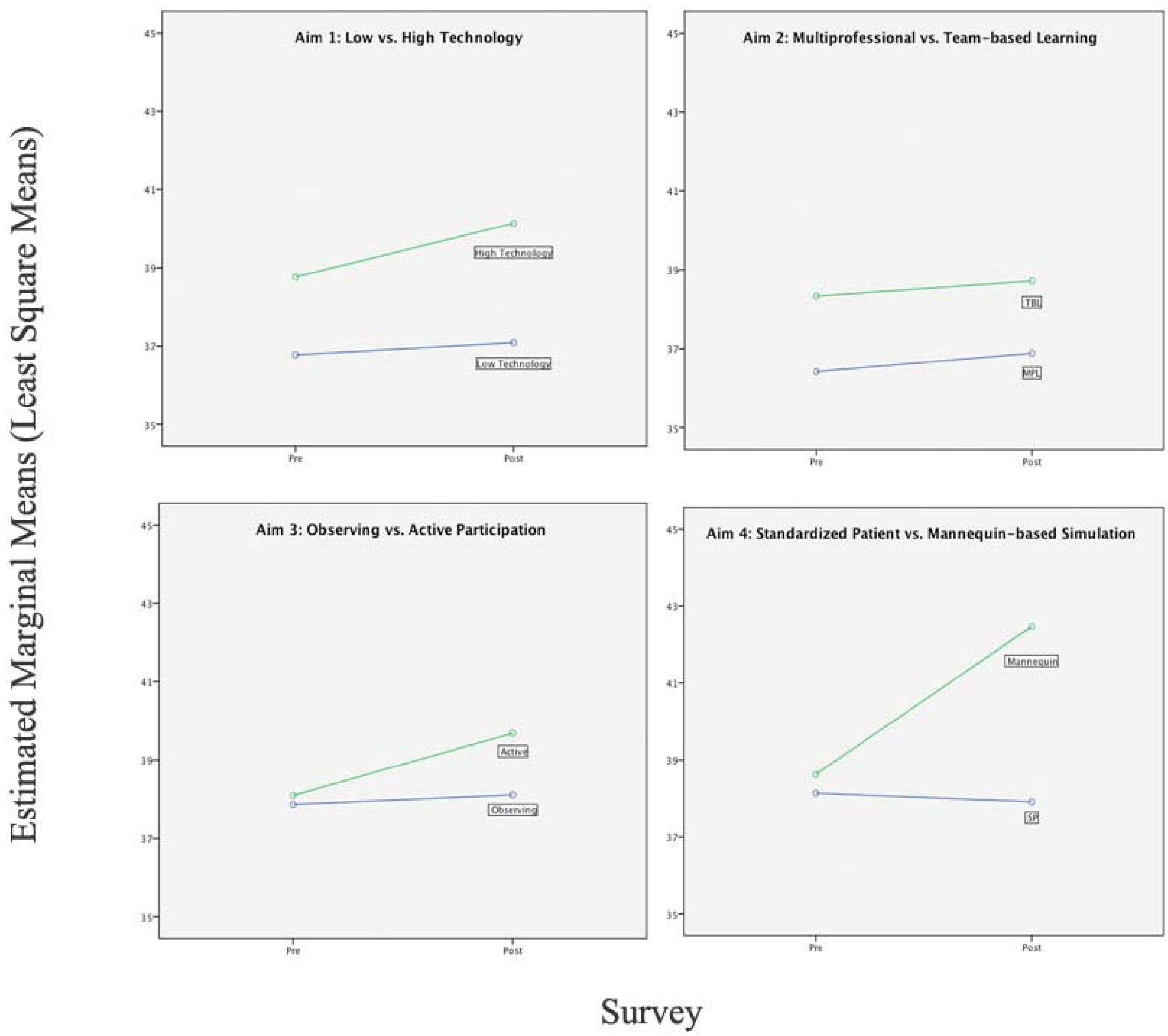

Figure 14. Line plots of the estimated marginal means (least square means) of comparisons.

little difference in means from both the pre- and post-tests for both multiprofessional and team-based learning, suggesting that the significant changes did not occur from the interventions.

Aim 3: Observing versus Active Participants

From the third aim, the following research hypothesis was tested:

Upon completion of the lab, there will be no difference in perceived teamwork and collaboration between students who actively engaged in simulation and debriefing versus students who observed the simulation and engaged in the debriefing.

A summary of Aim 3 results of the repeated measures ANOVA can be found in Tables 7 and 8 and Figure 14. The means and standard errors for TWCS scores are presented in Table 7. The results for the ANOVA showed a non-significant pre to post effect, $F(1, 210) = 2.66$, $p = .104$ with adequate sample power.

Aim 4: Enhanced Standardized Patient versus Enhanced Mannequin-based Simulations

From this fourth aim, the following research hypothesis was tested:

Upon completion of the lab, there will be no difference in perceived teamwork and collaboration between students who actively engaged in simulation using mannequins versus simulated patients.

A summary of results of the repeated measures ANOVA are presented in Tables 7 and 8 and Figure 14. Along with the results of Aims 1— 3, the means and standard errors for TWCS scores for Aim 4 are presented in Table 7. The results for the ANOVA showed a small, statistically significant pre to post effect, $F(1, 101) = 5.83$, $p = .018$. There was little difference in means from the pre-tests for both standardized patient-based and mannequin-based simulation. There was a considerable difference in means from the post-tests for both standardized patient-based and mannequin-based simulation. This suggests that the significant changes occurred after the pre-test from the intervention.

CHAPTER FIVE

DISCUSSION

With the changing learning styles and technologically integrated behaviors of students reflecting newer and mixed generations, educators are compelled to conceptualize curricula differently than the structured didactic curricula of the past. The use of HCS, in its highly experiential and interactive form, supports a new culture of learning where learning opportunities for faculty are as attainable and as abundant as the learning opportunities for students. It transforms the educator from teacher to facilitator, where education is designed and situated to allow the co-creation of knowledge (Lave & Wenger, 2008). Although the learning in HCS occurs through this interactive experience, the opportunities for student learning must be engineered into a simulation. This requires planning, forethought, and substantial resources. As a result, many organizations have developed simulation programs to centralize these resources. Simulation programs, as either a central resource or a partnership of programs, continue to be accessed by multiple professions and professional programs, creating a hub for interprofessional activity. Simulation programs are in a position to bridge uniprofessional activities together, creating many venues for interprofessional activity. HCS has become a medium for expanding and developing IPE.

A Conversation in the Philosophy of Science

The growing enthusiasm and recognized benefits of HCS and IPE have created a rapid increase in adoption and initiation of newly created activities, pulling together both sciences into an overlapping field (see Figure 2 in Chapter One). Each science (HCS and IPE) continues in a discovery phase attempting to define and redefine its language, taxonomies, characteristics, and the variables that influence outcomes. These limitations are imposed on this combined field in a two-fold fashion, requiring a collaboration of the most artistic, inventive, tolerant, and detail-oriented scientists.

Based on Thomas Kuhn's theory of scientific revolutions (Kuhn, 1962), Schneider (2009) proposes four stages of a scientific discipline (see Table 9). Using Schneider's stages, HCS and IPE both show endurance as they enter Stage 3. As seen in Table 9, although the field (simulation-enhanced IPE) has yet to introduce new phenomena (Stage 1), imposed by the advances of HCS and IPE, the strings to its parent fields have pulled the field into Stage 2. Although literature is deemed "inadequate" with educators frequently "reinventing the wheel," the state of the field is not only appropriate; it is a necessary process. However, to continue advancing this field, optimally, scientists should sculpt activities that progress the characteristics of the field's scientific phase. As researchers and educators begin to establish methodology, equipment, and techniques, prudent planning is imperative with careful selection in techniques and development of a methodology for reporting.

Discussion of Results from the Comparative Study

Aim 1: Low Versus High-technology

The findings from the comparative study of low-technology and high-technology IPE methods modestly support the notion that high-technology is a more effective platform for teamwork and collaboration in IPE than low-technology (non-simulated) IPE. The findings reveal a significant difference between the pre-tests in both groups. Because the modalities were implemented consecutively rather than simultaneously (low-technology modalities occurred in years 2008-2010, whereas high-technology modalities

Table 9

Schneider's Four Stages of a Scientific Discipline with Four Types of Scientists

Stage	Characteristics of Stage	Optimal Type of Scientist
1	Establishing a New Language • Introduce new objects and phenomena as subject matter • Looking for resources, outside experts • Mistakes made • Missed elements by scientists bound to known facts	• Imprecise, inaccurate • Not afraid to make mistakes that they know will be corrected at a later time • Positive outlooks, ignore negative comments • Technical skills not needed • Linguistic • Philosopher • Writers • Understand facts and concepts
2	Establishing Methodology • creating a toolbox of methods and techniques • most cited • Re-application of methodology previously developed in another science to a new problem with adjustments	• Artistic • Ingenuous • Inventive • Able to implement ideas • Has high-risk tolerance • Promoter of new technology
3	Initial Application of New Methods to Phenomena and Objects • highest stage of original research publications • ground breaking new discoveries	• Hard-working • Detail-oriented • Precise • Receptive to 2nd Stage methods and technologies, but not to 1st stage propositions due to lack of applicability to immediately solve problems
4	Sustenance and Translation • Use previous knowledge for practical purposes • maintain and pass on scientific knowledge • new ways of presenting information • crucial revisions	• Re-evaluate role of discipline • Generate new ways to present discipline • Holds a broad spectrum of cultural and philosophical views • Resourceful • Writers of holistic comprehensive reviews • Help to focus future research

occurred in years 2010-2012), the differences in pre-test scores may have been due to time bias. Over the study time, students and faculty may have become more familiar and accepting of technology, simulation, and experiential activities. The lab likely improved over time with increasing faculty experience and comfort. Accounting for the significant difference within the group pre-test scores, the findings reveal a slight, yet statistically significant, advantage for high-technology methods over low-technology methods. According to Situated Learning Theory (Kolb, 1984), learning occurs with both a concrete experience and reflective experience and is co-created with other individuals. The high-technology methods allowed students to learn with, from, and about each other experientially through a clinically-relevant simulated environment and reflectively through debriefing. The low-technology methods lacked the situated environment.

Aim 2: Multiprofessional versus Team-based Learning

The comparison between multiprofessional and team-based learning revealed a non-significant parallel increase (.08 difference in pre- and post-test variance) suggesting no difference between multiprofessional and team-based learning. The consistent differences between groups may also be due to time bias (multiprofessional learning occurred in 2008-2009 and team-based learning occurred in 2009-2010). The results suggest a small positive effect on student perceived teamwork and collaboration through both multiprofessional and team-based IPE methods. The findings from the first analysis suggest that simulation may be a more effective method for IPE; however, the use of multiprofessional and team-based learning may increase IPL when used in conjunction with simulation-based IPE.

Aim 3: Observational versus Active Participation

A common challenge in HCS-based education is to accommodate larger numbers of students relative to available faculty or simulation equipment. To overcome this challenge, many learner groups are divided into active and observing participants (see Table 4). The findings from the comparative study of observational and active participation suggest no difference in perceived teamwork and collaboration. This may be a result of active participation by all learners during the debriefing that followed the simulation. Fanning and Gaba (2007) posit that debriefing, more so than the active simulation, is where learning takes place. It is thought that guided reflection or facilitator-led discussions create prolonged learning through reconstruction of the events, self-reflection, and cognitive assimilations. This group reflection around the situated event also supports the main tenets of Situated Learning Theory (see Figure 1).

Aim 4: Enhanced Standardized Patient versus Mannequin-based Simulation

The findings from the comparative study of enhanced standardized patient and enhanced mannequin-based simulation support the notion that mannequin-based simulation is a more effective simulation medium for IPE teamwork and collaboration than standardized patient simulation. Both modalities were enhanced with an embedded standardized wife. The use of standardized patients and mannequins present their own limitations, for example, non-verbal personal communication is limited in mannequin use so the scenario used with a standardized patient could not be used with the mannequin, just as invasive techniques are limited in standardized patient use and so the scenario used with a mannequin could not be used with a standardized patient. Such limitations resulted in confounding differences between the interventions. The mannequin simulation was more clinically urgent than the standardized patient simulation, introducing a more pressurized environment with factors that were not studied in this analysis. Because students are expected to assess the mannequin and correctly interpret its capabilities, the mannequin-based group also received a more hands-on orientation to the environment. This may have allowed additional comfort within the situated learning environment, potentially more positively affecting learning.

Strengths of the Study

The study compared approaches in IPE seen as best-practice approaches and identified as the most common simulation-enhanced IPE (Palaganas & Andersen, 2012). The research design sought to address deficiencies identified in reviews of literature: need for further use of theory (Reeves et al, 2012), lack of rigorous measurement instruments (Zhang et al., 2011), small sample size (Freeth et al., 2005), and collection of baseline data (see Chapter 2). This study was planted in the longest and strongest interprofessional activity provided at Loma Linda University and had a subsequent large sample size for the primary analysis, allowing the ability to perform sub-analyses. This study was performed at a single institution. Single-site studies generally serve as a limitation; however, given the variability of simulation programs, using multiple sites may have contributed a multitude of unnecessary confounding variables. Understanding the undeveloped state of this field, the researchers used a theoretical framework and clarified terms of reference. Overall, the students evaluated the lab positively.

Limitations

At this stage of the science, reporting of limitations is crucial to the field's success. The lab was structured so that future comparative analysis of modalities may be performed, including this secondary analysis. Despite the advantages of using secondary analysis (e.g. large sample size, reduced costs, identifying ways to improve program evaluation instruments), there were limitations noted that are typical for secondary analysis. The details of this study were not solidified until after the data had been collected. Many limitations were determined post-data collection that could not be corrected. Interestingly, many of these limitations mentioned below were limitations disclosed in published prospective studies in the field; this, too, reflects the field's stage of science as mentioned above.

Lab Design

For some students, the lab was required; for other students, it counted as credit for a course or clinical hours and may have been optional amongst a list of accepted activities. Whether it was required or an elected requirement was not noted or explored and, hence, not controlled. Although this may have been conveyed through the pre-test, it may have influenced change scores from pre- to post-test (e.g. student upset that it was required as indicated in a low pre-test, found the experience somewhat worthwhile and submitted a high post-test score).

The composition of groups may have differed despite being distributed as evenly as possible. Generally, there were one to two medical students, one to two nursing students and one of the remaining professions. Whether the limitation of participation from certain professions in each group affects the outcomes was not a variable in this study.

The activities were aimed for students to act or focus on their post-licensure role. The students often discussed their student roles during debriefing. Whether participation in real-time student roles versus post-licensure roles is more effective was not explored.

Evaluation Instrument

There was a very high ceiling effect found throughout the study; in other words, there was little discrimination toward the top of the TWCS. This led to a questioning of the construct: is this effect a result of a theoretical limit or data limit? It is possible that the instrument does not accurately measure perceptions of teamwork and collaboration in a pre-licensure IPE setting. The students may also have marked scores without fully reading or understanding the items. There was no reverse coding in the subscale to offset this potential bias. The demographics obtained in the evaluations did not assess a student's prior experience clinically and with simulation; thus the study did not assess for a novelty effect.

Unaccounted Differences between Modalities

There are unaccounted differences between the modalities. For example, the mannequin-based simulation group received a necessarily lengthier orientation to equipment, room, and environment as compared to the standardized patient simulation group, who was oriented to the process, phone system, vital sign machine, and nurse's station. When oriented to the mannequin, the students were asked to listen to lung and heart sounds so that they can distinguish normal from abnormal sounds over the audible mechanical sounds, as well as areas to feel for pulses. This may have created motivation for hands-on participation and increased comfort and acceptance with environment and fidelity. There were no control groups structured into each analysis.

Time Bias

Because this study occurred over a period of time where IPE and HCS grew in popularity, there is a potential for time bias. With this particular time bias, students may have become more familiar and accepting of simulation and experiential activities. Over time, the faculty also became more familiar with the teaching each year and discussed within the lab faculty committee ways to improve and standardize the lab. Despite this bias, time was not controlled in the analysis because each intervention is paired to a year and the time variable, "lab year," therefore, reflected multiple confounding variables. "Lab year" overlapped with other variables that were controlled and the inclusion of "lab year" in the analysis could potentially derail the findings of the interventions. As a result, lab year was not used in the analysis and the researcher interpreted the results with this potential bias in mind.

Debriefing

Throughout simulation literature, debriefing has been considered to be the "heart and soul" of healthcare simulation (Fanning & Gaba, 2007). It is where the processing of knowledge occurs in a group. In this study, debriefing was used as a time for reflective guidance. This structure allowed for variability between groups based on the individual students that composed each group. One strong negative or positive perspective may influence the perspectives of other members. The students were asked to complete the post-test following the debriefing and, accordingly, the debriefing may have influenced the post-test results.

Characteristics that Influence Outcomes

Characteristics found in the use of an educational modality that may influence outcomes were identified (but not fully explored) during the scope of this study.

General Applications of Simulation

Faculty

A longstanding confounding variable in education is the quality and "likeability" of faculty by students, colleagues, and superiors alike. Interprofessional education requires additional knowledge in:

- interprofessional practice as applicable to the learner groups;
- IPE competencies, as well as the newest research and recommendations for IPE;
- IPE planning, design, implementation, and formulation of design and evaluation teams;
- spheres of influence and change theory;
- translational research; and
- assessment of learners in IPE, including existing validated and reliable evaluation instruments (Hammick et al., 2008; Howkins & Bray, 2008).

Furthermore, as outlined in the Society for Simulation in Healthcare's Domains for Certified Healthcare Simulation Educators (2012), educators using simulation require additional knowledge in:

- experiential teaching and learning theory;
- simulation equipment;
- simulation principles, practice, equipment, and methodology;

- assessment of learners using simulation;
- management of simulation resources and environments; and
- engagement in simulation scholarly activities.

The level of an educator's knowledge in these areas, along with teaching talent, professional values, and capabilities can greatly influence a learner group's outcomes. The educators in this study had a range of levels of knowledge and were, therefore, controlled during the analysis as a confounding variable.

Students

By the definition of interprofessional education, students are learning "with, from, and about" each other. Each student brings with him/her unique knowledge, previous experiences, energy, attitudes and perspectives, personality, mental frames, and communication skills. The combination of these unique factors affects the co-creation of knowledge and may greatly influence the interprofessional learning. There were no unique student factors explored in this study.

Familiarity and ad hoc teams

Group familiarity with one or more members also influences the learning outcomes. In groups that had more than one profession (e.g. three nurses), the within-profession students were typically familiar with each other. Knowing how team members work together may increase team comfort or, on the contrary, if there are only a few members who are familiar with each other. This may create sub groups within the team making it difficult to work together. Whether the co-creation of knowledge is more efficient in working teams versus ad hoc teams has not yet been studied in simulation-enhanced IPE, but may be a significant group characteristic affecting outcomes.

Multiprofessional Methods

Of the modalities chosen for this study, the multiprofessional method is the closest resemblance to traditional didactic methods. Multiprofessional methods involve students from multiple professions, sitting together in a classroom facilitated through a case study via a lecturer and slides. These students essentially learn side-by-side in parallel and not necessarily from and about each other. This methodology accommodates larger groups of students and eliminates a burden on human resources. Because the learning is guided through slides followed by discussion, the teaching is structured and can be prepared by a novice educator, whereas simulation methodologies require expertise. When comparing multiprofessional methods to simulation methods, educator factors should be controlled. Participation often becomes less required in larger groups, and thus, learning and critical thinking becomes more optional than required. Situated Learning Theory posits that participation is an essential characteristic to learning outcomes (Lave & Wenger, 2004).

Team-based Methods

Team-based methods used non-clinically based methods (e.g. team-building exercises) tied into a clinically-focused debriefing. This method eliminates the need for participation and equal sample sizes of each profession. Without a clinically focused activity, the student may not find the activity relevant and, as a result, may question its "worthiness of time" (Knowles, 1980). Conversely, team-based methods require participation of all individuals and team participation that may contribute to positive outcomes. Although there were varying degrees of clinically focused activities, the degree to which a clinically focused activity influences IPE learning outcomes was not explored in this study.

Simulation Methods

Psychological Safety

Three instances during the lab revealed the need to address psychological safety. A fundamental characteristic for the use of simulation methods is the establishment of psychological safety (CAHSP, 2012). For students to fully engage in a simulation, their fears or potential fears should be addressed or insecurities resolved. For example, a student may be worried if their grading professor is behind the mirror or will be reviewing the video (if used). Confidentiality of their performance may affect simulation behavior and the resulting learning outcomes. Although scenarios are typically developed to fit curricular needs, a particular scenario may elicit past memories in students that could affect the learning of the group. These memories may be personal, traumatic, or sad. Educators must be able to address such a breach in psychological safety should it arise.

Observing Participants

The observing participants passively observe a simulation where active participants are in the observed clinical environment. The observing participants then actively engage in reflection using reflecting team-structured debriefings. Situated Learning Theory has a concrete experience and a time for reflection (Lave & Wenger, 2008). Whether observation through video projection and one-way mirrors served as a concrete experience was not studied. Whether debriefing served as a concrete experience also was not studied. The observing team provided feedback for the active teams. This process of providing feedback may have provided these students with a skill essential to IPP and safe patient care.

Technology-enhanced standardized persons

An issue identified during the study was student familiarity with the standardized patient and standardized wife. The previous experience (e.g. scenario or performance evaluation) may influence the students' interaction with the standardized patients and the learning outcomes. With standardized patients, students may be hesitant to touch or examine the patient. In standardized patient-based simulation, students' preconceived engagement may include the understanding that no invasive measures can be used in this type of simulation. Fidelity may be compromised if invasive measures are required. This limitation may be resolved with proper orientation and the integration of technology that allows invasive procedures with standardized patients.

Embedded simulated person-enhanced mannequin-based simulations

Innovations in current education include ways to incorporate technology to best serve a technology-inclined population of students. The use of high-technology mannequins may be intriguing to "techie" students, creating a "techie effect." Mannequin-based simulation has begun a recent phase of promotions through media (e.g. healthcare TV shows, news releases), conferences, and journals. As simulation programs continue to grow within institutions, mannequin-based simulation is seen as a new type of education, creating a "novelty effect" that students may find exciting. Equally important is the students' familiarity with mannequin-based simulation, including familiarity with cues and limitations of the mannequins. This may contribute to a "comfort effect" where students who are familiar with mannequin-based simulation are more comfortable with the equipment and processes of this type of simulation than students who have not participated previously in a simulation. Fidelity of the equipment, scenario, and environment is crucial to the learning outcomes of mannequin-based simulation. Although mannequin-based simulation fosters a hands-on experience to practice assessment skills, as well as invasive and diagnostic procedures, the immediacy of cues affects the fidelity of the simulation. Depending on the learning objectives of the simulation, embedded simulated persons may be added to a simulation to establish more situational fidelity; however, they are typically not standardized (do not go through formal training and evaluation as to accuracy of portrayal). Thus, an embedded simulated person may subtract from the fidelity of a simulation if the portrayal is over or under the intended role.

Challenges

The challenges encountered during this study are similar to the challenges noted in existing literature. The most common challenge in the literature was scheduling of students. This was a biannual challenge during the implementation of this lab. Scheduling was also a challenge for use of the simulation center that was increasing in its daily services. Scheduling of the simulation modalities was also difficult because these modalities required an extensive amount of human resources. The interprofessional lab committee was composed of fourteen faculty from each involved program (including simulation and standardized patient staff and faculty). Due to the challenges of scheduling a monthly planning and assessment meeting, full committee attendance was rare. This was overcome through detailed minutes and coordination by the lab's director (the researcher of this study).

Development of the lab and learning activities were also challenging. As described above, the design of experiential learning activities require more initial planning. Considerable time was given to ensuring that the activities were relevant to all groups and to the negotiation of active roles where there was overlap. The time commitment for this lab was substantial (generally 8 hours a month per committee member), which was most often in addition to a normal workload. Faculty development and redundancy of knowledge and skills was found to be necessary for continued replication and in cases of missing faculty. A common challenge in simulation is that scenarios cannot be fully structured or standardized and, to maintain the fidelity of the simulation, the clinical facilitator must be able to interact realistically and immediately with any student action; therefore, the real-time faculty behind the simulation cannot be novice providers.

Theoretical Implications and Recommendations

There is a need to share frameworks and develop theory in the field (HCS and IPE; refer to Chapter Two). In alignment with Situated Learning Theory, and as part of the introductory work prior to the data analysis reported in this study, a model of interprofessionalism was developed through the process of concept analysis (Palaganas & Jones, 2012). This model can serve as a guiding framework for further investigation of how to foster IPE. According to this model, the simulation should be patient-centered with opportunities for bi-directional interactions between and among all professions present, supporting opportunities that highlight mutual respect (see Figure 15).

The defining attributes of interprofessionalism are: 1) interaction, 2) mutual respect, and 3) the patient as a common goal. The modalities explored in this study

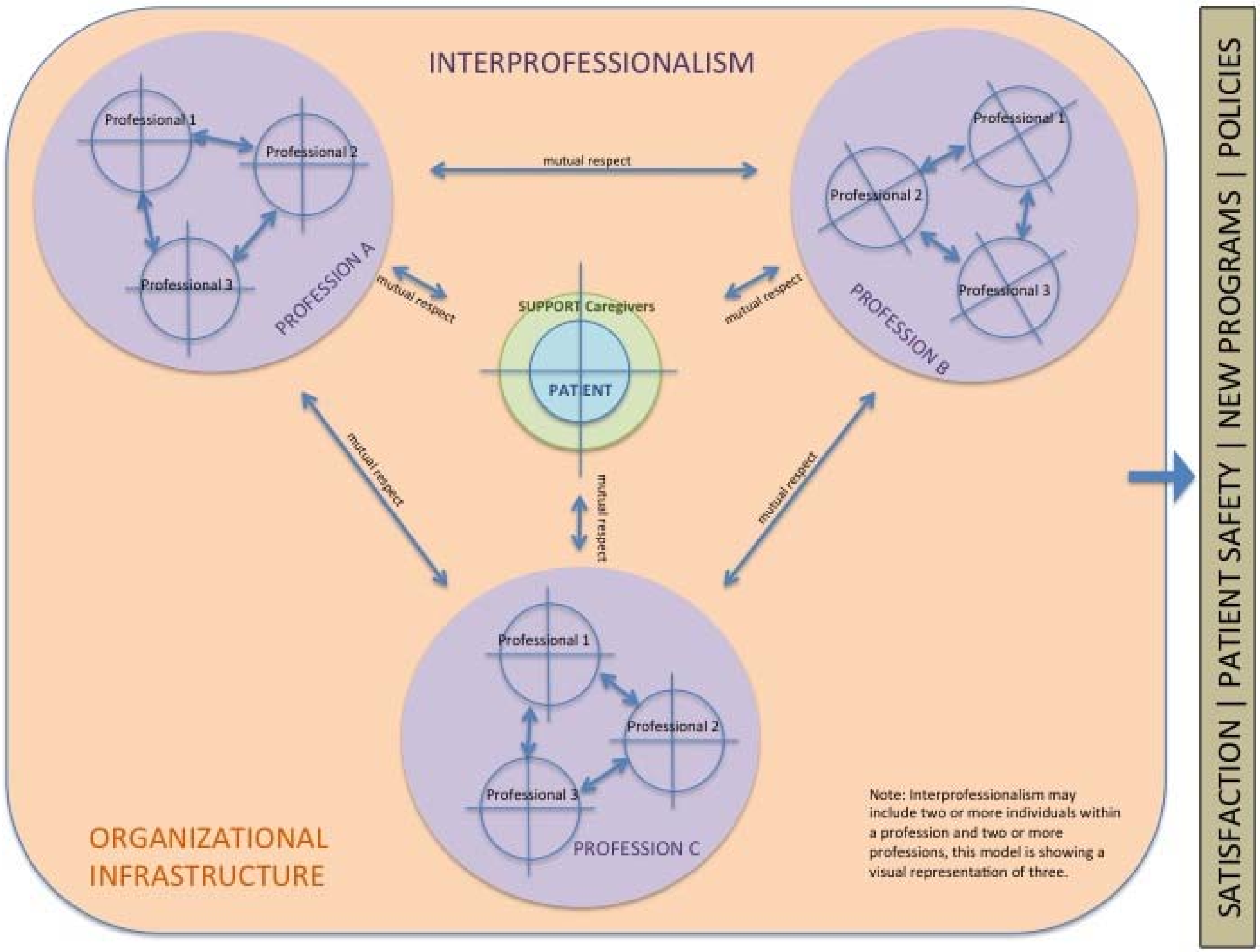

Figure 15. Conceptual model of interprofessionalism.

require interaction and collaboration, foster respect, and allow reflection of patient-centered care. Although simulation can be engineered to situate learning toward interprofessionalism, specific factors that influence outcomes remain unknown and are not evident in the literature.

As suggested above, a “reinventing of the wheel” is potentially a necessary process for the field and for educators. This thought is supported by the premises of situated learning. According to Uhlig, Lloyd, and Raboin (personal communication, June 16, 2012), often, it is the social process of working together to understand and find new ways of doing things that generates new capabilities in a healthcare team, rather than the specific techniques or methods that are developed or used. In other words, the “wheel” should not be the focus, but rather the social and relational work itself. The findings of this study (as detailed above) suggest that the social process of working together finding new ways of doing things that allowed the students to successfully complete the lab may have been the most important characteristic contributing to positive outcomes.

While the social processes of simulation-enhanced IPE creates learning, learning can best be situated by eliminating the obvious errors, or errors that are prominent in the literature. Educators and researchers may benefit from an established framework that can assist in elimination of these issues. Based on the thoughts and findings from this study, the following framework is offered to educators and researchers in the field.

SimBIE RVA Framework

This Simulation-based Interprofessional Education Reliability-Validity-Assessment (SimBIE RVA) Framework© may fill gaps identified in the present study as it relates to the field and reinforces the endeavors of the field. It can be a resource for

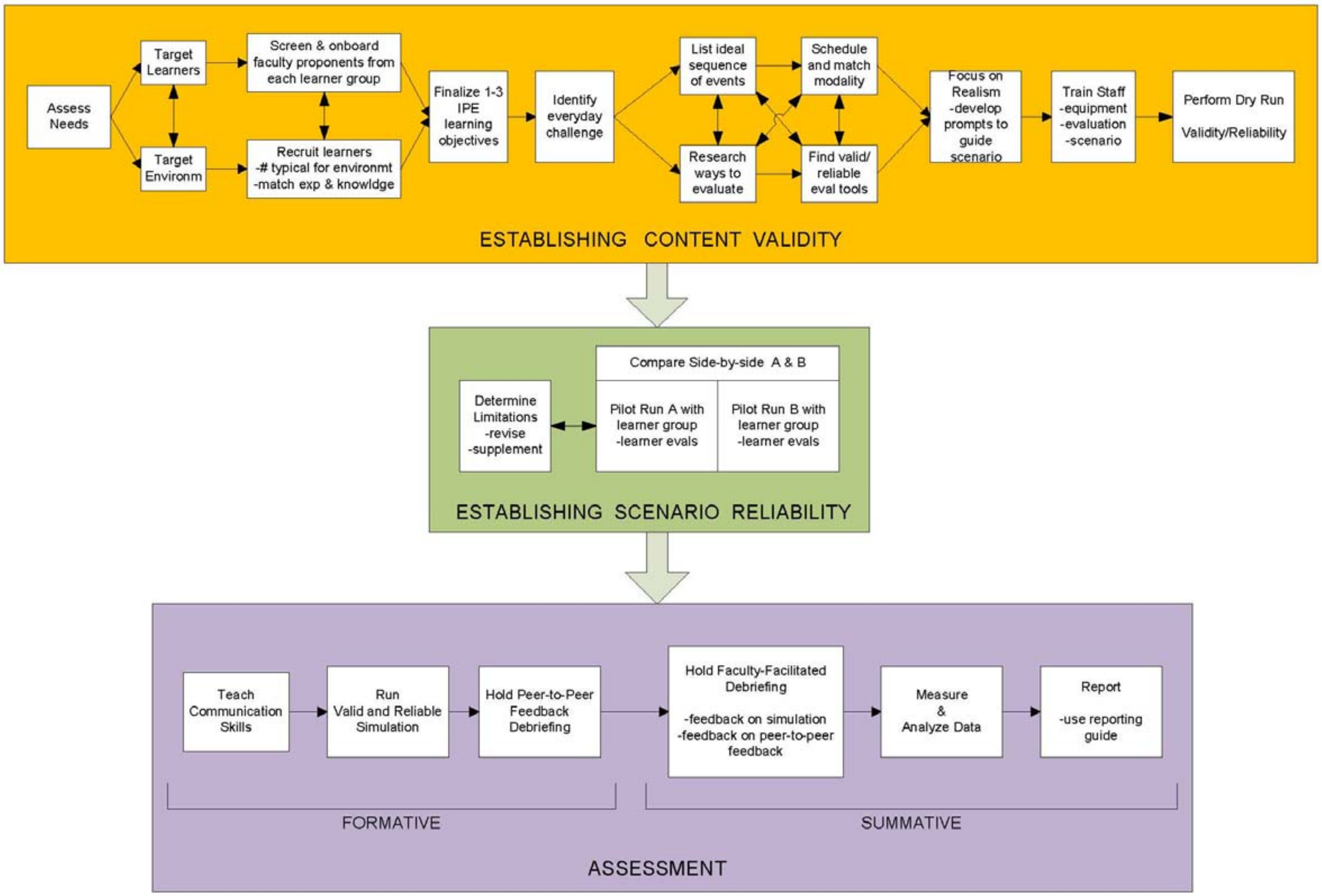

Figure 16. SimBIE RVA Framework. 2012 © Janice C. Palaganas

educators, researchers, and simulation programs intent upon building interprofessional learning through simulation-enhanced IPE. The present study indicates the difficulty in establishing reliability, validity, and accurate assessment due to the complexity of and uncertainties within the field. Complexity and uncertainty cause difficulties in establishing strong, valid, and reliable findings. The SimBIE RVA Framework may have strengthened the study presented here and may help educators and researchers further understand their simulation and IPE practice, clarify complex areas already studied, and build their own curriculum for interprofessional learning using existing evidence and findings as a foundation.

Preventing Adverse Learning

While creating and implementing simulation-enhanced IPE, HCS and IPE educators have an obligation to recognize and be mindful that there is a possibility that negative perspectives around interprofessional practice may develop. Although adverse learning experiences may occur randomly, the likelihood for positive outcomes may depend on the factors highlighted above, including substantial planning using an anticipatory design with an emphasis on faculty development, awareness for and support of possible characteristics that lead to positive outcomes, as well as recognition of and purposeful muting of possible characteristics that lead to negative outcomes.

As the SimBIE RVA Framework suggests, the reliability of the simulation should include “modality matching.” Highly realistic and complex simulations are not always appropriate (Jeffries, Clochesy, & Hovancsek, 2009). All simulators have strengths and limitations. HCS educators are given yet another responsibility: to know the capabilities, strengths, and limitations of available simulation equipment. These capabilities should be matched to the learning objectives set by faculty, the learning level of the students, and the cues necessary to guide students toward achieving the learning objectives.

As applicable to all education, HCS and IPE educators have ethical obligations that require reflection on individual desires for the education along with personal assumptions. Often, educators seek students from other professions to add a more realistic experience to a simulation designed for one profession. This creates a uniprofessional design that may benefit one group of students more than other professional groups, allowing the opportunity to create negative learning and proliferate the very stereotypes that IPE strives to alleviate. When asking other professions to participate, educators should involve faculty (as content experts) from the added profession to create equal learning opportunities. During debriefing, many assumptions arise in conversation–from both students and educators. Educators, in this context, are often role models and should be aware of their own personal assumptions around the professions involved, IPE, and HCS to prevent modeling views that may be adverse to the intended learning.

Areas for Future Study

As mentioned throughout the discussion, there are many areas in this field that have yet to be studied. Three areas of future study that were highlighted in this study and are foundational to the field are: 1) determining how to appropriately measure IPE by its definition when using simulation modalities, 2) the use of debriefing, and 3) the effects of SimBIE or IPsim.

Measuring Interprofessional Education

IPE is defined as, "two or more professions learn about, from, and with each other to improve collaboration and the quality of care" (World Health Organization [WHO], 2010, p. 13). Because of this, every student becomes a confounding variable. The use of rigorous qualitative methods or mixed methodology may assist in future studies.

The Use of Debriefing

Does the co-creation of knowledge occur primarily during the simulation or during the debriefing? In debriefing, students also learn how to provide peer-to-peer feedback and, in this process, learn how to communicate their thoughts to a team of other professions. This skill is relevant to clinical practice. A focus on developing this skill of feedback and communication may be key in teaching healthcare providers how to work together.

The Effect of SimBIE or IPsim

The review of research literature (see Embedded Paper, Chapter 2) revealed a difference in teaching methods based on the focus of the simulation objectives. Simulation-based IPE (SimBIE) are simulations that are structured using IPE objectives according to the WHO (2010, p. 13) definition of IPE, "two or more professions learn about, from, and with each other to improve collaboration and the quality of care." Interprofessional simulations (IPsim) are structured around objectives that demonstrate skills specific to individual professions or participants. Future study around the effectiveness of SimBIE or IPsim in achieving interprofessional learning can inform educators on how best to develop objectives and simulations around those objectives.

Areas for Future Study from Aims

There were also areas for future study identified within each aim. The findings and discussion from the first aim (low versus high-technology) questioned time bias and the experience and comfort of faculty over time. Because technology in simulation changes rapidly, as well as discoveries in best practice, it is not uncommon for a simulation course to change and improve over time. The effect of time bias on simulation-enhanced IPE may further inform simulation-enhanced IPE course or lab design.

The degree to which faculty is a confounding variable in any educational program is an age-old question in education. As seen in the findings of Aim 1, this is particularly a concern in simulation-enhanced IPE. Qualitative research around faculty characteristics that can best predict high interprofessional learning could provide a foundation for research around faculty as a confounding variable in simulation-enhanced IPE.

The findings and discussion from the second aim (multiprofessional versus team-based learning) suggested the potential use of combining multiprofessional and team-based learning and simulation. Human and technical resources are a major concern in simulation. Research regarding "dosing" of each in combinations may find methodical mixtures that can result in effective interprofessional learning and relieve the pressures of human and technical resources.

The findings and discussion from the third aim (observational versus active participation) questioned the effectiveness of observation (video or real-time). It suggested that debriefing is as effective as a hands-on experience; however, given the limitations of this study, additional research is needed. In addition to the suggested future studies above (see "The Use of Debriefing, p. 128), research in this area can also relieve the pressures of human and technical resources because observation may allow for larger numbers of learners.

The findings and discussion from the fourth aim (enhanced standardized patient versus mannequin-based simulation) suggested the need for further comparison and examination of characteristics that exist in standardized patients and mannequin-based simulation that lead to interprofessional learning. Strengths and limitations of each modality may guide the examination of characteristics. As an expansion of this suggestion, the effectiveness of embedded simulated persons in comparison to standardized patients in simulation-enhanced IPE may also contribute knowledge to the strengths and limitations of each method.

Lab and Evaluation Design

Other areas identified for future research as a result of this study concerns the design of: 1) the lab or simulation and 2) measurement for the evaluation of collaboration. Questions regarding lab design include:

- What effect does IPE have on learning in required courses versus elected courses?
- What is the most effective number of members and disciplines comprising a team for simulation-enhanced IPE?
- Is it more effective for students to engage in simulation-enhanced IPE in their current role as students or in their post-licensure role?

The findings of this study revealed the need for continued research using the TWCS subscale as an accurate measure of teamwork and collaboration. Other valid and reliable instruments that measure teamwork and collaboration should be examined, chosen, and undergo preliminary testing to determine the appropriateness of its use in studying the intended research questions. Instrument development, the use of all 19 RIPLS items, and the use of newly developed instruments in this area may also provide better insight into this variable and the factors around this variable.

Conclusion

Because the field of HCS and IPE has entered a discovery and exploratory stage, thoughtful reporting will be crucial to future developments. This dissertation has provided information on HCS and IPE from the literature, presented a study that examined HCS as a platform for IPE, and considerable reflection of the findings as they relate to the field. It contributes to the growing findings around factors in IPE methods that influence positive and negative outcomes. This study also reveals many questions foundational for this science. Use of the information from the present study may assist in thoughtful planning for future simulation-enhanced IPE and research.

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APPENDIX A

SOURCES FOR TERMS OF REFERENCE

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APPENDIX B

OUTCOMES-BASED MATRIX FOR INTERPROFESSIONAL LAB

GOALS & OBJECTIVES*	AGENDA TOPIC	THEORY& COMPETENCY	TEACHING STRATEGY	EVALUATION
1. Distinguish types of healthcare professions. (K,low) 2. Determine potential patient needs. (S,high)	Who comprises a healthcare team? • Types • Career Paths	Constructivist RR2, RR4, TT8, TT10, TT11	Review the types of health professionals. Integrated Quiz	Formative = questions or discussion
3. Recognize the benefits of interprofessionalism. (A,low) 4. Provide opportunity to increase skills for clinical/crisis intervention with patient and family. (S, high) 5. Participate in a simulation scenario that includes cognitive, technical, and behavioral threads. (S,high) 6. Apply clinical knowledge to case. (S,low) 7. Promote critical thinking (S, high)	Why this lab? • Overall benefits • Cognitive + Technical + Behavioral • Theory	Constructivist Cognitive Educational VE1, RR1, RR3,	Review some benefits of interprofessionalism Discuss this lab as a bridge from curriculum to clinical practice. Develop plan of care.	Summative and Formative = simulation Formative = reflective teams Formative = debriefing groups Formative = encourage questions or comments Summative = completed plan of care.

8. Differentiate roles in healthcare. (S,low) 9. Recognize role, scope of role, scope of practice, expertise responsibilities, education, importance, and resources of other team members. (S, high) 10. Recognize participation specific to individual team role toward collaboration. (S, low)	Roles in healthcare	Behavioral RR2, RR4, TT8, TT10, TT11	Discuss roles in simulation. Discuss responsibilities.	Formative = simulation
11. Describe individuals in the team. (K,low) 12. Increased awareness of team skills: conflict resolution/communication techniques (S,high) 13. Participate in a simulation. (S,high) 14. Appraise characteristics of effective team members. (A,high)	Becoming a Healthcare professional as part of a team. Recognize importance of team.	Cognitive Constructivist Behavioral Experiential CC1-8 TT1-11	4-facts orientation activity Have group facilitate from video. Have group debrief debriefing.	Formative = discussion during activities
15. Reframe the topics learned	Putting it all together	Experiential	Group facilitation and discussion	Formative = reporting of group

		RR5, RR8		experience Summative = quality of debriefing
16. Distinguish collaboration methods. (K,high) 17. Evaluate lab methods for use in your teaching practice. (K,high)	What can this lab mean to me?	Situational RR1, RR5, RR8	Student Storytelling	Formative = discussion
18. Indicate helpful and non-helpful areas of today's lab. (A,low)	Evaluation	Adult Learning CC1	Pre-evaluation/post-evaluation	Summative = discussion Summative = post eval

* K=Knowledge; S= Skills; A= Attitudes; high = Analysis, Synthesis, or Evaluation level of Bloom's Taxonomy; low = Knowledge, Comprehension, or Application level of Bloom's Taxonomy

Specific Values/Ethics Competencies:

VE1. Place the interests of patients and populations at the center of interprofessional healthcare 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 healthcare 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.

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.

Specific Roles/Responsibilities Competencies:

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.

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.

Specific Interprofessional Communication Competencies:

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.

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 relationships (University of Toronto, 2008).

CC8. Communicate consistently the importance of teamwork in patient-centered and community-focused care.

Specific Team and Teamwork Competencies:

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 healthcare.

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 care.

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.

APPENDIX C

INTERPROFESSIONAL EDUCATION AND HEALTHCARE SIMULATION SYMPOSIUM ORGANIZATIONS

- The National Patient Safety Foundation
- Joint Commission
- National League for Nursing
- Association of American Medical Colleges
- American Association of Colleges of Osteopathic Medicine
- American College of Surgeons
- Royal College of Physicians and Surgeons of Canada
- Association of Allied Health Professions
- American Association of Colleges of Pharmacy
- American Dental Education Association
- National Association of EMS Educators
- American Association of Colleges of Nursing
- American Nurses Association
- American Organization of Nurse Executives
- Institute of Healthcare Improvement
- American Society for Bioethics and Humanities
- American Society of Anesthesiologists
- Association of Standardized Patent Educators
- International Nursing Association for Clinical Simulation and Learning
- Quality & Safety Education for Nurses
- Society for Simulation in Healthcare
- The Josiah Macy Jr. Foundation

APPENDIX D

LITERATURE DATABASE FIELDS

ENL	Ref# and citation
Administrative	Type
	First Author Last Name
	First Author First Name
	Profession/Credentials
	Institution/Program Affiliation
	Contact Info
	Other Authors
	Title
	Journal
	Year
	Country
	Search Method
Purpose	Purpose
	Construct/Method of learning/teaching
	Rationale
Theory	Theory or Framework applied
Research Methods	Research Design
	Source of data
	Data Collection methods
Specific and Expected Learning Outcomes	Implied or stated learning outcomes
	Specific Skills
Sample and Context	Population
	Recruitment
	N
	GIS
	Duration
	Frequency
	Learner Level
	Faculty composition
	Professions
Findings	Results
Impact	Kirkpatrick
Rate Eval	Methods of Evaluation
	Method of allocation
	NHMRC

	Pathway
	T Level
Strength	SOF
Ethics	Ethics
Educational	Descriptor
	Educational Level
	Target
	IPEC Competency Domain
Educational Features/Sim Use	Debriefing Suitability
Sim	Modality/Equipment
	Benefits of Sim IPE
	Challenges of Sim IPE
Performance Improvement	Learning
Impression	Comments
References	Primary Sources
	Obtained?
Patterns	patterns
Future	Areas for Future Study
Notes	

APPENDIX E

TEACHING MATERIALS

TEAM AND SIMULATION-BASED HEALTHCARE INTERPROFESSIONAL LAB

INTERPROFESSIONAL LAB COMMITTEE
Loma Linda University
10 September 2010

Teaching Materials

1. **Faculty Instructions and scripting**
2. **Presentation for benefits and definitions of IPE**
3. **IPL Defining Roles and Experiences Video**
4. **Orientation Activity**
5. **Patient Scenario**
6. **Plan of Care Forms**
7. **Team Debriefing Guide**
8. **Faculty Assessment and Evaluation Instruments**

1. Faculty Instructions and scripting

Faculty, please remember that the best way for students to learn is reflective practice and self-identification. Although your role is to guide this reflection; as much as possible, allow the students to discover for themselves the benefits of teamwork.

Minute Orientation

You can ask students to find their names on the team roster to find their room and team assignment.

Note: We will begin the day as a large group and have them separate following the orientation activities. They will need to know which room they are in for when we do break into smaller groups.

Pre-evaluation

Have the students complete the pre-evaluation. They will need to know their team assignment in order to write it in at the top of their evaluations. They will also need to write down a confidential reference number to match their pre- and post-tests and drawings. You can suggest that they use the date of birth or initials of someone they know for reference. Please explain that this is for document-matching and privacy-protection purposes.

INSTRUCTIONS FOR SMALL GROUP SESSION

1. Review Agenda for your session with your students
2. Four Facts
    a. The instructions are on the students' handouts.
    b. Every faculty should also join this activity with the students. You can write your facts on the whiteboard as an example.
    c. At the end of the activity, discuss:
        i. Why did we get some guesses wrong?
        ii. What were we doing or thinking to make our guesses?
        iii. Emphasize how we often work from stereotypes
        iv. Correlate the discussion with healthcare and working with other professions
3. TIP FOR FACULTY: REMEMBER THE OBJECTIVES OF THE COURSE!
    a. As long as you can get the students to reflect on their own practice and understand why interprofessional practice is important, you have reached our primary goal.
4. TIP #2 FOR FACULTY: HAVE FUN AND MAKE IT FUN!!!!
5. Start your activities
6. Debrief each activity
    a. Ask at the end of each activity debriefing: "How can this relate to your practice?"
7. Summary discussion: After you are finished with your activities, ask:
    a. To summarize the day, how would you define interprofessional practice?
    b. What would you do differently now in your own practice?
8. Evaluations
    a. Remind students to write their personal reference on the top of their evaluations
    b. Remind students to check if there is a back page
    c. Ask students to take time to tell us how we can make this lab better for their profession and level.
9. Thank the students for their time, instruct them to leave evals in the middle of the table and step out into the hallway until they are finished.
10. COMPLETE THE FACULTY SURVEY and return to Janice.

Post-Sim Debriefing

During debriefing, you can ask the following questions (open-ended and not impregnated with an answer or judgment).

- ❑ How did you feel about that?
- ❑ Can someone summarize the case for us?
- ❑ Active team, tell us about your experience.
- ❑ Observing team, tell us about your experience.

Regroup, Summarize, and Conclude

Use this time to explore the concept of interprofessionalism. You can use these questions to guide the discussion.

- ❑ What does "professionalism" mean to you?
- ❑ Do you feel that there are steps to achieving professionalism?
- ❑ Can you tell me what "interprofessionalism" means to you?
- ❑ Going back to interprofessionalism, do you feel that there are steps that a team must take to achieve interprofessionalism?
- ❑ How do you know interprofessionalism when you see it?
- ❑ Have you ever witnessed or experienced an incident of interprofessionalism? What did you observe or what did you experience that convinced you that it was interprofessionalism?
- ❑ Can you tell me about a time or an event where you felt interprofessionalism was poorly demonstrated?
- ❑ What would be your highest dream of what interprofessionalism would look like? What is the ideal of what interprofessionalism would be.

You can ask the students: Can anyone share with all of us,

- What have you learned today?
- If there is something you would do differently next time, what would it be?

Emphasize the importance of Interprofessionalism, that they are the future of healthcare and can hopefully learn from this lab and implement changes to make future healthcare more safe for the patient. (5 minutes)

Open the floor for questions and answers.

Simulation Instructions and Scripting

How many of you are new to simulation?

<u>MSC</u>

The most important thing to understand about the Medical Simulation Center is that, when we are here, you do not have to worry about making mistakes or knowing everything. We expect you to make mistakes. And you may not. But if you do, we expect you to LEARN from your mistakes. We expect that you will LEARN something today whether or not there are mistakes. We are recording the scenarios today, but you have all signed confidentiality forms, and we have signed confidentiality forms. The videos do not leave the center. They will, however, be used for research and your specific names will not be used.

<u>Student Confidentiality</u>

We also take very seriously your role in confidentiality. You can talk about today generally, but you are not allowed to talk about specific names and details tied to any person. We also expect that you do not discuss the case with those who have yet to attend this lab. You would not be giving them an advantage and it would subtract from their learning experience.

2. Presentation for Benefits and Definitions of IPE

Loma Linda University
INTERPROFESSIONAL LAB

2011-2012 LLU Interprofessional Committee

Session Agenda

- Pre-survey
- 1:10 Establishing a glossary
- 1:20 Video: Interprofessional Roles
- 1:35 Panel of Professions –ask your questions!
- 2:00 Benefits of IPE
- 2:20 BREAK
- 2:30-4:50 Small Group Sessions (one break during)
- Post-survey & Evaluations

PURPOSE OF TODAY

WHY IPE?

- Educating in silos
- 85 percent of poor patient outcomes
- Holistic patient care
- Patient-centered with family involvement
- IPE → IPL → IPP
- Shared concepts
- Deeper understanding of own profession and how each of us fit into the bigger puzzle
- Educational certification and accreditation

A GLOSSARY

Establishing Terminology

Interprofessional Education

- **Interprofessional education/training (IPE)** describes those occasions when two or more professions learn with, from and about each other to improve collaboration and the quality of care. It is an initiative to secure *interprofessional learning* and promote gains through interprofessional collaboration in professional practice (Hammick et al., 2008).
- **Serendipitous interprofessional education** is unplanned learning between professional practitioners, or between students on *uni-professional* or *multi-professional* programs, which improves interprofessional practice (Freeth et al., 2005). (versus Formal IPE)

Multi-professional Education

- **Multi-professional Education** is when members (or students) of two or more professions learn alongside one another: in other words, parallel rather than interactive learning (Freeth et al., 2005).

Interprofessional Learning

- **Interprofessional learning (IPL)** is learning arising from interaction between members (or students) of two or more professions. This may be a product of *interprofessional education* or happen spontaneously in the workplace or in education settings (d. *serendipitous interprofessional education)* (CAIPE, 1997).

Interprofessional Practice

- **Interprofessional practice** is a way of practicing that is based on collaboration, using skills or attributes required for interprofessional teamwork (McCallin, 2005).

3. IPL Defining Roles and Experiences Video

4. Orientation Activity

FOUR "FACTS"

Part I: On this sheet, please list 4 facts about yourself -3 of which are true, 1 of them should be false.

1.

2.

3.

4.

Part II: Now, **as a group,** do the following steps in order one at a time.

1. Use the chart below to list the names of each person in your group.
2. Each person then reads their four statements aloud.
3. As each person reads their statements, write the number of the statement you think is false next to their name on the below chart and why.
4. Once each person has completed sharing the statements, go around the table, one person at a time and have the group go over which ones they thought was false and why. After everyone has revealed their guess, the person will reveal which one was really false.
5. You receive 1 point for every guess that is correct.
6. You receive 1 point for every person that guessed your fact incorrectly.
7. Who has the most points?

Name	False statement #	Why false?	Points (1 for each correct)
Number of people that guessed your fact incorrectly:			
		TOTAL	

5. Enhanced Standardized Patient Scenario

Loma Linda University Medical Simulation
Interprofessional Simulation Scenario
Revised 8/04/2010

Clinical Consultant - Interprofessional Lab Committee

Case Author(s) - IPL team

Presenting Complaint - Diabetes

Actual Diagnosis— Type 2 diabetes, poorly controlled

Patient Name - Albert Gonzalez

Patient Demographics:

1. Age: 50's
2. Sex: Male
3. Race: Caucasian
4. Height: Average
5. Weight: Obese

Patient Profile: Albert Gonzalez was discharged from the hospital three days ago, after being admitted for Hyperosmolar, hyperglycemic, non-ketotic syndrome. He was told at discharge that he needed to follow up at the clinic for instructions on how to better manage his medical conditions. Mr. Gonzalez lives at home with his wife and daughter, and relies heavily upon his wife to take care of not only the day-to-day household needs, In addition, she has been the primary care giver for her husband, since he was diagnosed with diabetes a little over a year ago. She is tired, worried, and angry that he does not take a more active role in his healthcare

Case Objectives:
1. To give students of various medical professions an opportunity to collaborate as a team in managing a diabetic patient.
2. To evaluate how each profession contributes to the management of patient care.

COURSE OBJECTIVES

1) **Recognize participation specific to individual team role toward collaboration.**
2) **Promote critical thinking**
3) **Recognize role, scope of role, scope of practice, expertise responsibilities, education, importance, and resources of other team members,**
4) **Discuss challenges of collaborative care in chronic care and disease prevention of underserved populations specific to diabetes care and critical care.**
5) **Increased awareness of team skills: conflict resolution/communication techniques**
6) **Determine treatment planning, delivery of services and diagnostic assessment including medication management.**
7) **Provide opportunity to increase skills for clinical/crisis intervention with patient and family.**

Patient Personal Presentations and Emotional Tone - Albert Gonzalez:

You are a 50-60 year old male who has recently been discharged from the hospital with complications from diabetes. You rely on your wife for all of your needs. You will be forthcoming and willing to answer questions, (but expect your wife to answer specific questions regarding your medical health history.) You are a proud stubborn man, and are annoyed that you are expected to make any changes in your routine to improve your illness. You have an abrasive relationship with your wife, due to your unwillingness to help manage your health problems. You are wearing clean, but older well-worn clothing.

In response to the questions regarding your medical issues you answer,

"I don't know, my wife handles all of that."

If you are asked, "What kind of medical problems do you have?" you answer,

" I have diabetes and high blood pressure, but I don't remember what else I have. (You will have to ask the wife, she handles all of that.)"

You can answer (**ad lib**) all other question <u>unrelated</u> to your medical problems (You do not know your medical history or medications very well).

If you are asked, " What kind of medications do you take?" You answer,

“ I am supposed to take all kinds of medication. For my blood pressure, cholesterol; I don’t know all the medicines I am or should be taking. My wife knows more about that stuff”.

If you are asked “ Are you following a diabetic diet”? You answer,

“ I can’t eat that health food stuff. It has absolutely no flavor, and I won’t eat it”.

Psychosocial Questions:

If you are asked about your employment: (you can ad lib the following information)

This is a sore subject for you. You have been a truck driver all of your adult life. A few months ago your yearly DMV medical screening came up, and due to you uncontrolled high blood pressure, they would not renew your license. Well, without a license you can’t work, and now you can’t provide for your family. You are very bitter toward the DMV about this.

If asked about your marriage, you answer,

“ I have been married to Martha for a long time, almost thirty years. She is a good woman most of the time. Sometimes I think that she just forgets that I am the man of the house, and that she needs to take care of my needs”.

If you are asked about your daughter, you talk about her with pride(the following is information relating to your daughter Michelle Gonzalez)

Her name is Michelle Gonzalez. She is 23 years old, and lives at home with you and Martha. She works in Irvine for a computer software company as an administrative assistant. You don’t know what it is that she does, but you know she’s good at it. She also takes classes at night, in hopes of one day becoming a teacher. She tries very hard to help out at home as much as possible, but has a very busy schedule with commuting to work every day, and taking night classes.

History of the Present Illness:

You were just discharged from the hospital two days ago. You were informed that you needed to follow up at the clinic for instruction on how to manage your diabetes.

In response to questions regarding your hospitalization:

You can talk about how you are really not sure all the things they did for you while in the hospital, in fact you don't really even remember going to the hospital. During your stay your mind started to clear up, and by the time they were discharging you home you felt much better; however, you were told you still needed to follow up here at the clinic.

You have an ulcer on your left foot that has caused you little to no pain. You feel that walking on it has made it worse, so you use the ulcer as an excuse for your lack of physical activity.

In response to questions about the ulcer on your left foot:

You can talk about how the ulcer started to appear about three or four months ago. You know it's there, but it really doesn't cause you any pain. You do worry about it getting worse, so you use the ulcer as an excuse for sitting around, and not doing much at home.
If the doctor probes the ulcer, you can complain of a slight increase in pain.

You were diagnosed with diabetes 18 months ago, and have been hospitalized two times in the past year for your diabetes when your blood sugars went really high (500-600 range).The first time was when you were diagnosed with diabetes, 18 months ago, when you had a bad case of "flu." The second time was about 6 months ago when you had an infection in your leg (cellulitis).

When you were diagnosed with diabetes, you were started on oral medications, but because your blood sugars remained high you were started on insulin as well. Your wife gives you your insulin shots at night. She also checks your blood sugars once in a while (several times a week). They usually run from 160-350. You were seeing the doctor every few months until you lost your insurance 4 months ago. Now you have to pay cash for each visit, which is a hardship. You and your wife attended diabetes education classes, but you are not really following the diet, exercising or checking blood sugars like they instructed you.

Problems from your diabetes: You occasionally experience **blurry vision** when your sugars are too high. You have not had your eyes examined. You have had **trouble with erections** for the past 6 months. You have **decreased sensation in your feet**, but you do not have burning pain in your feet. You do not check your feet every day. You haven't had any chest pain, dizziness, stomach problems, changes in bowel movements or urination. You haven't had a skin ulcer before this episode.

You have a list of medications that you refer to, if asked what medications you take. “My wife takes care of that— I don’t pay any attention to them.” The med list has the following medications:

Metoprolol 100 mg po bid
Glyburide 5mg bid
Avandia 4mg qd
Cipro 500mg bid
Metformin 1000 mg po bid
Lipitor 10 mg po qd
Levemir 10ml 30 units sq qhs
Arnica topical ointment (for ulcer)

Past Medical History:

Other medical conditions you have include:
High blood pressure—for the past ten years. It has been “OK”— you are not sure of the numbers—“150/90?”, but your wife gives you your medicine every day.
Hyperlipidemia (high cholesterol), which was diagnosed at the same time as your diabetes. You think it was around 220.
Kidney stones - the last time you suffered from a stone was in 2005. You passed it after having a lot of pain.
Coronary artery disease - for the past ten years. You occasionally have chest pain when you walk too fast for a few blocks, or if you get upset. You had a stress test that showed “problems.” You just try to take it easy and you don’t get the pain and therefore aren’t short of breath either.

You occasionally notice your heart beating fast and hard (palpitations) for a minute or two.

Patient Risk Factors:

You and your wife attended diabetes education classes, but you really don’t want to eat the portions or the food that was recommended. You like meat, cheese, ice cream, and other foods that you were told to avoid. In addition you do not limit salt in your diet. You will eat cooked vegetables and some canned fruit.

You and your wife have been married 30 years, and have had no other sexual partners. You have never had a sexually transmitted disease. You have not had sexual relations for 6 months because you have had problems with erections, which doesn't help with your self-esteem.

Although you are depressed about your current situation, you have never considered suicide. You are angry at life, and feel like you deserve better after working hard to provide a living for your family.

Family History:

Your father died of a heart attack at age 56. Your mother died of complications from hip surgery at age 72.

Psychosocial/Personal History:

You were a truck driver, but could not renew your license due to your poor health. You lost your job a few months ago, and are very concerned about how you are going to provide for your family, and afford all the medical expenses when you don't even have medical insurance. You feel as though you are sinking into debt. You are depressed over your health, as well as your family's lack of income.

If asked about your employment:

This is a sore subject for you. You have been a truck driver all of your adult life. A few months ago your yearly DMV medical screening came up, and due to you uncontrolled high blood pressure, they would not renew your license. Without a license you can't work, and now you can't provide for your family. You are very bitter toward the DMV about this.

Your Home Life:

You live at home with your wife and 25 year-old daughter. Your wife complains that you are lazy, and need to be more helpful, especially when it comes to managing your health. Another source of stress is that the family car is breaking down on a regular basis, and that makes it hard to get to appointments. You have to rely on your daughter to get you where you need to go.

Information you may volunteers or questions you have for the student:

If asked why you are not taking better care of yourself, you respond

"Medications are too expensive, why are they so expensive? I don't have health insurance since I lost my job."

" I'm not sure the meds work anyway, how do the meds fix my problems (diabetic meds, blood pressure meds)?"

"Why does it cost so much just to be seen by a doctor?"

"**Why do I have to take so many different medications?"**

Things you would NOT do or say*:*

You would not accept that you should be handling your own healthcare need, that is why you got married. Your job is to work and bring home the income, and her job is to take care of whatever needs you have.

Physical Examination -

Your left foot ulcer should be examined.

If the foot is examined, the physician will find an ulcer about dime size. The ulcer should be virtually pain free, except if probed, and then should have a slight increase in pain

If a blood pressure is taken, then it can read high (161/97), blood sugar if checked can read (182).

Expected Sequence of Events:

Presentation: **Confederate nurse** gives report to nurse.

Report from nurse:

"The patient in room 5 is taking longer than we expected, I'm going to go in with Dr. Hart to do a pelvic. Do you think you can take Albert Gonzalez for me? He's here for diabetes and a foot ulcer -pretty much the same as every visit."

Minutes 0-2: Nurse interacts with patient and family

Minutes 2-8: Physician and PA with nurse at bedside

Minutes 8—15: MFT, Pharmacy, and/or Social Work

Repeat Case

Post simulation: Debriefing

Technical Staging:

a. Location Clinic Patient Room

b. Overall description Mr. Gonzalez is sitting up in bed fully clothed. (His wife Martha is sitting in a chair next to his bed) Both are dressed in average everyday street clothes.

c. Equipment Needed Accu-check machine, Blood Pressure cuff and sphygmomanometer

d. Disposable Items Gloves, Gaze, probing Q-tips

e. Moulaging Ulcer on Albert's left foot, wrapped in gauze, with a yellowy tent on the gaze around where the ulcer is. There should be a slight cyanotic color around Albert's toes.

f. Vital Signs if needed Blood Pressure: 161/97
Pulse: 82
Accu-check: 182

Martha Gonzalez (Patient's Wife):

Martha Gonzalez Demographics

1. Age: 50's
2. Sex: Female
3. Race: Caucasian
4. Height: Average
5. Weight: Average

Wife's Profile: Martha has been the primary care give for her husband, since he was diagnosed with diabetes a year and a half ago. She is tired, worried, and angry that he does not take a more active role in his healthcare.

In response to questions regarding Albert's medical issues, you respond:

"He doesn't do anything for himself, he expects me to do everything. I have to do all the housework, cook all the meals, and on top of everything else, now I am expected to be his nurse. I just can't do it all. He has to find a way to help out!"

(You do know all of his medical conditions, but are unsure if you are providing proper care).

In response to questions regarding Albert's medications:
(You will have a list of medications that you can hand to the nurse or doctor)
The list of medications:

Metoprolol 100 mg po bid, Glyburide 5mg bid, Avandia 4mg qd, Cipro 500mg bid, Metformin 1000 mg po bid, Lipitor 10mg po qd, Levemir 10ml 30 units injection sq qhs, Arnica tablets (for ulcer)

If you are asked about Albert's eating habits, you answer,

"When we were first told that Albert needed to change the way he eats, I really tried to make food that followed the diet recommendations. He would not eat them, and he got mad at me for feeding him food that tasted so bland. After a while I just gave up on the diet. It was either give up on the diet, or watch him starve to death.**"**

Psychosocial Questions:

If asked about your marriage, you answer,

I love my husband, but there is only so much that I can do. He has changed since getting sick and losing his job. He won't take care of himself. I work as a house cleaner during the day, and I take care of Albert every minute that I am home. I need him to take his health serious, and help me to help him.

If asked about Albert's job, you say:

" Albert losing his job has been hard on all of us, but what has been even harder is that the strong man that I married just seems to have given up. Now I have to carry the weight of the entire family, and that is not what I signed on for".

Wife's Personal Presentation and Emotional Tone -

You are clean and well kept, but dressed in well-worn lower middle class clothes. You are healthy, but tired. You are able to answer most questions about your husband's health and lifestyle. You sound tired and frustrated with your husband's emotional state and his lack of willingness to help at home.

6. Plan of Care Forms

Nursing (see Faculty Teaching Plan for other profession forms)

	Identified Needs:	Comments
Diagnosis		
Treatment		
Diagnostics		
Referrals		
Follow-up		

7. Team Debriefing Guide

Objectives	Yes	No, Debriefing
1. Recognize participation specific to individual team role toward collaboration	o Request for RN, PharmD, Social Worker, Case Manager, Dietitian to assist and/or come into patient's room	o Would you consider a PharmD, RN, Social Work, and Dietitian? o What roles do you think PharmD, RN, Social Work, and Dietitian have in the team? o Have you had PharmD, RN, Social Work, and Dietitian on the team? o Do you have any reservations?
3. Recognize role, scope of role, scope of practice, expertise responsibilities, education, importance, and resources of other team members	PharmD can: o Drug Management o Provide recommendations for drug changes to increase patient's compliance d/t drug interaction, ADRs, and cost. * Recognize that every profession on contribute in patients overall care. End goal is the patient. * Providing addition knowledge from various professional perspectives is an additive effect to patient care. *Every institution is different and not every institute as an interprofessional team on rounds and/or easily accessible. Make sure to find additional roles/ resources on in each institution and page each profession to visit the patient.	o What kind of roles do you think PharmD, RN, Social Work, and Dietitian have and/or have seen? o If you don't see a PharmD, RN, Social Work, and/or Dietitian—where/what could you do to locate one? o Would you consider paging a PharmD, RN, Social Work, and Dietitian to visit the patient o How would you consider keeping contact information of each profession and advising them to visit patient for additive care?
5. Increase awareness of team skills: conflict resolution/communication techniques	o Allow every profession to participate in the treatment plan: at least 5 minutes for RN, PharmD, etc. o NO one profession is dominating the conversation.	o If a particular student profession- RN, PharmD, Social Worker, etc. does NOT participate—address that student "what are you considering? What are you thinking?"

8. Faculty Assessment and Evaluation Instruments

Interprofessional Lab

FACULTY EVALUATION INSTRUMENT

COURSE OBJECTIVE	No*	Yes, but*	Yes*	Comments
1. I felt like the students learned with, from, and about each other and each other's profession.				
2. This lab helped the students to understand the benefits of interprofessional practice (IPP).				
3. The students reflected on ways to increase IPP.				
4. This lab required the students to think critically.				
5. This lab required the students to reflect on my practice.				
6. The students recognized the importance and resources of other team members as a result of this lab.				
7. This lab increased the students' awareness of team skills.				
8. This lab provided an opportunity for the students to recognize team skills.				
9. Overall, the lab achieved interprofessional learning.				

Interprofessional Mannequin-based Simulation

ASSESSMENT INSTRUMENT

date ___________ room _______

PERFORMANCE MEASURE	No*	Yes, but*	Yes*	Comments
All team members communicated with each other.				
There was a clear leader.				
Duties were negotiated appropriately.				
The family member was asked to take part in the patient's care.				
Every professional listened respectfully to each other.				
Every professional advocated for the patient.				
Information was shared between professions.				
The team demonstrated mutual support.				
All conflicts were resolved collaboratively.				
The team functioned effectively.				

*__No__: Multiple critical behaviors absent or poorly performed
Yes, but: Most critical behaviors present, but some performed unacceptably
Yes: All critical behaviors present and performed acceptably

Standardized Patient Faculty Evaluation

Case Name:____________________________ SP Name:_______________________________

Did the patient portray the emotions/pain of the case accurately?
YES NO SOMEWHAT
Comments:____
____
____

Did the patient appropriately and accurately reveal the facts?
YES NO SOMEWHAT
Comments:____
____
____

Did the patient stick to the script, being mindful of the student's time?
YES NO SOMEWHAT
Comments:____
____
____

Did the patient volunteer checklist items?
YES NO SOMEWHAT
Comments:____
____
____

Did anything in the case portrayal seem difficult for the patient?
YES NO SOMEWHAT
Comments:____
____
____

INTERPROFESSIONAL LAB COMMITTEE

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APPENDIX F

QUESTIONNAIRES AND SURVEY INSTRUMENTS

*****_RIPLS Instrument reprinted and adapted here with permission_

Pre-evaluation Survey

Q1. Which academic program at LLU do you attend?

- ☐ 1 Medicine
- ☐ 2 Nursing
- ☐ 3 Nutrition
- ☐ 4 Pharmacy
- ☐ 5 Physician Assistant
- ☐ 6 Marriage & Family Therapy
- ☐ 7 Psychology
- ☐ 8 Social Work
- ☐ 9 Other (specify) ____________________

Q2. Gender: ☐ 1 Male ☐ 2 Female Age:_________

Please respond to the following statements about healthcare learning with other students.						
1= Strongly Disagree; 2= Disagree; 3= Neither Agree nor Disagree; 4= Agree; 5= Strongly Agree						
1.	Learning with other students will help me become a more effective member of a health care team	1	2	3	4	5
2.	Patients would ultimately benefit if health care students worked together to solve patient problems	1	2	3	4	5
3.	Shared learning with other health care students will increase my ability to understand clinical problems	1	2	3	4	5
4.	Learning with health care students before qualification would improve relationships after qualification	1	2	3	4	5
5.	Communication skills should be learned with other health care students	1	2	3	4	5
6.	Shared learning will help me to think positively about other professionals	1	2	3	4	5
7.	For small group learning to work, students need to trust and respect each other.	1	2	3	4	5
8.	Team-working skills are essential for all health care students to learn	1	2	3	4	5
9.	Shared learning will help me to understand my own limitations	1	2	3	4	5
10.	I don't want to waste my time learning with other healthcare students	1	2	3	4	5
11.	It is not necessary for undergraduate health care students to learn together	1	2	3	4	5
12.	Clinical problem-solving skills can only be learned with students from my own department	1	2	3	4	5
13.	Shared learning with other health care students will help me to communicate better with patients and other professionals	1	2	3	4	5
14.	I would welcome the opportunity to work on small group projects with other health care students	1	2	3	4	5
15.	Shared learning will help to clarify the nature of patient problems	1	2	3	4	5
16.	Shared learning before qualification will help me become a better team worker	1	2	3	4	5
17.	The function of nurses and therapists is mainly to provide support for doctors	1	2	3	4	5
18.	I'm not sure what my professional role will be	1	2	3	4	5
19.	I have to acquire much more knowledge and skills than other health care students	1	2	3	4	5

COURSE OBJECTIVES

Each student will:

1. **learn with, from, and about each other and each other's profession;**
2. **understand the benefits of interprofessional practice (IPP);**
3. **reflect on ways to increase IPP;**
4. **demonstrate critical thinking;**
5. **demonstrate reflective thinking;**
6. **recognize importance and resources of other team members;**
7. **increase awareness of team skills; and**
8. **provide opportunity to recognize team skills.**

Check here: ☐ if you have read and understand the objectives for this course.

You may ask any faculty present for the lab to clarify any of the objectives.

Post-evaluation Instrument

Q1. What is your overall evaluation of the lab? (check one box) ☐5 Very Worthwhile
☐4 Somewhat Worthwhile ☐3 Neutral ☐2 Not Very Worthwhile ☐1 Not Worthwhile At All

Q2a. **The following lab exercises helped expand my understanding of the importance of interprofessional care and collaboration**					
	Strongly Disagree	**Somewhat Disagree**	**Neutral**	**Somewhat Agree**	**Strongly Agree**
a) Professional Roles	1	2	3	4	5
b) Team building Exercise	1	2	3	4	5
c) Interprofessional Activity	1	2	3	4	5
d) Debriefing	1	2	3	4	5
e) Planning Collaborative Care	1	2	3	4	5

Please respond to the following statements about healthcare learning with other students.						
1= Strongly Disagree; 2= Disagree; 3= Neither Agree nor Disagree; 4= Agree; 5= Strongly Agree						
1.	Learning with other students will help me become a more effective member of a health care team	1	2	3	4	5
2.	Patients would ultimately benefit if health care students worked together to solve patient problems	1	2	3	4	5
3.	Shared learning with other health care students will increase my ability to understand clinical problems	1	2	3	4	5
4.	Learning with health care students before qualification would improve relationships after qualification	1	2	3	4	5
5.	Communication skills should be learned with other health care students	1	2	3	4	5
6.	Shared learning will help me to think positively about other professionals	1	2	3	4	5
7.	For small group learning to work, students need to trust and respect each other.	1	2	3	4	5
8.	Team-working skills are essential for all health care students to learn	1	2	3	4	5
9.	Shared learning will help me to understand my own limitations	1	2	3	4	5
10.	I don't want to waste my time learning with other healthcare students	1	2	3	4	5
11.	It is not necessary for undergraduate health care students to learn together	1	2	3	4	5
12.	Clinical problem-solving skills can only be learned with students from my own department	1	2	3	4	5
13.	Shared learning with other health care students will help me to communicate better with patients and other professionals	1	2	3	4	5
14.	I would welcome the opportunity to work on small group projects with other health care students	1	2	3	4	5
15.	Shared learning will help to clarify the nature of patient problems	1	2	3	4	5
16.	Shared learning before qualification will help me become a better team worker	1	2	3	4	5
17.	The function of nurses and therapists is mainly to provide support for doctors	1	2	3	4	5
18.	I'm not sure what my professional role will be	1	2	3	4	5
19.	I have to acquire much more knowledge and skills than other health care students	1	2	3	4	5

Q9. How would you describe your race/ethnic origin? (check one box) (Response is optional)

- ☐1 White
- ☐2 Black
- ☐3 Hispanic
- ☐4 Native American
- ☐5 Asian or Pacific Islander
- ☐6 Arabic
- ☐7 Indian
- ☐8 Other ________________

Q10. What did you like most about today's lab?

Q11. What did you like least about today's lab?

Q12. Other comments?

Note: Original Source—Parsell, G. & Bligh, J. (1999). The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). *Medical Education, 33*, 95-100.

APPENDIX G

PERMISSION FOR USE OF RIPLS INSTRUMENT

Gmail by Google

Janice C. Palaganas <jpalaganas.ssh@gmail.com>

Permission for: Readiness for Interprofessional Learning Scale

Permission Requests - UK <permissionsuk@wiley.com> Wed, Sep 5, 2012 at 11:30 AM
To: "jpalaganas.ssh@gmail.com" <jpalaganas.ssh@gmail.com>

Dear Janice Palaganas,

Thank you for your email request.

Permission is granted for you to use the material requested for your thesis/dissertation subject to the usual acknowledgements and on the understanding that you will reapply for permission if you wish to distribute or publish your thesis/dissertation commercially.

Permission is granted solely for use in conjunction with the thesis, and the article may not be posted online separately.

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Best Wishes,

Verity Butler

Permissions Co-ordinator

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From: Goldweber, Paulette - Hoboken **On Behalf Of** Permissions - US
Sent: 29 August 2012 15:27
To: Permission Requests - UK
Subject: FW: Permission for: Readiness for Interprofessional Learning Scale

!

!

!

From: Janice C. Palaganas [mailto:jpalaganas.ssh@gmail.com]
Sent: Wednesday, August 29, 2012 10:23 AM
To: Permissions - US
Subject: Permission for: Readiness for Interprofessional Learning Scale

[Quoted text hidden]

APPENDIX H

INSTITUTIONAL REVIEW BOARD DOCUMENT

LOMA LINDA UNIVERSITY
ADVENTIST HEALTH SCIENCES CENTER

INSTITUTIONAL REVIEW BOARD

RESEARCH PROTECTION PROGRAMS

24887 Taylor Street • Suite 202 • Loma Linda, CA 92350

(909) 558-4531 (voice) • (909) 558-0131 (fax)

Notice of Determination of Human Subject Research ***IRB# 5120111***

To: **Winslow, Betty W**

Department: **School of Nursing**

Protocol: **Exploring healthcare simulation as a platform for interprofessional education**

☑ The IRB has determined that this activity **DOES NOT** meet the definitions of human subject research (see below).

Reason(s):

- ☐ Not a systematic investigation.
- ☐ Not designed to develop or contribute to generalizable knowledge.
- ☐ Not about living individuals).
- ☑ Not obtaining or receiving private individually identifiable information.
- ☐ Data or specimens were not collected specifically for this study.
- ☐ Coded data or specimens are used, but the researcher does not have access to the key to the code).
- ☐ No direct intervention or interaction.

This study does not require IRB review or approval. If this activity is used in conjunction with any other human experimentation or if it is modified in any way, it must be re-reviewed by IRB staff. Your cooperation in LLU's shared responsibility for the ethical conduct of research is appreciated.

☐ The IRB has determined that this activity DOES meet the definitions of human subject research and requires further review. Submit to:

- ☐ Exempt/Expedited Review
- ☐ Convened Board

See http://www.llu.edu/research-affairs/forms-and-online-tools.page? for further details.

Sincerely,

Linda G. Halstead

Linda G. Halstead, MA
IRB Administrator

Definitions (45 CFR 46.102):

Research: a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.

Human Subject: a living individual about whom an investigator conducting research obtains (1) data through intervention or interaction with the individual, or (2) identifiable private information