The Integration Of Simulation-enhanced Interprofessional Education Into Undergraduate Clinical Laboratory Science Curriculum

Dana Powell Baker
University of South Carolina

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THE INTEGRATION OF SIMULATION-ENHANCED INTERPROFESSIONAL EDUCATION INTO UNDERGRADUATE CLINICAL LABORATORY SCIENCE CURRICULUM

by

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Submitted in Partial Fulfillment of the Requirements
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Ann Vail, Dean of the Graduate School
DEDICATION

Commit to the LORD whatever you do, and He will establish your plans (Proverbs 16:3). Thank you, God, for the strength, the grace, and perseverance to see this degree through. You saw me through every obstacle, challenge, and trial in this journey.

To my parents, I honor you and the sacrifices you had to make to ensure your daughters were able to fly (Exodus 20:12). To my sisters, my lifelong best friends, I have your backs forever. Your love and strength have carried me through my entire life. I love you all so much. In celebration of your life and legacy, daddy this one is for you for I am the fruit of your tree. Thank you for being the wind beneath my wings.

To my supportive husband and beautiful daughters, I cherish you all for your unwavering love and patience as I spent countless days consumed in this work. I cannot wait for many more matching pajama nights and family vacations. I look forward to spending more time with my family. I hope in some small way, you are inspired and know that all things are possible. My girls, you can be whatever you want to be in life...do not (ever) shrink your gifts for anyone.

To my extended family, friends, and Sorors, thank you for being my village. There is no way I would have made it through without your encouragement and positive affirmations. Dr. Bridges, your text messages meant the world to me! Thank you all for believing in me and reminding me not only who I am but WHOSE I am. Much love.
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To Dr. Emily Diederich and the simulation center team, I cannot say thank you enough. Thank you for being curious with me and for allowing me to be curious with you. To my faculty peers, especially Dr. Letycia Nuñez-Argote and Brad Pfaltzgraff, thank you for being on this ride with me and supporting this incredible work along the way.

Most importantly, to our current and future clinical (medical) laboratory science students. Thank you for your curiosity and engagement in the clinical learning process. It warms my heart to know that our future generation of medical laboratory scientists are passionate about the profession and committed to positively impacting patients’ lives. Remember you are patient advocates and your contributions matter. Shine bright!
ABSTRACT

This action research study aimed to integrate simulation-enhanced interprofessional education (Sim-IPE) into the undergraduate clinical laboratory science (CLS) program curriculum. The undergraduate CLS curriculum was comprised of didactic coursework and hands-on learning experiences in the student laboratory. This traditional CLS curriculum model was uniprofessional in its design and educated students in silos rather than on interprofessional teams with other health professions students. Lack of collaboration on healthcare teams has led to increased medical errors and decreased patient safety in clinical settings.

Recent studies have indicated that effective communication and teamwork among healthcare professionals has led to improved patient outcomes and optimal quality of care. Professional organizations, such as the American Society for Clinical Laboratory Sciences (ASCLS), recommended the integration of patient safety concepts into pre-certification curricula. To address this problem of practice, I proposed the use of simulation-based procedural training (SBPT) as a bridge between the completion of the undergraduate CLS students’ laboratory courses and their transition into the clinical practicum. As a modality, the SBPT was selected to help undergraduate CLS students
strengthen technical skills, practice interpersonal skills, and increase their confidence prior to their entry into a real-world clinical laboratory for their clinical practicum.

The first research question focused on the impact of the Sim-IPE activity on the undergraduate CLS students' understanding of patient safety and quality of care concepts. The second research question explored how participation in the Sim-IPE activity helped undergraduate CLS students see themselves as contributors toward increasing patient safety. The third research question inquired about how undergraduate CLS students viewed their role as members of the healthcare team in terms of professional identity and visibility. As a mixed methods research study, qualitative and quantitative data collection instruments were used to address the research questions. The findings revealed student participant perceptions of increased awareness of patient safety and quality of care concepts with recognition of their professional contributions to the interprofessional team. Furthermore, the data supported the students’ transfer of learning from their participation in the proposed intervention into their clinical practicum experience.

**Keywords:** Clinical laboratory science, immunohematology, interprofessional education, medical laboratory science, safety, simulation
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AHRQ</td>
<td>Agency for Healthcare Research and Quality</td>
</tr>
<tr>
<td>AACN</td>
<td>The American Association of Colleges of Nurses</td>
</tr>
<tr>
<td>AAMC</td>
<td>The Association of American Medical Colleges</td>
</tr>
<tr>
<td>ASCLS</td>
<td>The American Society for Clinical Laboratory Science</td>
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<tr>
<td>ASCP</td>
<td>The American Society for Clinical Pathology</td>
</tr>
<tr>
<td>CLS</td>
<td>Clinical Laboratory Science/Clinical Laboratory Scientists</td>
</tr>
<tr>
<td>CMS</td>
<td>Center for Medical Simulation</td>
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<tr>
<td>ELT</td>
<td>Experiential Learning Theory</td>
</tr>
<tr>
<td>HCS</td>
<td>Healthcare Simulation</td>
</tr>
<tr>
<td>INACSL</td>
<td>The International Nursing Association for Clinical Simulation and Learning</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine</td>
</tr>
<tr>
<td>IPE</td>
<td>Interprofessional Education</td>
</tr>
<tr>
<td>IPS</td>
<td>Interprofessional Simulation</td>
</tr>
<tr>
<td>MLS</td>
<td>Medical Laboratory Science/Medical Laboratory Scientists</td>
</tr>
<tr>
<td>NAAACLS</td>
<td>The National Accrediting Agency for Clinical Laboratory Science</td>
</tr>
<tr>
<td>NCIPE</td>
<td>The National Center for Interprofessional Practice and Education</td>
</tr>
<tr>
<td>NLN</td>
<td>National League for Nursing</td>
</tr>
<tr>
<td>SHP</td>
<td>School of Health Professions</td>
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<tr>
<td>SOM</td>
<td>School of Medicine</td>
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</table>
SON................................................................. School of Nursing
Sim-IPE........................................ Simulation-Enhanced Interprofessional Education
SBE............................................................... Simulation-Based Education
SBPT........................................................... Simulation-Based Procedural Training
UME.............................................................. Undergraduate Medical Education
WHO............................................................ World Healthcare Organization
CHAPTER 1
INTRODUCTION

According to the Mayo Clinic, it is estimated that 60 to 70 percent of all healthcare decisions regarding a patient's diagnosis and treatment are based on diagnostic laboratory test results (Mayo Clinic, 2015). Clinical laboratory test results aid healthcare practitioners in determining appropriate clinical interventions while providing patient care including the decision to initiate antibiotic treatment, request a blood transfusion, or to prepare a patient for surgery. The people behind these laboratory tests, known as medical (or clinical) laboratory scientists, are the vital healthcare detectives working behind the scenes to provide data that leads to informed clinical decision making by healthcare practitioners. For many certified medical laboratory scientists, the role of the profession contributes towards the outcomes of thousands of patients with limited to no direct patient interaction.

Although diagnostic laboratory results are intended to improve patient diagnosis and treatment, laboratory testing has been implicated in cases of medical error when lack of collaboration or miscommunication was noted among healthcare team members (Rodziewicz et al., 2021). In 2016, medical error was listed as the third leading cause of death in the United States resulting in 251,454 deaths per year, which is roughly equal to 700 lives lost per day (Makary & Daniel, 2016). In response to this alarming statistic,
the healthcare industry and pre-licensure academic programs have sought solutions to proactively decrease the number of medical errors. Due to the number of incidences associated with laboratory testing and patient safety, the Joint Commission National Patient Safety Goals® developed a specific list of goals for laboratory service programs to improve patient safety. In recent years, the list of patient safety goals for laboratory services has included improving the accuracy of patient identification to prevent wrong-patient errors and to improve the effectiveness of communication among caregivers to ensure timely provision of treatment for patients. (The Joint Commission, 2021).

Rodziewicz et al. (2021) asserted that deficiencies in education and training have led to medical errors and lack of patient safety awareness. Lack of preparation and limited patient safety education have been noted in the professional education of students in the schools of health professions including medicine, nursing, other health science disciplines (Wu & Busch, 2019). To prevent or mitigate medical error, Rodziewicz et al. (2021) noted collaboration among interprofessional healthcare teams promotes a safe environment for patients while contributing to the improvement of patient safety. To avoid laboratory services-related patient errors, such as failure to report critical or abnormal laboratory results, education should be used to promote safety practices including reduction of diagnostic errors (Plebani, 2015). Perspectives in laboratory medicine have shifted over the years to emphasize the promotion of a patient-centered approach to laboratory-related errors including those that occur beyond the walls of the laboratory such as diagnostic test result interpretation (Plebani, 2015).
The field of clinical laboratory medicine has recognized the importance of integrating patient safety concepts in its pre-certification curricula for undergraduate medical laboratory science program students (Walz et al., 2015). The traditional undergraduate curriculum for clinical laboratory science (CLS) programs tends to focus on the technical and procedural training component necessary for carrying out various testing responsibilities in the clinical laboratory setting (Scanlan, 2013). In a position paper written by the American Society for Clinical Laboratory Science (2015), it was recognized that the Clinical Laboratory Science profession needs to fully integrate patient safety concepts into pre-certification curricula and entry-level competencies for graduates. This framework, guided by the Institute of Medicine (IOM), aims for improving patient safety and the provision of quality healthcare (Walz et al., 2015). Other healthcare professions, such as medicine and nursing, have integrated competencies and professional activities into their respective program curricula focused on the improvement of patient safety and the delivery of quality care (American Association of Colleges of Nursing, 2008; Association of American Medical Colleges, 2017).

Currently, clinical laboratory science education programs are exploring innovative teaching strategies to address competencies within its pre-certification curriculum for implementing patient safety concepts. The National Accrediting Agency for Clinical Laboratory Science (NAACLS) recognized the importance of collaboration in the diagnosis and treatment of patients (NAACLS, 2020). As the accrediting agency for educational programs in clinical laboratory sciences, NAACLS standards for entry-level
competencies of medical laboratory scientists includes the ability to communicate and disseminate laboratory test results to members of the healthcare team (NAACLS, 2020). Beard et al. (2015) noted that collaboration among healthcare professionals (e.g., physicians, nurses, clinical laboratory scientists) is a multifaceted process that requires joint responsibility and knowledge sharing across healthcare professions in providing patient care. Generally, there are many examples of interprofessional practice involving nursing and medicine students as this tends to be a recognizable team dynamic in most teaching hospital or medical settings (Beard et al., 2015, p. 84).

Broadly, the clinical laboratory science profession has been an underutilized resource, or hidden profession, due to lack of exposure and visibility to other healthcare professions outside of the physical clinical laboratory environment (Rohde, 2014; Lippi et al., 2015). Most of the work of a clinical laboratory science professional is performed behind the doors of the clinical laboratory often situated away from the direct patient care areas such as hospital room floors (Kurec, 2016). These medical professionals are significant members of the healthcare team, yet these professionals are not formally integrated into the healthcare team (Kurec, 2016; St. John, 2020). Often referred to as the “hidden profession,” the presence of medical laboratory science in healthcare fills a crucial role in the diagnosis, detection, treatment, and monitoring of diseases in patients (Rohde, 2014). The laboratory results generated by medical laboratory personnel is reviewed and interpreted by healthcare clinicians to support a diagnosis or treatment plan in patient care. Therefore, the accuracy and reliability of diagnostic
laboratory test results are crucial for providing safe, patient care (Kurec, 2016; St. John, 2020).

**Problem of Practice**

Stemming from the 2001 Institute of Medicine (IOM) report titled “Crossing the Quality Chasm,” the six quality aims for healthcare introduced in the report stipulated that healthcare services should be safe, effective, patient-centered, timely, efficient, and equitable (IOM, 2001; Morris et al., 2013). Although there were efforts by several health science programs to address the six IOM aims in their respective program curricula, a 2010 survey of CLS program directors suggested that “existing medical [clinical] laboratory science program curricula have not yet fully incorporated the IOM aims” for improving patient safety and quality of care (Morris et al., 2013).

Undergraduate CLS programs, such as the one discussed by Beard et al. (2016), established the need to transform their health science education delivery method to involve team-based learning for CLS program students (p. 84). Similarly, the CLS program at our academic institution actively sought innovative teaching strategies, such as simulation and interprofessional education, for embedding patient safety concepts into the curriculum (Beard et al., 2016). To adequately prepare the future CLS practitioners in the undergraduate CLS program, we identified the need to integrate simulation-enhanced interprofessional education (Sim-IPE) to address the lack of patient safety and quality of care concepts in the existing program curricula.

In a review of bachelor’s degree medical laboratory scientist education, Scanlan (2013) described the following two main educational models used in the baccalaureate
program curriculum: “2+2” and the “3+1.” For example, the traditional “2+2” model focuses on completing general education courses within the first two years of baccalaureate study then the remaining two years are concentrated on CLS program specific courses (Scanlan, 2013). Alternatively, the “3+1” model is considered as a variation of the “2+2” traditional model in that all pre-requisite college courses must be completed prior to the start of the final program year dedicated to CLS specific courses (Scanlan, 2013, p. 7). The undergraduate CLS curriculum at our institution utilizes the traditional “2+2” educational model comprised of CLS discipline-specific courses. The existing CLS curriculum was not sufficient in addressing all six IOM aims to effectively educate learners about the provision of quality patient care in the today’s interdisciplinary healthcare environment.

Undergraduate CLS education employing the traditional curriculum model is structured to be “compartmentalized and departmentalized” with limited to no interaction across healthcare disciplines (Beard et al., 2015, p.83). Furthermore, domains such as patient safety, tend to be limited to certain aspects of patient identifiers (e.g., patient name, date of birth) and accuracy in laboratory testing analyses (Morris et al., 2013). Morris et al. (2013) asserted that interdisciplinary learning experiences with other healthcare disciplines will better prepare CLS program students for patient-centered care with increased understanding of patient safety. In today’s healthcare environment, the tendency to work in silos is considered outdated and no longer falls into alignment with patient safety initiatives (Taylor et al., 2017).
This research along with the American Society for Clinical Laboratory Sciences’ (ASCLS) recommendation for integrating patient safety concepts into pre-certification curricula has motivated CLS educators to brainstorm solutions for addressing this problem of practice in the curriculum. Ginsberg and Wlodkowski (2015) recommended that postsecondary educators need to be increasingly intentional and imaginative about their instructional practice. Through the recommendation of ASCLS and healthcare accrediting bodies like the Joint Commission, the undergraduate CLS program at the academic medical center sought out opportunities to increase patient safety awareness concepts among learners within its own curriculum. The traditional undergraduate CLS curriculum provided limited exposure to patient safety concepts whereas other academic programs on campus integrated innovative teaching practices, such as simulation-based education, to embed patient safety into their respective curriculum. To supplement the existing undergraduate CLS curriculum, simulation-based procedural training was used to address the problem of practice to better prepare pre-certification CLS students for their future roles as members of the interprofessional healthcare team.

**Theoretical Framework**

The theoretical framework for this research study was comprised of the overarching educational theory of constructivism in addition to the instructional models of situated learning and experiential learning. These models have served as the foundation for the development of healthcare program curricula within various academic institutions. Furthermore, the integration of these models will provide the framework necessary to support the chosen intervention for the problem of practice in
this research study. Mukhalalati and Taylor (2019) remarked about the pivotal role of integrating adult learning theories in healthcare professional education programs to promote evidence-based educational practice while improving student understanding in the context of quality patient care.

**Constructivist Theory**

Constructivism is a student-centered learning theory that promotes self-learning experiences guided by the course instructor. Among healthcare professional and health science educators, there has been a notable educational paradigm shift towards the application of constructivism to motivate learners to construct new knowledge through their interactions between their previous experiences and newly acquired knowledge (Klopper, 2002). Dennick (2016) asserted that “all medical and health science educators should be aware of the fundamental principles of constructivism and the extent of its influence on educational theory and clinical practice (p. 204).”

In constructivism, philosopher John Dewey promoted ideas about learning through meaningful and engaging experiences that involve individual, social, and environmentally realistic interactions (as cited in Beard, 2018). As individual learners, students have their own thoughts and beliefs; however, constructivism encourages the interaction of students through knowledge sharing. Both individual learning and peer interactions are extremely valuable components to the learning process itself.

The constructivist theory tends to focus more on concrete learning experiences. Dewey’s (2018) education philosophy of constructivism led to the development of experiential learning (Beard, 2018). The main objective of this learning theory was to
reinforce the students’ capacity to effectively contribute to society at large. Dewey’s writings about “concrete learning experiences” or experiential education is relevant in modern-day conceptions as it relates to adult pedagogy in healthcare-related academia (as cited in Beard, 2018).

**Situated Learning**

Lave and Wenger (1991) first described situated learning through a concept referred to as legitimate peripheral participation (p. 29). This concept provides a way to speak about relations between learners, both novice and experienced, in communities of knowledge and practice (Lave & Wenger, 1991, p. 29). Situated learning suggests that knowledge needs to be presented to learners in its authentic context (Wang et al., 2017). The authentic context refers to educational settings and situations that would normally involve the application of that content knowledge (e.g., simulation center).

Students are encouraged to learn through participation in a sociocultural practice, or interaction, with other participants (Lave & Wenger, 1991, p. 29). The constraints of the traditional classroom setting in enabling situated learning, technology-supported learning environments (e.g., simulation) have been increasingly researched to support learning with real-world problems and authentic tasks in blended environments (Wang et al., 2017). This learning concept bridged with simulation practice is an applicable approach in the healthcare simulation setting and the situations (or scenarios) used to promote these professional interactions between learners.
Experiential Learning

David Kolb’s (1984) experiential learning is based on the theories of John Dewey, Kurt Lewin, and Jean Piaget (p. 20). Experiential learning requires interaction with other learners while building knowledge (Ulrich et al., 2014). David Kolb’s experiential learning emphasizes that learning occurs through discovery and active participation in concrete experiences (Kolb, 1984, p. 21). Learners are encouraged to learn through participation in concrete learning experiences that invoke relevant real-life questions and inquiries (Drake, 2012). Kolb’s four-stages of learning cycle are based on Jean Piaget’s focus on learners gaining knowledge through active interaction with their environments (Kolb, 1984, p. 23). The four stages include the whole learning process of active experimentation, concrete experience, reflective observation, and abstract conceptualization or learning from the experience (Kolb, 1984, p. 21).

Experiential learning provides learners the ability to gain knowledge through hands-on experiences, such as simulation-based education activities (Aebersold, 2018). This educational approach to the problem of practice can prove to be immensely valuable for students to better grasp concepts with communication and shared decision making (Morris et al., 2013; Salazar, 2017). Simulation-based experiential learning is an effective way to promote interprofessional education teamwork across different healthcare disciplines (International Nursing Association for Clinical Simulation and Learning, 2017). Experiential learning is one of the commonly referenced educational theories used to guide the development and implementation of simulation-based interprofessional education activities. As noted by Morris et al. (2013), simulation
exercises of clinical interactions between healthcare team members representing more than one healthcare discipline (e.g., physicians and nurses) will enhance the skills of CLS program students in their preparation to work in interdisciplinary healthcare teams (p. 201).

**Model of the clinical learning process.** Isabel (2016) referred to experiential learning as “the basis for clinical education” in the “interactions among student, environment, and instructor (p. 68).” As a conceptual framework, experiential learning was the foundation for the clinical learning process in the training of health professions students. In a study of medical laboratory science students, Isabel (2016) it was noted that the participants were engaged through direct interactions with their clinical instructors such as asking questions or receiving guidance through each step of the laboratory testing process (Isabel, 2016). In a published article, Isabel (2016) presented a five-step model of the learning process derived from the student participant descriptions of their clinical experience. Based on the experiential learning theory, the first step of the model included the clinical instructor demonstrating the procedural step while the student observed the process. The second step transitioned to the student practicing the process while the clinical instructor observed. For the third step, the student performed the laboratory process unobserved, and the clinical instructor reviewed the students results. The third step was repeated as needed until the student became more confident in their ability to perform the process successfully. In the fourth step, the student worked independently with the ability to ask the clinical instructor
questions as needed. When the student reached the fifth step, they gained confidence in their task performance and was able to effectively solve problems on their own.

**Healthcare Simulation**

Renowned simulationist, Dr. David Gaba (2004), described simulation as a technique that allows users to participate in learning activities based on real-life experiences guided by faculty and are immersive in nature (Gaba, 2004). Healthcare simulation (HCS) is a science used to mimic real-life patient-care scenarios in environments very similar to the clinical setting (Palaganas et al., 2014). The use of HCS has become the preferred and recommended method of choice for interprofessional education activities for undergraduate health professions programs (Palaganas et al., 2014). Due to the interactive nature of simulation, there is an embedded promotion of learning through intrinsic factors such as motivation and peer interaction.

Educational activities comprised of student participants from two or more healthcare programs have been known to stimulate a collaborative environment where students are learning from, with, and about each other (National Center for Interprofessional Practice and Education, 2018). Simulation-enhanced interprofessional education (Sim-IPE) provides a collaborative approach for development of interprofessional practice competencies and mastery of interprofessional communication through knowledge sharing among student participants (International Nursing Association for Clinical Simulation and Learning, 2021). Healthcare simulation has been commonly used in the pre-licensure curriculum for medicine and nursing students as it encourages teamwork, collaboration, and effective communication in
healthcare teams (ASCLS, 2015). By utilizing a collaborative approach in patient care, this interprofessional practice where more than one healthcare discipline is presented has been proven to increase patient safety (Beard et al., 2015).

Simulation-enhanced interprofessional education (Sim-IPE). In 2016, the International Nursing Association for Clinical Simulation and Learning (INACSL) developed evidence-based guidelines including the Standards of Best Practice: SimulationSM. The standard was updated to the Healthcare Simulation Standards of Best Practice™ Simulation-Enhanced Interprofessional Education (2021) and serves as a reputable resource for this research study. The Sim-IPE was designed for interdisciplinary participants to engage in learning from, about, and with each other to foster effective collaboration and improve patient healthcare outcomes (INACSL, 2021, p. 49; World Healthcare Organization, 2010, p. 31). The necessary criterion for meeting the standards for best practice in simulation education are as follows (INACSL, 2021):

1. Conduct Sim-IPE based on a theoretical or a conceptual framework.
2. Utilize best practices in the design and development of Sim-IPE.
3. Recognize and address potential barriers to Sim-IPE.
4. Devise an appropriate evaluation plan for Sim-IPE.

Integrated Theoretical Approach and Simulation

To address competencies within the pre-certification curriculum, there is an immediate need to create an integrated curriculum that incorporates evidence-based approaches for improving patient safety (ASCLS, 2015). More specifically, undergraduate CLS educators must identify a method for CLS students to practice patient safety
concepts through the contribution of clinical laboratory expertise to the interprofessional healthcare team. Healthcare simulation offers an environment for the cultivation of interprofessional collaboration and practice in the management of patient cases while increasing competency regarding patient safety concepts.

The integrated learning theories (situated learning theory, constructivist theory, and experiential learning) selected as the framework for this action research study will aide with the design of the intervention used to capture student learning outcomes in a real-life clinical situation. Based on this theoretical framework, the integration of Sim-IPE into undergraduate CLS program curriculum will provide a realistic portrayal of the healthcare team. The practice of interprofessional collaboration within a simulated clinical environment can potentially lead to successful learning outcomes for learners. Furthermore, it will be beneficial to the learners as well as to those individuals working with them to facilitate interactions that will yield better prepared undergraduate CLS program students for potential interactions in the real-life healthcare setting.

**Purpose of the Study and Research Questions**

The purpose of this study was to observe the impact of the integration of a simulation-enhanced interprofessional education (Sim-IPE) activity on undergraduate CLS students for increased patient safety awareness and enhanced understanding of quality of care concepts. The research study itself was centered around the use of a Sim-IPE activity as the proposed educational intervention that involved two healthcare professions, CLS and nursing, with participation of the undergraduate CLS program students as well as nursing faculty. The following research questions were addressed:
1. What is the impact of simulation-enhanced IPE on an undergraduate CLS student participants’ understanding of patient safety and quality of care following participation in a simulation scenario?

2. By participating in a simulation-enhanced IPE activity, how does this immersive experience help undergraduate CLS students see themselves as contributors towards patient safety?

3. How do undergraduate CLS student participants view their role as members of the healthcare team?

The first research question was focused on the impact of Sim-IPE on the undergraduate CLS students’ understanding of patient safety and quality of care. Through this study, I was hoping to capture their broad understanding about the importance of patient safety and quality of care in a healthcare setting. The second research question was intended to build onto the first question by exploring how the Sim-IPE activity helped undergraduate CLS students see themselves as contributors to patient safety. Upon determining their foundational understanding about patient safety and quality of care, I wanted to observe how they applied their understanding of those concepts within their professional role as medical laboratory scientists through their participation in the Sim-IPE activity. The third research question was explored to address how undergraduate CLS students viewed their profession-specific role as members of the healthcare team. In other words, I wanted to gather insights from undergraduate CLS students about their own perceptions of professional identity and visibility as contributing members on the interprofessional healthcare team.
According to Morris et al. (2013), the integration of undergraduate CLS program students into Sim-IPE along with other healthcare professions will increase their exposure to patient safety concepts. Through this learning experience, there were opportunities to gauge student and faculty feedback, capture emerging themes or perceptions among undergraduate CLS students, and track their level of awareness for patient safety as well as quality of care concepts through the data collection instruments including the post-simulation event assessment, daily journal entries, audiovisual recordings of the Sim-IPE activities, and interviews.

**Positionality**

Herr and Anderson (2015) noted the evolution of action research conducted by organizational insiders versus outsiders (Herr & Anderson, 2015, p. 29). According to this statement, I am one of the organizational insiders utilizing action research in pursuit of deepening my knowledge and understanding of teaching practice within the undergraduate CLS curriculum. I am inspired to use my current academic institution as an ideal setting for this research study in that I have the opportunity to bring about organizational change (Herr & Anderson, 2015). As a researcher, I am aware that I need to be mindful of how my individual frame, thought process, bias, and beliefs can potentially impact the study itself. In some regard, I need to be objective in my viewpoint; however, I must remain open to the discovery of unexpected findings.

In reflection of my own experience as a medical laboratory science student, I was not adequately prepared to interact with other health professions on the healthcare team within the programs’ traditional “2+2” curriculum model. Therefore, I carried this
belief into my career as a Medical Laboratory Scientist. I was accustomed to other healthcare professionals not understanding my role or the contributions of my profession towards their clinical decision-making processes. Nearly twenty years later, I am working as a CLS program educator with an increased awareness for the importance of preparing future laboratory professionals for potential interactions in the clinical setting. In my current position within a large academic medical center, our program was challenged with exploring innovative approaches to improve the existing curriculum through exposing undergraduate CLS students to other members of the healthcare team.

As a university professor, I had an invested interest to develop an integrated curriculum that will meet the needs of our future pipeline of clinical laboratory professionals. As a medical laboratory scientist, I possessed the educational background and clinical experience to be able to relate to the problem of practice as well as to the study participants. My interest in this topic stemmed from a need to seek a solution to the promotion and advocacy of the medical laboratory profession to other members of the healthcare team. Furthermore, there have been problems identified in practice where students in some programs have not received enough hands-on technical experience to meet the requirements for entry-level clinical work. By profession, I was an insider who worked in collaboration with outsiders to transform our practice (Herr & Anderson, 2015). There will be additional discussion on the trustworthiness of the data and the noted observations as it is paramount to the validity of this study.
Overview of Methodology

This mixed methods study was designed to study the integration of undergraduate CLS students into simulation-enhanced interprofessional education events and its impact on development of patient safety awareness including profession-specific contributions to quality of care. The research study will be structured to represent clinical content leveled to the academic curriculum of undergraduate CLS students in their fourth year of the program. Using the mixed methods approach, the research was focused on the interactions and actions of undergraduate CLS students with a nurse colleague on the healthcare team (Efron & Ravid, 2013, p. 40). Specifically, practitioner action research gained popularity in the fields of education and healthcare professions (e.g., nursing) as it allowed insiders of an organization to function as the researchers (Herr & Anderson, 2015).

Action research is a reflective process that often is triggered in response to a particular problematic situation where some action or cycle of actions are taken to address an issue in practice (Herr & Anderson, 2015). In health science education, the problem of practice tends to naturally evolve from ones’ own teaching practice in the clinical learning environment. Interprofessional education has been deemed an essential component in the development of a collaborative practice-ready healthcare workforce, one in which healthcare practitioners work together to provide comprehensive services and improve patient safety outcomes (Reinhold et al., 2017). Action research was a fitting approach for this study given this method addresses real issues within the
educational environment and provides opportunity for immediate implementation of an intervention developed to meet learner educational needs (Herr & Anderson, 2015).

Due to the interprofessional nature of this research study, it necessitated the use of Sim-IPE as the methodology in providing a collaborative approach for the development and mastery of interprofessional practice competencies (International Nursing Association for Clinical Simulation and Learning, 2016). Additionally, simulation-based educational experiences have been recognized as an effective way to promote teamwork among interprofessional healthcare teams and patient safety concepts (International Nursing Association for Clinical Simulation and Learning, 2016). According to the Simulation Innovation Resource Center (SIRC), simulation was noted as an excellent approach to provide opportunities for interprofessional learners to develop, practice, and refine interprofessional skills such as communication, collaboration, and teamwork within the context of a patient care scenario (National League for Nursing, 2021). The Sim-IPE activity, a simulation-based procedural training, was designed to focus on patient specimen testing in the blood bank section of the clinical laboratory. This proposed educational intervention required interprofessional collaboration between the healthcare professions represented, pre-certification medical laboratory scientists and a licensed registered nurse. The simulation activity was planned and coordinated in partnership with the simulation educational delivery team.

Summary of Findings

In summary of the research findings, the integration of the proposed intervention, simulation-enhanced interprofessional education, proved to be beneficial
for undergraduate CLS students in their transition from the student laboratory into their clinical practicum experience. The use of simulation-based procedural training as the modality provided undergraduate CLS students an opportunity to practice technical skills and engage in interactions with another health profession. The undergraduate CLS students increased their awareness in patient safety and quality of care concepts as well as gained an enhanced understanding of their role on the interprofessional healthcare team. The transfer of learning into their future clinical practice included their enhanced understanding of their crucial role in the provision of safe, patient care and the importance of effective communication while working as a team. Overall, the undergraduate CLS students expressed appreciation for the opportunity to practice in a safe learning environment prior to their transition into a real-world clinical environment. Based on their perceptions, they felt better prepared for their future role as medical laboratory scientists and collaborative team members in the delivery of patient care.

**Significance of the Study**

An article published in the Journal of the American Medical Association (JAMA) stated that technology-enhanced simulation training in health professions education is consistently associated with large effects for outcomes of knowledge, skills, and behaviors and moderate effects for patient-related outcomes (Cook et al., 2011). The outcomes for learners in a technology-enhanced simulation environment leads to increased knowledge, improved clinical skills and heightened confidence in their hands-on abilities. The added benefits of incorporating standardized IPE simulations into healthcare pre-certification curricula, such as an undergraduate CLS program, includes
improved self-confidence and performance for learners regarding interprofessional communication (Shrader et al., 2015).

Barer et al. (2019) urged clinical laboratory personnel to develop strong networks and engage with other professions beyond the laboratory (Barer et al., 2019). Regarding patient safety outcomes, it is important to share best practices, collaborate with other healthcare disciplines, and create those opportunities to learn from each other (Barer et al., 2019). Furthermore, this collaboration proves to be an essential component for decreasing medical errors (Beard et al., 2015). As a result, there is improvement to patient safety and emphasis on providing quality patient care. Although this study is intended to generate knowledge for patient safety concepts, the outcomes of this research study cannot be generalized for all potential stakeholders. Clinical laboratory science professionals, CLS faculty, and simulation education educators can benefit from reading this study as it relates to their field of expertise.

**Definition of Terms**

The following terms include definitions and may be found throughout the study to provide additional content-related information:

**Clinical (or Medical) Laboratory Scientists (CLS/MLS):** Often called medical laboratorians, are vital healthcare detectives, uncovering and providing diagnostic laboratory data from clinical laboratory analyses that assist clinicians in patient diagnosis and treatment, as well as in disease monitoring or prevention (ASCLS, 2019).
**Experiential Learning:** Encourages the use of concrete experience to gain knowledge and reinforce learning (Beard, 2018).

**Formative assessment:** An observation of learner’s actions; observations that help the educator determine the degree to which the learner’s educational needs are being met by the learning activity (Jiao & Lissitz, 2018).

**Healthcare Simulation (HCS):** the imitation or representation of one act or system by another (Foisy-Doll & Leighton, 2018).

**Identity:** the collective aspect of the set of characteristics by which a thing or person is definitively recognized or known or the set of behavioral or personal characteristics by which an individual is recognizable as a member of a group. (Websters II New College Dictionary).

**Interprofessional Education (IPE):** occurs when students from two or more professions learn from, about and with each other in a collaborative effort to improve health outcomes for patients (The National Center for Interprofessional Practice and Education, 2018).

**Procedural Simulation (also referred to as simulation-based procedural training or process-oriented simulation):** the use of a simulation modality (for example, task trainer, manikin, computer) to assist in the process of learning to complete a technical skill(s), or a procedure, which is a series of steps taken to accomplish an end (INACSL, 2016).
Silo Mentality: a tendency to prefer to work within one’s own section (or discipline) isolated from other without sharing knowledge nor fostering a collaborative network (Barer et al., 2019).

Simulation-Enhanced Interprofessional Education (Sim-IPE): Sim-IPE enables learners from different healthcare professions to engage in a simulation-based experience to achieve linked or shared objectives and outcomes (INACSL Standards of Best Practice™: Simulation-Enhanced Interprofessional Education, 2021).

Summative assessment: A measurement of knowledge, skills, or abilities (usually in a high-stakes evaluation); Use of data to determine learner’s competency level (Jiao & Lissitz, 2018).

Organization of the Dissertation

The dissertation is organized as follows: Chapter 1 introduces the study and the problem of practice. This chapter includes background of the clinical laboratory science profession and healthcare simulation. The background of work is followed by the theoretical and conceptual framework that underlies the study. Subsequently, the purpose of the study, research questions, rationale, and positionality of the researcher is presented. In addition to research design, data collection and analysis is laid out in Chapter 1. The chapter concludes with the significance of the study including examples of limitations and barriers of the study.

Chapter 2 covers the contents of the literature review including the theoretical framework. Chapter 3 provides the mixed methods methodology used for research design and the data analyses. Chapter 4 includes the research findings and Chapter 5
concludes the research study with a summary of the findings and an action plan for future implications of study outcomes.
CHAPTER 2

REVIEW OF THE LITERATURE

In recent studies, it was reported that the lack of collaboration among healthcare teams attributed to decreased patient safety concepts contributed to the lack of collaboration among healthcare teams (Busari et al., 2017). Specifically, the problem of practice in this research study centered around the issue of patient safety as it has been considered “the most paramount topic in healthcare training” (Levine et al., 2013). In the Comprehensive Textbook of Healthcare Simulation, Levine et al. (2013) discussed the plight of healthcare training where learning takes place primarily within the clinical environment, not within the program curricula. This method of training has led to inexperienced, or underprepared, healthcare professionals causing medical errors resulting in potential harm to patients (Levine et al., 2013).

In response to this important finding, Taylor et al. (2017) cited that many academic institutions including professional healthcare organizations have sought solutions to emerging issues in the healthcare industry. These identified issues included, but not limited to, the following: increased rate of medical errors, decreased clinical competency among healthcare practitioners, and loss of healthcare personnel due to retirement-related attrition (Taylor et al., 2017). One of the notable themes in the review of literature emphasized the importance of fostering collaborative practice with
other healthcare professions while challenging the traditional curriculum structure (Foisy-Doll et al., 2018). Taylor et al. (2017) stated that working in siloes, or within one’s own healthcare discipline, is outdated and does not suit meeting current patient safety initiatives in the healthcare environment.

Foisy-Doll and Leighton (2018) asserted that educators are responsible for incorporating patient safety concepts into the educational experiences of healthcare professions students. The core concepts of patient safety outcomes that should be included in healthcare professions program curricula are as follows:

1. historical trajectory of patient safety;
2. the language of patient safety and person- and family-centered care;
3. the culture of blame and shame;
4. transparency and accountability in delivering safe effective care;
5. disclosure and reconciliation in adverse events;
6. flattening of power structures to create well-functioning teams;
7. leadership and followership;
8. communication;
9. systems thinking and healthcare as industry;
10. healthcare delivery systems engineering;
11. high-reliability organizations and lessons learned from aviation, engineering, and nuclear;
12. human factors and technology;
13. risk management and total quality improvement, and
14. knowledge of tools and resources for healthcare providers (Foisy-Doll & Leighton, 2018; Patient Safety Education Program, 2016; World Health Organization, 2011).

**Purpose of the Study and Research Questions**

To begin addressing the problem of practice, it was important to consider potential opportunities for interactions to take place between undergraduate CLS
program students and another healthcare profession. A possible solution was the development of a simulation-enhanced interprofessional education (Sim-IPE) activity involving participants from one or more healthcare professions in addition to undergraduate CLS program learners. The following research questions were addressed:

1. What is the impact of simulation-enhanced IPE on an undergraduate CLS student participants’ understanding of patient safety and quality of care following participation in a simulation scenario?

2. By participating in a simulation-enhanced IPE activity, how does this immersive experience help undergraduate CLS students see themselves as contributors towards patient safety?

3. How do undergraduate CLS student participants view their role as members of the healthcare team?

The review of literature on the integration of simulation-enhanced interprofessional education (Sim-IPE) into undergraduate CLS program curriculum was categorized into the following major themes: theoretical framework in healthcare simulation and interprofessional education (IPE), goals for simulation-enhanced interprofessional education in pre-certification healthcare programs, and the instructional design of the undergraduate CLS curriculum. Furthermore, the literature review explored opportunities for learners in Sim-IPE and potential challenges for educators during the integration of Sim-IPE into the undergraduate CLS curriculum.
Machi and McEvoy (2016) described the purpose of a literature review as a “position on the state of that knowledge” that leads into further exploration of the literature related to the topic. The purpose of the research inquiry was to explore the current knowledge available on the topic of simulation-enhanced interprofessional education (Sim-IPE) used in healthcare education for the promotion of patient safety concepts among participants and the empowerment of learners to collaborate as an interprofessional healthcare team. One of the main considerations in conducting a literature review was finding information that addresses the key ideas of simulation, interprofessional education, and the mixed pedagogical approach of Sim-IPE in undergraduate CLS education (Machi & McEvoy, 2016). The literature review included the work of subject matter experts in curriculum theory, healthcare simulation, and professional training of pre-certification undergraduate CLS students.

A literature search for existing research studies related to the use of simulation-enhanced interprofessional education in pre-certification healthcare programs primarily relied on health science databases including AccessMedicine, PubMed, ProQuest, ScienceDirect and Wiley Online Library. The search for content related publications included terms such as “medical laboratory science,” “clinical laboratory science,” “simulation-enhanced interprofessional education,” “procedural simulation,” “medical laboratory science and simulation,” “clinical laboratory science and simulation,” “medical laboratory science IPE,” and “clinical laboratory science IPE.” Other search databases, such as EBSCO and Google Scholar, were used to gain access to academic
publications discussing socio-scientific ideology and interprofessional education in health science programs. Peer-reviewed journals and textbooks on healthcare simulation, interprofessional education, and curriculum design were used in the literature review. Additional research studies and articles were discovered as other sources for further exploration in the reference lists of cited publications.

**Theoretical Framework for Health Science Education**

Categorically, the study of clinical laboratory science fits into the area of health science education. Therefore, the theoretical framework for this research study incorporated the integrated learning theory approaches of the situated learning theory and Dewey’s Constructivist theory with an emphasis on experiential learning. These educational theories have served as the foundation for the development and design of health science curricula within various healthcare disciplines. These educational theories provided the framework necessary to support the proposed implementation of Sim-IPE into the undergraduate CLS curriculum.

**Situated Learning**

In 1991, Jean Lave and Etienne Wenger originally described situated learning as “a process that occurs through legitimate peripheral participation (LPP) in communities of practice (Lave & Wenger, 1991; O’Brien & Battista, 2020). Wang et al. (2017) referred to the situated learning theory (SLT) as knowledge that needs to be presented to learners in its most authentic context. Wang et al. (2017) referred to the authentic context as educational settings and environments that would normally involve the realistic application of that content knowledge (e.g., simulation center, clinical

Learners are encouraged to obtain knowledge through engagement and interaction with their peers outside of the traditional classroom setting. There are notable parallels between the foundation of SLT and Kurt Lewin’s belief that knowledge should be fostered through problem solving in real-life situations (Herr, 2015). Lewin’s research on group dynamics and team learning included the following three developed themes: reflective conversation plays a significant role, the emergence of functional role leadership in the team, and the experiential learning process is key to team learning and development (Kolb & Kolb, 2009).

**The Development of Experiential Learning Theory (ELT)**

The foundational work of Kurt Lewin has been notably recognized for contributing to the experiential learning theory (ELT) developed by John Dewey (Kolb & Kolb, 2009). American philosopher and educational reformer, John Dewey, promoted his belief about learning through meaningful experiences that involve individual, environmental, social, and realistic interactions (Beard, 2018). Both individual learning and peer interactions are considered to be extremely valuable components to the learning process itself. Through this process of learning, Dewey believed that this form of learner-centered pedagogy would better prepare learners to be active members of their own communities (Aubrey & Riley, 2017). Dewey’s (2018) writings about “concrete
learning experiences” or experiential education is relevant in modern-day conceptions as it relates to adult pedagogy in healthcare-related academia (Beard, 2018).

Ulrich et al. (2014) asserted that the process of experiential learning requires interaction with other learners while building one’s own content knowledge. Experiential learning theory provides learners the ability to gain knowledge through knowledge transfer, practice communication skills while handling challenging clinical situations, and further development of professional behaviors in the clinical setting (Miles, 2018). Schiro (2013) inferred that curriculum designed for attainment of experiential knowledge involves the appropriate sequences of experiences for learners to interact with and from which they can construct knowledge. Notably, experiential learning through simulation-based education allows for learners to improve their psychomotor, cognitive, and affective skills which are necessary for preparation of an entry-level medical laboratory science professional (ASCLS, 2021; Miles, 2018).

Shifting the paradigm in healthcare training from experiential learning within one healthcare discipline to incorporating more than one healthcare discipline requires a common educational strategy. Experiential learning through simulation has been attributed to enhancing technical skills and clinical competency while increasing patient safety awareness among learners (Levine et al., 2013). According to Levine et al. (2013), experiential learning in simulation requires both practice and feedback as it allows for learners to apply previously acquired content knowledge and technical skills to new situations. Experiential learning is one of the commonly referenced educational theories used to guide the development and implementation of simulation-enhanced
interprofessional education activities. Based on the tenants of experiential learning, simulation is a useful educational strategy to reinforce key clinical concepts through participation in an immersive learning experience. Learners are enabled to better grasp conceptual concepts through the practice of procedural tasks to increase clinical competency and strengthen soft skills through social interaction with other members of the healthcare team.

**Healthcare Simulation and Interprofessional Education**

Dr. David Gaba (2004) stated that healthcare simulation is a technique, not a tool, which allows learners to participate in educational activities based on real-life experiences guided by educators and are immersive in nature (Gaba, 2004). Healthcare simulation (HCS) is a technique used to mimic real-life patient-care scenarios in environments very similar to the clinical setting such as a simulation laboratory or a simulation center (Palaganas et al., 2014). HCS has become the preferred and recommended educational delivery method of choice for interprofessional education activities built into the curriculum of undergraduate health professions programs (Palaganas et al., 2014). The immersive and interactive nature of simulation promotes learning among participants learning through intrinsic factors such as self-motivation and peer interaction.

**Interprofessional education.** Interprofessional education (IPE) activities are comprised of learners from two or more healthcare programs in a mutual learning activity based on a common subject. Simulation-enhanced interprofessional education (Sim-IPE) provides a collaborative approach and structure for increasing
interprofessional practice competencies (e.g., roles and responsibilities) and mastery of interprofessional communication through knowledge sharing among learners (INACSL, 2021). Although simulation has roots in aviation and military industries, simulation is commonly used in the pre-licensure curriculum for medicine and nursing students.

HCS and interprofessional education are known to encourage teamwork, promote collaboration, and increase effective communication skills on healthcare teams (ASCLS, 2015). Beard et al. (2015) observed this collaborative approach to patient care and form of interprofessional practice (where more than one healthcare discipline is represented) has been proven to result an increase in positive patient outcomes. According to the study conducted by Beard et al. (2015) there was demonstratable value of interdisciplinary collaboration between nursing and medical laboratory science (MLS) students. The curriculum needs in healthcare education requires the creation of learning opportunities that encourage learners to work collaboratively to improve patient outcomes (Slusser et al., 2019).

**Simulation-enhanced interprofessional education.** Simulation-based education (SBE) has been described as a method that allows for learners to “develop, refine, and apply knowledge and skills in a risk-free, but immersive and realistic environment” (Levine et al., 2013). The International Nursing Association for Clinical Simulation and Learning (2021) refer to simulation-based experiential learning as an effective way to promote interprofessional education teamwork across different healthcare disciplines. Simulation-enhanced interprofessional education (Sim-IPE) was designed for participants from two or more different healthcare professions to engage in learning
about, from, and with each other to enable effective teamwork collaboration and improve patient healthcare outcomes (World Healthcare Organization, 2010). Foisy-Doll and Leighton (2018) referenced the International Nursing Association for Clinical Simulation and Learning (INACSL) simulation-enhanced interprofessional education (Sim-IPE) standard while discussing patient safety in simulation in healthcare education:

Simulation-enhanced interprofessional education (Sim-IPE) enables learners from different healthcare professions to engage in a simulation-based experience to achieve shared or linked objectives and outcomes (INACSL, 2021, p. 49).

This interprofessional approach to simulation-enhanced education provided a guiding framework in bringing various healthcare professions together to practice teamwork skills including communication and working together, collaboratively, thus broadening their understanding of how their professional role contributes to the overall care of patients.

**Procedural simulation.** The International Nursing Association for Clinical Simulation and Learning (INACSL) described procedural simulation as “the use of a simulation modality (e.g., task trainer, manikin, computer) to assist in the process of learning to complete a technical skill(s), or a procedure, which is a series of steps taken to accomplish an end” (INACSL, 2016, pp. S43-S44). Also referred to as process-oriented simulation or simulation-based procedure training, Gent and Kainth (2022) noted that simulation-based procedure training (SBPT) “is now integrated within health professions education with literature demonstrating increased performance and translational
patient-level outcomes” as well as measurable improvements related to patient safety awareness (p. 1). In the integration of SBPT into health professions curriculum, the role of feedback and the debriefing process were mentioned as “crucial steps for skill acquisition” among student participants (Gent & Kainth, 2022, p.7). To address the practice gap for health professions curriculum, the use of theory informed SBPT should be considered for the integration of a clinical learning process centered around the completion of technical skills or a procedure such as diagnostic laboratory testing (Gent and Kainth, 2022).

**Clinical Laboratory Science and Healthcare Simulation**

Webb et al. (2021) conducted a scoping literature review regarding the use of healthcare simulation in the medical laboratory science profession. The review promotes the need for more research studies in the field medical laboratory science education and the incorporation of evidence-based practices, such as simulation, to address interprofessional healthcare team competencies (Webb et al., 2021). To address competencies within the pre-certification undergraduate CLS curriculum, the current structure needs to be reformed with an innovative strategy that integrates evidence-based approaches for improving patient safety outcomes. In response to the emerging need for patient safety awareness among undergraduate CLS learners, program educators must identify a suitable method for undergraduate CLS students to practice patient safety concepts through the contribution of clinical laboratory expertise to the interprofessional healthcare team. Simulation-enhanced interprofessional education offers a realistic clinical environment for the cultivation of interprofessional
collaboration and team approaches in the management of patient cases while increasing clinical competency regarding patient safety concepts and teamwork.

To provide evidence-based guidelines for the development of simulation-enhanced interprofessional education activities, INACSL developed the Healthcare Simulation Standards of Best Practice™ to share best practices in simulation and to provide evidence-based guidelines in the design, implementation, and evaluation of simulation activities (INACSL, 2021; Webb, 2021). The Standards of Best Practice (SoBP) include guidelines for the following processes: professional development; prebriefing; simulation design; facilitation; the debriefing process; operations; outcomes and objectives; professional integrity; simulation-enhanced IPE (Sim-IPE); and evaluation of learning and performance (INACSL, 2021). The INACSL simulation-enhanced interprofessional education (Sim-IPE) standard serves as a bridge between simulation pedagogy and interprofessional education (INACSL, 2021). The prescribed criterion for meeting the concepts of the INACSL Sim-IPE standard is provided below:

Based on a theoretical or a conceptual framework; utilize best practices in the design and development of Sim-IPE; recognize and address potential barriers to conducting Sim-IPE; and devise an appropriate evaluation plan for Sim-IPE.

(INACSL, 2021, p.50)

The conceptual framework for Sim-IPE involves the integration of experiential learning and situated learning theories. These integrated theories chosen for this research study will foundationally support the learning processes and impact on student awareness of
patient safety concepts and the impact of their profession-specific roles in simulation-enhanced interprofessional education activities.

**Self-efficacy and Self-confidence in Simulation-Based Education**

In the context review of simulation-based education, I thought it was pertinent to examine how self-confidence and self-efficacy factor into the performance of undergraduate CLS students. Foundationally, Bandura’s (1977) self-efficacy theory was useful in understanding the relationship between learning and performance. Self-efficacy was described as “the belief one has in being able to execute a specific task successfully in order to obtain a certain outcome” (Druckman & Bjork, 1994, p. 174; Bandura, 1977). Within the context of social learning theory, self-efficacy has been “conceptualized as arising from diverse sources of information conveyed by direct and mediated experience” (Bandura, 1977, p. 203). Through direct experience, such as simulation-based education, self-efficacy can be attained based on personal expectations in connection with perceived mastery of skills (Bandura, 1977).

Moreover, self-confidence was defined as the perceived ability or “the belief that one can successfully execute a specific activity” (Druckman & Bjork, 1994, p. 174). To develop a sense of the health profession, Swift et al. (2022) described self-confidence as “a key influence in the process of learning because students learn when they feel confident” (Swift et al., 2022, p. 1; Bjork et al., 2014). Furthermore, the learning environment and chosen modality of the learning activity should be considered as factors that influence the development of clinical skills (Swift et al., 2022). In a 2008 study, most of the health professions students who participated in a simulation-based
activity reported increased confidence in their clinical skills (Laschinger et al., 2008). Additionally, the authors of this study observed a connection between increased confidence and student perceptions of achieved clinical competence (Laschinger et al., 2008). The results of their study indicated the effectiveness of using a simulated learning experience in high learner satisfaction, enhanced understanding of clinical content, and increased confidence through skill acquisition (Laschinger et al., 2008).

**Historical Perspectives**

Discussing the evolution of clinical laboratory science curriculum necessitates an understanding of the history of the profession itself. During World War I, there was a severe shortage of trained laboratory personnel to work in the clinical laboratories (Delwiche, 2003). Prior to World War I, the clinical laboratory profession was mainly comprised of pathologists (physicians who specialize in laboratory medicine) and their trained assistants (Delwiche, 2003). Specifically, these laboratory assistants were trained to perform basic laboratory procedures which supported the work of the pathologists.

The limited number of qualified laboratory professionals prompted the development of laboratory training programs. In doing so, the training programs met the growing need to support the pipeline of laboratory assistants. Additionally, the American Society for Clinical Pathology (ASCP) used this opportunity to provide standardization in laboratory personnel education and created the board of registry in 1928 to certify laboratory personnel (Delwiche, 2003). As an organization, ASCP played a vital role in establishing standards and guidelines for clinical laboratory science education (Burke, 2000).
Regarding the traditional structure for clinical laboratory science education, there are a limited number of articles related to the topic of curriculum design and theory. Dissimilar to commonly chartered paths to become an educator, faculty in health science programs usually transition to higher education through alternative routes (Halupa, 2015). Although health science program faculty may be considered subject matter experts in their respective fields (e.g., Medical Laboratory Scientist), the educator may not possess the formal education experience in educational theories and curriculum ideologies (Halupa, 2015). In the literature review process, the research studies located were authored by CLS educators discussing the content theory delivered to learners, but no specific details related to the ideologies that influenced the curriculum design for CLS education.

As we transition from historical perspectives in undergraduate CLS curriculum, resources such as the scoping review of medical laboratory science and simulation highlight the need for the clinical laboratory curriculum to evolve to meet the needs of today’s learners (Webb et al., 2021). Webb et al. (2021) stated that “there is a need to enhance the clinical learning curriculum beyond laboratory skill and diagnostic interpretation competency (p. 1).” It was proposed to address this need through the integration of simulation-enhanced interprofessional simulation. Although the use of healthcare simulation has grown as an evidence-based methodology in education for other healthcare professions such as medicine and nursing, only 2 out of thirty-two articles in the scoping review were identified fully describing the use of theoretical framework (or evidence-based methodology), implementation of best practices, and an
evaluation plan for improving the simulation activity toward an interprofessional education initiative (Webb et al., 2021, p. 3).

Currently, the integration of healthcare simulation, including effective methodologies, is well-documented for medicine and nursing professions (Cook et al., 2011; Cheng et al., 2007). However, the peer-reviewed literature for undergraduate CLS education or the medical laboratory science profession and the use of Sim-IPE is limited (Webb et al., 2021). As noted by Olson et al. (2020), there is a gap in the literature regarding teaching and preparation of undergraduate clinical laboratory science students for future practice on interprofessional teams. Therefore, an interprofessional education initiative is needed as an increasingly important aspect of healthcare involves collaboration of interprofessional teams to provide adequate patient care in complex clinical situations (Olson et al., 2020).

**Psychological Fidelity versus Sociological Fidelity in Sim-IPE**

One of the most important elements of effective simulation-enhanced interprofessional education is the concept of psychological fidelity. Sharma et al. (2011) defines psychological fidelity in simulation as “the degree to which the learner perceives simulation to be believable.” The more realistic portrayal of a patient case in a simulation scenario is noted to prompt learners to recall key aspects of medical conditions based on relevant information and contextual knowledge introduced in the patient case. Simulation literature tends to focus more so on the realistic aspects of simulation regarding psychological fidelity; however, important sociological factors such as professional identity, hierarchy, and conflict among interprofessional learners are
often overlooked (Sharma et al., 2011). These sociological factors have the potential to impede the development of interprofessional skills such as communication, teamwork, knowledge sharing, and collaboration (INACSL, 2021).

Khalili et al. (2013) elaborated on sociological factors such as professional identity and its impact on interprofessional education. Given the curriculum of health science or medical education programs, learners tend to learn within their own uniprofessional identity which can lead to individuals viewing their own profession as different or better than other professions (Khalili et al., 2013, p. 448). These perceptions can interfere with effective teamwork and collaboration among interprofessional learning activities. Additionally, some healthcare professions students with strong uniprofessional identities may view interprofessional practices as a threat to their own profession-specific boundaries (Khalili et al., 2013). The focus on one’s own professional practice can potentially lead to conflict and miscommunication within the interprofessional team. Interprofessional skills such as effective communication and teamwork have been referred to in simulation literature as non-technical skills that are secondary, yet necessary, to the culture of patient safety in healthcare settings (INACSL, 2021; Sharma et al., 2011).

Thomas and Reeves’ (2015) recommendation for educators emphasizes the maintenance of sociological fidelity in interprofessional education by guiding learners to focus on the patient as the center of their interprofessional learning experience. Watts et al. (2020) cited healthcare simulation as an “effective strategy for implementation of interprofessional activities.” Furthermore, Watts et al. (2020) identifies the seemingly
authentic learning experiences of simulation-enhanced interprofessional education as a key component of clinical training for future healthcare professionals. For the successful implementation of simulation-enhanced interprofessional education, it is important for educators to consider the “key aspects [of integration] to ensure a quality and consistent experience for all [healthcare program] learners.” (Watts et al., 2020).

**The Role of CLS in Sociological Fidelity**

Bayot and Naidoo (2019) stated that the most significant value for each laboratory professional to recognize is the importance of their role in patient welfare. Beyond the laboratory testing performed in clinical settings, laboratory professionals contribute to the screening and surveillance of diseases impacting public and global health. Therefore, it is imperative to aid learners in conceptualizing and comprehending the magnitude of their contributions towards improving the quality of lives for others. Senge (2012) discussed the idea of community engagement and how the establishment of mutual reflection and joint learning initiatives among community members is becoming more prominent in academic settings.

In the context of clinical education, educators are encouraged to consider what learners should learn, how they should learn the content, what qualities do educators want learners to develop, where the science base or foundation stands, how long it should take to learn it, and how to transfer their clinical competency from the classroom setting to professional practice (Grant, 2014). As simulation educators and researchers, Brown and Miller (2016) stated that academic institutions are integrating interprofessional simulation into program curricula to bring different healthcare
professions programs together to prepare them for their future real-life clinical experiences. Regarding sociological fidelity, it is imperative for CLS learners to be included in Sim-IPE for these simulations “to be effective and authentic” in an interprofessional learning experience (Brown & Miller, 2016).

**Clinical Laboratory Science and Dimensions of Diversity**

Concerns about sense of belonging and inclusion tend to be more commonly discussed regarding social justice issues among underrepresented communities. Nevertheless, lack of inclusion can be applicable to professional identities associated with careers such as the clinical roles represented on the healthcare team. The idea of ‘making the invisible visible’ is not too far removed from the clinical laboratory science profession. A notable article titled, “The Hidden Profession that Saves Lives,” author Dr. Rodney Rohde (2020) asserted that “clinical laboratory science is one of the most underrecognized [and at times underappreciated] healthcare professions.” In the New York Times article, “ Nobody Sees Us: Testing-Lab Workers Strain Under Demand,” a medical laboratory scientist stated that “doctors and nurses are very visible, but we work behind the scenes” (Wu, 2020). In other literature, the clinical laboratory science profession has been referred to as a profession “working in the shadows of healthcare” which further illustrates the lack of visibility experienced by laboratory professionals. This invisible workforce has faced a considerable number of challenges over the years where the lack of visibility has prompted a call to action by organizations such as the American Society of Clinical Pathology (ASCP) to propose strategies for increasing the visibility of the profession.
Visible and invisible identity is listed as one of the themes within the social justice curriculum in addition to diversity, justice, and action (Learning for Justice, 2019). Within the Teaching Tolerance Social Justice Standards framework, identity is used to describe how learners will develop their identity based on their association in multiple groups in society and the impact of how they are identified in a community with others (Learning for Justice, 2019). The concept of identity includes visible and invisible characteristics such as language, career, and education. In an article about professional identity, Otto (2018) expanded upon the education, professional culture, and careers of clinical laboratory professionals. Otto (2018) stated that the foundation of identity is acquired during the academic preparation of clinical laboratory science students. Competencies including ‘work in interprofessional teams’ and ‘provide patient-centered care’ were noted as approaches to emphasize the professional identity of clinical laboratory science professionals in improving patient safety (Otto, 2018).

According to the Loden and Rosener (1990), the dimensions of diversity wheel was developed as a framework for thinking about the different dimensions in relation to identity and individual experiences (Loden & Rosener, 1990). Primary, or internal, dimensions such as age and ethnicity cannot be changed and are more apparent on a surface level. Secondary, or external, dimensions, such as occupation and education, are connected to identity as well. As described by the American Association of University Women (AAUW), identity “is a combination of characteristics, attributes, experiences or behaviors that make us who we are” (American Association of University Women, 2022). Our identity influences “how we see ourselves and how others see us” (American
Association of University Women, 2022). Although one’s occupation is categorized as a secondary dimension of diversity, some individuals consider their occupation as a “part of their identity.”

In collaboration with the University of Washington Center for Health Workforce Studies, the American Society for Clinical Pathology released their study findings titled “Clinical Laboratory Workforce: Understanding the Challenges to Meeting Current and Future Needs.” In this groundbreaking study, it was noted that increased visibility for the clinical laboratory profession can lead to improved collaboration between the clinical laboratory and the healthcare team (American Society for Clinical Pathology, 2020). An informant in the workforce study stated that the clinical laboratory should be “viewed as part of the larger hospital system” and there needs to be a raised awareness of the “value of the lab to the outcomes and impacts on patient welfare” (American Society for Clinical Pathology, 2020, p. 31). Regarding the sense of underappreciation, it was stated that “there needs to be an appreciation for the contribution of the lab” to the healthcare team (American Society for Clinical Pathology, 2020, p. 31).

To address the visible identity of clinical laboratory science professionals, Webb et al. (2021) suggested that simulation “provides an opportunity to promote the value of the laboratory on an interprofessional team” (p. 6). Furthermore, Webb et al. (2021) asserted that Sim-IPE is “vital to role development” for CLS program students “because it removes professional ambiguity and assumptions” about the identity of clinical laboratory scientists on the interprofessional healthcare team (p. 7). By relying on laboratory data and other profession specific skills, clinical laboratory professionals can
leverage this information to aid in the early detection of diseases and improved clinical interventions used in patient care by the healthcare team (Wheeler, 2020). In preparing undergraduate CLS learners, educators should explore opportunities to incorporate professionalism and professional identity into the undergraduate CLS curriculum to enhance the visibility of the profession to other healthcare professionals.

**Related Research**

A study in interprofessional collaboration involving over ninety undergraduate medical laboratory science and nursing education students was constructed at a smaller educational institution with the focus of easing learners from the classroom to clinical practice (Beard et al., 2015). Beard et al. (2015) conducted this research study with three simulation groups comprised of nearly ninety learners over a period of three semesters. The educators in this study designed deliberate student engagement (DSE) activities that required students to collaborate in the course of providing patient care. The outcomes of the study indicated that there is value in interprofessional collaboration in demonstrating an overall improvement in student perceptions of interdisciplinary practice (Beard et al., 2015). The future implications of this study indicated a need for more purposeful studies that investigate if learner participation in interprofessional education leads to improved communication and fewer medical errors (Beard et al., 2015). Beard et al. (2015) recommendation for future research was to include comparisons of group responses (e.g., nursing and medical laboratory science students) to assess perceptions of their ability to effectively communicate on interdisciplinary teams.
Emes (2015) conducted a study comprised of medical laboratory science (MLS) students to assess their confidence in their ability to perform required transfusion science competencies following their participation in a simulated clinical laboratory. Two identical surveys were designed with quantitative and qualitative questions to measure the MLS students self-perceived confidence in relation to the Canadian Society for Medical Laboratory Science (CSMLS) Transfusion Science competencies (Emes, 2015). As an important note, the participants completed four semesters of the MLS program which included interprofessional collaboration coursework prior to their participation in this simulation experience (Emes, 2015, p. 23). The fifty student participants completed the surveys before and after their participation in the simulation experience. The outcomes of this research study suggested that simulation-based education as an effective tool to increase students’ confidence in their abilities to perform transfusion competencies (Emes, 2015). For future implications, the author noted that “adaptations of this study methodology have significant implications for evaluation of simulation curricula in other MLS programs and in other applied health care educational settings (Emes, 2015, p. 26).”

In another transfusion-related clinical practice simulation, Rhees et al. (2015) published a study about their academic institutions’ use of a simulated approach to teach an interprofessional team of health professions students how to recognize and manage a blood transfusion reaction in a patient care setting (p. 225). A total of 170 students participated in this clinical practice simulation experience over a two semester period (Rhees et al., 2015). The student participants were affiliated with the following
three health professions programs: Medical Laboratory Science (MLS), Bachelor of Science in nursing (BSN), and Acute Care Nurse Practitioner (ACNP). The faculty team designed a high fidelity, mannequin based, immersive simulation scenario in a simulated hospital environment to promote learner engagement and clinical learning (Rhees et al., 2015). The scenario encouraged the student participants to enhance their understanding of each other’s role on the healthcare team, share their knowledge, correctly perform profession-specific procedures, and effectively communicate to ensure patient safety (Rhees et al., 2015). For the immersive simulation, students were divided into small interprofessional teams with representation from each program area. Each student had a specific role in the patient case which involved the recognition of signs and symptoms of a transfusion reaction (Rhees et al., 2015).

The results of the study revealed observations of the MLS students areas of strength including “positive patient identification prior to phlebotomy, correct specimen labeling procedures, correct read-back procedure of cross-matched blood, and correct interpretation of the transfusion reaction (Rhees et al., 2015, p. 228).” Areas for improvement included “proper reporting of critical laboratory values using the SBAR (Situation, Background, Assessment, and Recommendation) technique and appropriate read-back procedure to verify reported information (Rhees et al., p. 228).” By the end of the study, Rhees et al. (2015) shared their lessons learned with one of those lessons focused on the impact of the MLS students participation in the immersive simulation with other health professions. In their feedback, the MLS program students indicated “they had never seen what occurs at the patient’s bedside after the donor blood leaves
the laboratory” and that the experience allowed the students to learn more about each other’s roles on the healthcare team. In a complex patient case, the students were able to grasp how each member of the healthcare team contributed to the management of patient care and their role in protecting patient safety (Rhees et al., 2015).

Brown and Miller (2016) incorporated undergraduate CLS program students into an immersive simulation experience while using two physical locations (the simulation center and the CLS student laboratory) simultaneously. Over 194 learners from seven different healthcare professions programs participated in this immersive simulation event (Brown & Miller, 2016). Regarding the participation of CLS learners, the authenticity of the simulation was increased by conducting patient testing in a separate physical location from the simulation center. As noted by Brown and Miller (2016), the clinical laboratory was not centrally located in most healthcare settings and a majority of the communication between clinical team members primarily takes place over the telephone.

By utilizing a separate location for clinical testing, CLS learners were able to mimic realistic phone communication during the interprofessional simulation activity with other members of the healthcare team (Brown & Miller, 2016). Additionally, the CLS learners located at the CLS student laboratory performed a variety of diagnostic laboratory tests on patient samples while managing incoming phone calls from the intensive care unit in the simulation center. Some of the learner takeaways from this immersive simulation experience included a “a new level of understanding about each
other and the roles they play in patient care” as well as “acknowledging the vital role of the clinical laboratory in healthcare” (Brown & Miller, 2016, p. 251).

Salazar (2017) conducted an exploratory case study to assess the perceptions of clinical laboratory science students related to their participation in interprofessional education in service learning and clinical preceptorship experiences. The constant comparison method was used to identify the emergence of themes or patterns from the raw data collected in this study (Salazar, 2017). A purposive sampling with five undergraduate CLS students was used to qualitatively assess how CLS students conceptualized interprofessional education and recognize any cultural norms from their interactions with other healthcare professions. The findings of this study indicated that the CLS participants believed that participation in IPE reduced professional hierarchy, promoted equality, and maximized the effectiveness of interprofessional collaboration among represented healthcare professions” (Salazar, 2007, p. 65). Additionally, Salazar (2007) noted emerging themes from the raw data such as mutual respect, knowledge sharing, and the formation of professional identities.

The historical narrative of the CLS profession was indicative of a siloed training approach that is no longer applicable in today’s healthcare environment. Therefore, it is important to use these research studies as a point of reference for notable findings and emerging themes as it relates to student perspectives. The findings in these studies tend to focus more so on professional roles and identities on an interprofessional team. As we progress forward in modern CLS education, it is intended to use the outcomes of this study to shift the paradigm of undergraduate CLS teaching and learner preparation by
focusing on the learners’ perceptions regarding their own role on the interprofessional healthcare team while assessing their level of patient safety awareness.

**Summary**

Based on the review of literature, simulation-enhanced interprofessional education appears to have a promising future in shifting the paradigm forward in team-based education especially with the involvement of more healthcare professions programs such as clinical laboratory science. Although there are limited research publications about the integration simulation-enhanced interprofessional education into undergraduate CLS curricula, other healthcare professions such as nursing and medicine have provided well-documented practices in the incorporation of simulation activities under the guidance of theoretical framework (Aebersold, 2018; Webb et al., 2021). Simulation and interprofessional education literature suggested an increasing need for further collaboration and incorporation of healthcare professions programs to promote visibility of the CLS profession. Simulation-based education allows for experiential learning to take place without imposing risk or harm to patients whereas interprofessional education provides opportunities for different professions to learn how to work effectively together. The literature review provided pedagogical approaches for development, design, implementation, assessment, and evaluation of the successful integration of simulation-enhanced interprofessional education into undergraduate CLS curriculum. Based on the current literature, other undergraduate CLS programs have observed benefits of Sim-IPE including improved communication,
teamwork, role clarity, and increased awareness of professional contributions to positive patient outcomes.

The components of this literature review served as the foundational blueprint for the proposed research study. The integration of Sim-IPE into the undergraduate CLS curriculum will provide learners with an educational opportunity that reflects a realistic encounter in patient care while enhancing their own professional identity. As cited in the literature, the practice of interprofessional communication will prepare undergraduate CLS learners for potential interactions in the real healthcare setting. Through experiential learning and simulation-based procedural training, the literature indicated that patient safety concepts were reinforced through the development of interprofessional skills such as effective communication and teamwork for future participation on interprofessional healthcare teams.
CHAPTER 3
METHODOLOGY

Conventionally, the approach for educating undergraduate health science program students (e.g., clinical laboratory science) within their own profession-specific discipline has led to ineffective communication and limited collaboration among the healthcare team resulting in patient medical errors (Palaganas et al., 2014; Reinhold et al., 2017). The problem of practice for this research study was centered on undergraduate clinical laboratory science (CLS) program students and addressed their lack of exposure to patient safety concepts within the traditional CLS program curriculum as it related to practicing interprofessional healthcare team skills such as effective communication. Using the mixed methods approach, the research study focused on the qualitative elements of the research findings, such as perceptions and attitudes, as well as quantitative information extrapolated from survey responses. The research questions that were addressed in this study are as follows:

1. What is the impact of simulation-enhanced IPE on an undergraduate CLS student participants’ understanding of patient safety and quality of care following participation in a simulation scenario?
2. By participating in a simulation-enhanced IPE activity, how does this immersive experience help undergraduate CLS students see themselves as contributors towards patient safety?

3. How do undergraduate CLS student participants view their role as members of the healthcare team?

The research study was designed to help undergraduate CLS educators address the gap in embedding patient safety concepts among pre-certification clinical laboratory science students prior to their entry into the clinical laboratory workforce. By integrating fourth year (recognized as final/senior year per programmatic curriculum) undergraduate CLS program students into a Sim-IPE activity, the study posited this learner group will be exposed to other healthcare professions during their clinical practicum experience. Additionally, the proposed study was designed to gather data on the participants’ knowledge and perceptions related to their role in patient safety awareness.

Research Design

The mixed methods research study was designed to identify opportunities for undergraduate CLS students to increase patient safety awareness and to demonstrate the contributions of their role to the overall healthcare team in the provision of quality patient care. According to Creswell and Creswell (2018), qualitative research “emerged in the health sciences only in the last couple of decades,” thus making it imperative for researchers to review the characteristics for the use of qualitative methods in a research study (p. 180). As a discipline, clinical laboratory science programs can be classified as a
health science due to the curricular focus on human sciences within the scope of healthcare. Although qualitative research has not always been used in the field of health sciences, this approach was applicable to this study given the use of a setting that mimicked the real-world clinical environment. The purpose of this qualitative research was to describe, explore and seek a deeper understanding of social phenomena occurring within their own natural, or real-world, setting (Cypress, 2015). This made the qualitative research process highly useful and applicable for social or human science related studies (Cypress, 2015). For example, qualitative research studies tend to occur in natural settings where participants and researchers have face-to-face interaction, such as interviews, allowing for collection of data onsite where the problem is being studied (Creswell & Creswell, 2018). Alternatively, quantitative research requires data collection from instruments, such as surveys, to aid in answering the research questions in an unbiased manner. For this study, the approach to quantitative research, structured around the scientific method, was aimed to generate objective data used to identify patterns, make predictions, and generalize results across larger populations (Burrell & Gross, 2017). Creswell et al. (2011) described the mixed methods approach as the “intentional collection” or integration of both quantitative and qualitative methods to combine the strengths of each in addressing the posed research questions (Creswell et al., 2011, p. 5).

**Proposed intervention.** According to the Core Competencies for Interprofessional Collaborative Practice (2011), interprofessional learning activities are primarily used to expose students to other healthcare professions, allowing educators to
assess student experiences based on their “reactions, attitudes and perceptions, knowledge or skill” (p. 26). This action research study focused on the proposed educational intervention of a Sim-IPE activity for undergraduate CLS students prior to the start of their clinical rotations at assigned clinical laboratories for their clinical practicum experience. The aim of the proposed intervention was to embed patient safety and quality of care concepts into the undergraduate CLS program curriculum for pre-certification undergraduate CLS program students. The intervention was planned to occur one week prior to the start of their clinical practicum and was intended to serve as a bridge between the completion of didactic coursework and their transition into a real-world clinical laboratory environment.

Due to the nature of the responsibilities related to the role of medical laboratory scientists, simulation-based procedural training was selected as the modality for the delivery of the Sim-IPE activity to assist in the process of clinical learning. The use of simulation-based procedural training has proven to be beneficial in preparing learners to perform a technical skill or procedure as well as increase learner’s confidence and strengthen their technical skills (INACSL, 2021; Lioce et al., 2020). The simulation-based procedural training activity was focused on blood bank laboratory testing practices which included the performance of a patient blood type and antibody screen. As outlined in Table 3.1, the design of the activity was divided into three components: the prebrief session which prepared students for the educational content of the simulation activity, the simulation activity when students were expected to perform simulation-based educational tasks related to blood bank laboratory testing, and the debriefing
process when learners would receive feedback from faculty and be guided through a reflective process co-facilitated by two or more faculty members.

Table 3.1 – Sim-IPE Design and Activity Timeline

<table>
<thead>
<tr>
<th>Phase</th>
<th>Brief Description</th>
<th>Time Allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prebrief</td>
<td>Faculty prepared students for the educational content of the simulation activity.</td>
<td>7-10 minutes</td>
</tr>
<tr>
<td>Sim-IPE Activity</td>
<td>Students performed simulation-based educational (SBE) tasks related to blood bank laboratory testing procedures.</td>
<td>1.5 hours</td>
</tr>
<tr>
<td>Debrief</td>
<td>Students were prompted to reflect on their experience while engaged in a meaningful discussion with their peers and faculty.</td>
<td>20 minutes</td>
</tr>
</tbody>
</table>

The immersive simulation-based procedural training activity was “influenced by learners’ characteristics, experiences, level of training, and preparation for the patient case” (Lopreiato, 2016, p. 17). Therefore, the clinical content of the simulation-based procedural training activity was leveled to the academic curriculum of fourth-year undergraduate CLS program students (INACSL, 2021).

*Simulation-based procedural training in blood bank.* Procedural training, or procedural simulation, uses a simulation modality (e.g., embedded simulated person) to support the process of students learning to complete a technical procedure (Lopreiato, 2016). Each two-hour simulation-based procedural training session was structured to accommodate up to three undergraduate CLS students for a total of six sessions. This simulation-based procedural training activity was intended to serve as a bridge between their student laboratory experience and prior to the start of their sixteen-week clinical practicum experience in a hospital setting. During the simulation-based activity, undergraduate CLS students utilized their profession-specific knowledge and technical
skills in a procedural training session focused on blood bank testing and multitasking in
the laboratory.

A 2018 ASCLS position paper titled *Addressing the Clinical Laboratory Workforce Shortage* suggested non-traditional approaches that broaden clinical laboratory training, such as simulation, as means to solve limited clinical training opportunities in the clinical laboratory setting (ASCLS, 2018). As fourth-year undergraduate CLS program students prepared to transition from the student laboratory into their clinical practicum experience, this procedural training was designed to further prepare them for the real-world clinical laboratory environment. Blood bank, also recognized as transfusion medicine or immunohematology, is an area in laboratory medicine commonly associated with patient safety factors impacting the safe transfusion of blood and blood components. Although the rate of blood transfusion reactions in patients have decreased, we still encounter errors in transfusion medicine such as patient misidentification (Harmening, 2020). These errors have been attributed to various risk factors including inadequate personnel training and inaccurate patient identification (Harmening, 2020).

This procedural training session was established to build upon student lab experiences in ABO/Rh blood typing and antibody screening (also referred to as ‘type and screen’) by incorporating modern laboratory testing equipment. The learning objectives for the session were as follows:
(i) compare the patient information from the test requisition against the information on the patient sample to ensure sample acceptability criteria have been successfully met;

(ii) test the patient sample for an ABO/Rh blood type and antibody screen utilizing automation in two different testing methodologies: tube agglutination and gel; and,

(iii) demonstrate multitasking abilities by answering phone calls in the laboratory while performing blood bank testing procedures.

Students were provided with a hands-on learning experience by performing an ABO/Rh blood type and antibody screen test using tube agglutination methodology (as performed in the student laboratory) and repeating the antibody screen using gel methodology to expose them to modern laboratory testing and equipment.

While students performed ABO/Rh blood type and antibody screen (type and screen) testing, a member of the nursing faculty called into the laboratory in the embedded simulation role of a nurse to inquire about the status of their patient’s blood type and the antibody screen test. In the student laboratory setting, undergraduate CLS program students were not introduced to other administrative functions, such as answering a telephone call, while carrying out clinical laboratory testing procedures. As this group of learners transitioned from the student laboratory setting into the real healthcare environment, basic interpersonal skills (e.g., answering phones, addressing clinician concerns) would become necessary in their day-to-day operations in the clinical laboratory. To support student participants in their telephone communication with the
nurse, the ISBARR (Identify, Situation, Background, Assessment, Recommendation, and Repeat) framework was provided on a wallposter near the telephone (see Appendix D) and a telephone interactions practice guide was placed on the counter near the telephone (Kostiuk, 2015).

The simulation-based procedural training design was aimed to integrate multitasking functions that will mimic potential situations they will encounter in the real-life clinical setting. Similar to the expectation of the real-world clinical laboratory environment, student participants needed to effectively communicate test information over the phone with a nurse while adhering to laboratory protocols that ensure patient safety (e.g., confirmation of patient identifiers such as name and medical record number) and quality performance of laboratory testing. Refer to Appendix A: Case Design Details – Procedural Training, for the case stem and session details for undergraduate CLS students participating in the simulation-based procedural training session.

In this simulation-based procedural training activity, the data collection instruments included a post-simulation event survey administered electronically by the simulation center. The data were utilized to assess themes such as patient safety and quality of care (refer to Appendix C) in the student participants responses. Additional data collection instruments were audiovisual recordings of the simulation-based procedural training sessions including the debriefing process, field note observations during the simulation-based procedural training sessions, student daily journal entries.
from the clinical blood bank practicum experience, as well as student and faculty interview responses.

**Clinical blood bank practicum.** Following the completion of the simulation-based procedural training, the fourth-year undergraduate CLS students were scheduled to begin their clinical practicum experience during the spring semester. The clinical practicum took place in a hospital or reference laboratory setting and was comprised of the following core clinical practicum areas in the clinical laboratory: clinical chemistry, clinical hematology, clinical microbiology and clinical immunohematology (also referred to as blood bank). Specifically, the clinical blood bank practicum was scheduled for three consecutive weeks out of the full sixteen-week clinical practicum period. Undergraduate CLS student participants completed their clinical blood bank practicum experience at various host hospital and laboratory locations throughout the state. During their sixteen-week clinical practicum, students were expected to apply learned theories and principles to the diagnostic testing practices of a clinical laboratory. Although all sixteen undergraduate CLS students were scheduled to start their clinical practicum at the same time, everyone was not scheduled to begin in the same laboratory sections. Each laboratory section corresponded with a clinical practicum course delivered by the clinical laboratory science department.

For this research study, I focused on transfer of learning from the simulation-based procedural training into the three-week clinical blood bank practicum. In addition to the in-person component of the clinical blood bank practicum, students were enrolled in an online clinical immunohematology practicum course. Due to scheduling
capacity, a limited number of students were scheduled in the blood bank for the same three-week period and were rotated into other laboratory sections as scheduled. All sixteen undergraduate CLS student participants were scheduled to complete their clinical practicum by early May 2023.

**Research Setting**

The clinical laboratory sciences department is housed on a large, metropolitan academic medical center campus where the integration of interprofessional simulation activities into pre-certification/pre-licensure health professions curriculum was promoted and supported by university administrators. Situated within the School of Health Professions, all the undergraduate CLS coursework taught on campus occurred in learning spaces shared with other healthcare profession programs such as prelicensure medicine and nursing program students (refer to Appendix E). A recently outfitted academic building was constructed on campus with a simulation hospital (including an inpatient clinical laboratory), clinical skills laboratories, and state-of-the-art learning spaces conducive to interprofessional activities. This building provided the CLS program with the opportunity to incorporate the participation of undergraduate CLS program students in Sim-IPE events with other healthcare professions learners in a realistic setting designed to authenticate Sim-IPE learning experiences. Specifically for the simulation-based procedural training session, a representative of the CLS faculty and nursing faculty were placed in a nearby debriefing room in the simulation hospital equipped with audio/visual technology to observe learners from a monitor and telephone access to receive and place calls to the inpatient laboratory.
Curriculum integration. The simulation-based procedural training activity was integrated into the clinical competency review course scheduled prior to the start of the clinical practicum. Although it was deemed as a no-credit course, it was mandatory per the curriculum requirement for the undergraduate CLS program. Students had to enroll and successfully complete all review content and procedures before they were cleared to start the clinical practicum. The course was intended to better prepare students through the reiteration of content knowledge and practice of technical skills leading into their transition into the clinical setting.

Sample

The research study participants were fourth-year undergraduate CLS students entering their clinical practicum experience during the final year of the baccalaureate of science degree program. Upon acceptance into the undergraduate CLS program, the junior (third year) and senior (fourth year) year students are referred to as CLS3 and CLS4, respectively, with the number portion correlated to their year in the program. The student participants successfully completed their required didactic and laboratory coursework prior to their assignment to a host institution for their clinical practicum.

During their final semester in the undergraduate CLS program, CLS4 students were assigned to partnering clinical host institutions to complete their clinical practicum, also referred to as clinical rotations, to gain hands-on experience in the clinical laboratory setting. The students were scheduled across the other clinical areas including chemistry, hematology, and microbiology for a three to four-week duration per section. Each clinical practicum area had a corresponding online course component, which consisted
of review materials and assigned coursework that aligned with the clinical laboratory content for each scheduled section.

The current cap or maximum number of enrolled learners for the undergraduate CLS program was twenty-eight students. For this study, sixteen undergraduate CLS students completed the course requirements leading up to clinical practicum and were eligible for participation in the simulation-based procedural training. Due to the small sample size, the selection criteria for the study have been limited to those undergraduate CLS students with marked completion of clinical immunohematology (also referred to as blood bank or transfusion medicine) lecture and laboratory coursework leading up to clinical practicum.

Data Collection Instruments

Observations, surveys, and interviews are all commonly utilized data collection strategies in action research (Efron & Ravid, 2013). In determining the type of data collection method, Efron and Ravid (2013) recommended asking oneself [the researcher] the following questions:

- What do I want to know?
- Which data sources will best enable me to collect the information I need?
- Can I obtain the information that I am looking for?

These questions guided which data collection instruments would be best suited for this study (Efron & Ravid, 2013). Multiple instruments were used for data collection including responses to a post-simulation event survey, field notes from observations of the simulation-based procedural training sessions, audiovisual recordings of the
debriefing process from the sessions, student daily journal entries from their clinical blood bank practicum experience, and interviews of student and faculty participants.

**Qualitative instruments.** To gather evidence of the participants’ understanding as it relates to the contribution of their role to quality improvement and safety of patient care, the qualitative instruments for this study included observations and two individual semi-structured interviews. Observations of student and faculty participants were conducted in person by the primary researcher during the scheduled sessions for blood bank procedural training. Two semi-structured interviews were used for student and faculty participants following the simulated learning experience.

**Observations.** In a qualitative observation, Creswell and Creswell (2018) noted that a researcher will take notes on the behavior and activities of study participants in either an unstructured or semi-structured way. As a qualitative observer, I used the evaluation forms provided (refer to Appendix B) to document my observations of the telephone interactions between the student participants and the nurse in the simulation-based procedural training activity. For the undergraduate CLS students who participated in the simulation-based procedural training sessions, they were aware of the role of the researcher as faculty and as a direct observer of their activities within the simulation environment. Although I recorded information as it occurred during the two-hour activity (e.g., multitasking abilities, laboratory testing performance, telephone communication skills), each session was recorded using a simulation software management solution. The web-based solution used by the simulation center captured in-room audio, including telephone audio (e.g., phone conversations), and visual
recordings within the simulation laboratory environment (Laerdal Medical, 2019). Audiovisual and digital materials are categorized as a type of qualitative data used in research as an unobtrusive method of data collection (Creswell & Creswell, 2018).

As stated by Mertler (2017), written notes or documentation can “become problematic” during formal observations (p. 133). Videotapes, or video recordings, are an alternative type of observation that serves as a data collection tool for recording observations (Mertler, 2017). In lieu of videotapes, the web-based recordings provided me with two ways to observe the same learner activity in real-time with field notes and retrospectively in viewing recorded participant activities. Audiovisual recordings are commonly used by the simulation center for education and debriefing purposes following a simulated learning experience. As a part of the simulation center policy for video recording, every participant read and signed a media authorization and release form consenting to audio/video recordings to be used for educational, quality improvement, and internal program purposes.

The debriefing process. At the end of each simulation-based procedural training session, a debriefing process was conducted to allow learners time to process and reflect on the experiential learning activity. Faculty participants, including the primary researcher, facilitated the debriefing sessions using the dynamic plus-delta debriefing model in which faculty observations were shared with the student participants (Kainth, 2021). This debriefing model consisted of three main phases: the opening or initial reactions phase, the plus-delta phase where we discussed what went well and where
there were opportunities for improvement, and a summary phase where a targeted application of the learning objectives occurred (Kainth, 2021).

For simulation instructor development, the CLS faculty involved in the SBPT sessions were invited to participate in a foundational course that prepared them to engage learners through a facilitated experiential learning process. Prior to the SBPT sessions, the CLS faculty participants were able to attend this course which covered how to use feedback and debriefing to close performance gaps with learners. Additionally, ongoing support from the simulation center education specialists was integrated into the launch of this SBPT activity. Prior to the scheduled SBPT activity sessions, the CLS faculty participants attended an instructor debrief prep meeting to practice the debriefing model and script with the simulation center education specialists to ensure their level of comfort with the co-debriefing process. Both CLS faculty participants had less than two years of debriefing experience in simulation prior to their involvement with this activity. Regarding the nurse faculty participant, they were trained in various debriefing models during their nine year tenure as teaching faculty in simulation. As an experienced debriefer and certified healthcare simulation educator, the nurse faculty participant contributed their debriefing expertise as well as their professional nursing career experience to the structured debriefing process.

As described by simulation-based education experts, Fanning and Gaba (2007), the structural elements of the debriefing process include the debriefers, those being debriefed, the simulation experience itself and the impact of the experience on participants in how they transfer what they have learned from the experience to their
future clinical practice. Other structural elements for debriefing involve recollection and report in which the reflective observation of the experience may be in verbal or written form (Fanning & Gaba, 2007). In other words, the debriefer shared their written recollection from their noted observations of the undergraduate CLS student participants in verbal form of what was observed during the simulation-based procedural training activity. Participants were encouraged to respond with their description of what happened during the activity in their own words. Learner-centered engagement in the debriefing process was crucial to the learning process because this is where the bulk of the learning takes place for learner participants (Reed, 2020). The undergraduate CLS students were encouraged to share their perspectives and their process of critical thinking through the learning activity which provided insight into their thought process while engaged in the activity.

An example of this would be my probing statement directed toward a simulation participant as follows: “During the simulation, I saw you immediately answer the phone after 1 ring when the nurse called, and I thought that was this demonstrated effective communication because it is important for quality patient care to report laboratory results in a timely manner. Tell me more about that moment.” In this example, I shared an observation based on my field notes of the procedural training activity. The participant was able to respond with their own description of the experience to validate my account of the experience. As co-facilitators, the faculty and primary researcher were able to confirm the accuracy of their observations through this exploratory discussion with learners during the debriefing process.
Interviews. Efron and Ravid (2013) stated that the interview is a major data collection strategy in teacher [practitioner] action research. Merriam and Tisdell (2016) expanded on this point that the use of the interview is necessary when we cannot observe behavior, feelings, or how people interpret the world around them. Additionally, interviewing is useful in case studies conducted with a small number of research participants (Merriam & Tisdell, 2016). There are occasions where an interview can serve as a follow-up method for posing additional questions to individual participants from observations and/or survey responses.

For this study, a semi-structured interview format was used for both faculty and student participants to pose several follow-up questions regarding patient safety, quality improvement, learner performance, and learner attitudes about their role on the interprofessional healthcare team. Prior to the interviews, I developed an interview protocol to establish the standardized process of asking questions and documenting interviewee responses during the interview. Creswell and Creswell (2018) suggested that the interview protocol should be two pages in length with proper spacing to allow enough room for capturing handwritten responses, notes and quotes from interviewees. The faculty and student interview question sets were designed with 8 to 10 content questions each and prepared prior to the scheduled interview dates. Both interview layouts were created with an introduction including the purpose of the study, the interview content questions and closing instructions to thank the interviewee for their time and to ask for approval to follow up with them at a future date for clarification of points shared during the interview (Creswell & Creswell, 2018). To ensure
that interviewees provided informative responses to each content question, I used probes such as “tell me more” and “could you explain your response more” which were helpful in expanding the length of the interview as well as capturing rich, meaningful responses (Creswell & Creswell, 2018, p. 191).

One semi-structured interview was used for the undergraduate CLS program students who were participants in the simulation-based procedural training (see Appendix F). The other semi-structured interview was used for faculty participants involved in the delivery of the simulation-based procedural training activity (see Appendix G). The student participant interview set, comprised of 10 semi-structured questions, were administered after the completion of their clinical practicum experience. These interviews were completed as individual virtual sessions via Zoom video conferencing platform. The posed questions prompted learners to share their opinions and any pertinent information regarding their sense of professional identity and the contributions of the CLS role to a culture of patient safety among the healthcare team.

The semi-structured interview process was used for undergraduate CLS student participants as a follow-up protocol to observations and post-simulation event survey responses. In addition to student-participant interviews, faculty-participant interviews were conducted to elicit their views and opinions of the interprofessional simulation activities experienced by the undergraduate CLS students (see Appendix G). The faculty-participant interviews were comprised of 8 semi-structured questions and were conducted virtually via Zoom.
During the introduction phase of the interviews, I explicitly stated to participants that the recordings would be viewed only by me as the primary researcher and used for research purposes only. The interview recordings were used to ensure accuracy of documented responses and for transcription purposes. All recordings were securely stored in a password-protected electronic device which required multi-factor authentication (MFA).

**Daily journal entries.** Daily logs (or journaling) are one of the most prescribed methods of reflecting on clinical practicum experiences. Each undergraduate CLS student enrolled in the clinical immunohematology practicum course was required to maintain a daily log each week during the three-week practicum period. Students recorded the sequence of events that occurred, the activities such as diagnostic testing procedures (e.g., blood typing), and the interprofessional encounters. As they completed their weekly journal entries, students were encouraged to reflect on lessons learned in their blood bank lecture, student laboratory experiences, and the simulation-based procedural training activity.

Furthermore, they were asked to describe how those concrete learning experiences transferred into their clinical practice. I reviewed the daily journal entries for any potential themes or comments about the students’ experience in simulation-based procedural training and interprofessional practice. I was hoping to capture any references made by students that connected their experience in simulation-based procedural training to any interprofessional encounters they may have experienced.
during their clinical blood bank practicum such as telephone interactions with other healthcare team members or interprofessional discussions related to patient safety.

**Quantitative instruments.** As a quantitative method, surveys can be used to capture trends and attitudes of learners who participated in immersive and procedural training simulation activities (Creswell & Creswell, 2018). In this study, the quantitative instrument was used to gather student participant feedback immediately following their participation in the simulation-based procedural training activity. The post event survey was created and administered by the simulation center.

**Post-simulation event survey.** Specifically, post-event surveys were conducted on undergraduate CLS program students to assess their feedback and perceptions regarding their simulation-based learning experience (SBLE) experiences during the simulation-based procedural training. The post-event survey was administered by the simulation center to all student participants at the end of each session. Using individual electronic devices such as personal mobile phones or tablets, student participants were asked to complete the survey prior to exiting the simulation center. Alternatively, student participants were able to use their personal mobile devices to scan the QR code provided on simulation center wall signage to access the post-event survey.

The survey was comprised of 10 multiple choice questions based on the five-point Likert scale as well as 7 open ended questions for a total of seventeen questions (refer to Appendix F). The survey responses were anonymous and only identified by school and program affiliation (e.g., School of Health Professions, CLS). The collected data were compiled by the simulation center educational delivery team and shared with
faculty during a debrief meeting following all completed simulation sessions. The undergraduate CLS student participants were able to include additional comments about their simulation-based procedural training experience.

Research Procedure

The data collection process began in January 2023 with the simulation-based procedural training sessions and continued throughout the spring semester until the end of the 2022-2023 academic calendar year as outlined below in Table 3.2.

Table 3.2 – Data Collection Timeline

<table>
<thead>
<tr>
<th>Date</th>
<th>Data Collection Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2023</td>
<td>The proposed intervention, simulation-based procedural training, was implemented. The undergraduate CLS student participants were scheduled to participate in one of six sessions delivered at the simulation hospital.</td>
</tr>
<tr>
<td>January-May 2023</td>
<td>Undergraduate CLS students started the sixteen-week clinical practicum experience which included a three-week rotation in the clinical blood bank section.</td>
</tr>
<tr>
<td>April 2023</td>
<td>Primary researcher obtained permission from the IRB to conduct research study.</td>
</tr>
<tr>
<td>April 2023</td>
<td>Primary researcher initiated review of daily journal entries completed by students.</td>
</tr>
<tr>
<td>May 2023</td>
<td>Primary researcher conducted interviews with student participants.</td>
</tr>
<tr>
<td>June-August 2023</td>
<td>Primary researcher completed interviews with faculty participants.</td>
</tr>
<tr>
<td>August 2023</td>
<td>Primary researcher wrapped up remaining interviews with faculty participants.</td>
</tr>
<tr>
<td>September 2023</td>
<td>Primary researcher reviewed audiovisual recordings from simulation-based procedural training sessions.</td>
</tr>
<tr>
<td>September 2023</td>
<td>Primary researcher completed analysis of data collected for the study.</td>
</tr>
</tbody>
</table>
Data Collection Methods

According to the Simulation Innovation Resource Center, simulation is an excellent venue to provide opportunities for interprofessional learners to develop, practice, and refine interprofessional skills such as communication, collaboration, and teamwork within the context of a patient care scenario (Simulation Innovation Resource Center, 2021). In correlation with the research design, both qualitative and quantitative data were collected during the same timeframe and will be given equal emphasis in the study (Mertler, 2017).

Qualitative. In January 2023, undergraduate CLS students on the clinical track were scheduled to participate in the simulation-based procedural training activity. All procedural training sessions were completed during the first full week of January inside the simulated laboratory setting within the simulation hospital. Along with faculty participants, one inside the simulated laboratory with students and the other located in an adjacent conference room for phone call management, I remained in the adjacent conference room with the nursing professional and a simulation center education specialist to document observations in real-time. While in-person for direct observations, I documented using field notes on the activities and the behaviors of the students as well as faculty participants.

As an observer in the room, I could not fully hear every interprofessional interaction on the telephone as I was only able to overhear the nurse faculty member in the room and the use of the live audiovisual feed. Subsequently, audiovisual recordings were filmed for all simulation-based procedural training sessions. I reviewed the
audiovisual recordings after the sessions were completed. In doing so, I was able to listen in on the direct telephone communication between the undergraduate CLS student and the nurse. All audiovisual recordings are kept on a secure server by the simulation center which is password-protected, and recordings can only be accessed via authorized ports. These telephone interactions included the undergraduate CLS students identifying themselves and engaging in an interprofessional conversation about patient test results. In reporting the laboratory test results, the student participants had to ensure patient safety through the practice of requesting pertinent information such as the confirmation of the patient’s name, medical record number, date of birth, and a readback (or repeat) of the test result. I noted these additional observations in my field notes upon review of the recorded sessions.

According to the Healthcare Simulation Standards of Best Practice™ for the debriefing process, all SBE activities “must include a planned debriefing process” (INACSL Standards Committee, 2021, p. 27). The debriefing process has been described as “a critical component of SBE that provides a venue for learners to reflect on action, discuss areas for improvement, and incorporate new information with previous knowledge” (Cheng et al., 2016, p. 32). The debriefing process in simulation was developed to promote reflection, improve performance, and encourage transfer of learning to future clinical practice (INACSL Standards Committee, 2021; Cheng et al., 2016). Following each simulation-based procedural training session, student participants were transitioned from the simulated clinical laboratory into a debriefing conference room where faculty co-facilitated this post-SBE discussion. When used with clinical
teaching and instructor feedback, the plus-delta approach “can be used as the primary conversational strategy in a debriefing” session (Cheng et al., 2021). The undergraduate student participants were guided into the debriefing process by the faculty participants involved in each simulation-based procedural training session. By using a co-debriefing strategy, two or more faculty participants facilitated the debriefing process together.

All recorded simulation-based procedural training sessions were divided into the three following sections: prebriefings which prepared students for the educational content of the simulation activity, scenario or activity in which students performed simulation-based educational (SBE) tasks related to blood bank laboratory testing, and the debriefing component where most of the learning occurred for students through feedback and guided reflection (INACSL Standards Committee, 2021).

**Interviews.** As a follow up to the simulation-based procedural training, the student interviews were conducted during the months of April and May. The interviews were scheduled in this manner to allow time between the procedural training and the completion of their blood bank clinical practicum at their hospital site. The clinical blood bank practicum for each student was scheduled at various times throughout the semester. Therefore, the interviews were scheduled individually and at different times based on their clinical rotation itinerary. To provide convenient interview times, each interview was conducted via Zoom in forty-five minute increments to allow time for responses and any follow up questions.

Faculty participants were interviewed via Zoom using semi-structured interview questions. Their interviews were scheduled after their engagement with the blood bank
procedural training. Each interview was scheduled in forty-five minute increments to allow time for follow up questions and any notes of clarification. Faculty interviewees included the designated simulation center education specialist, two CLS faculty members who participated in the procedural training, and the nurse faculty member who interacted with the undergraduate CLS students as the interprofessional healthcare team member. As the primary researcher, I created both sets of interview questions and requested validation of these questions to be completed by a CLS faculty member who was familiar with blood banking, simulation and interprofessional education.

**Daily journal entries.** During the blood bank clinical practicum, students had to submit daily journal entries at the end of every week for their immunohematology practicum course. Between the months of April through May, the daily journal entries were collected from the CLS program faculty assigned to the immunohematology practicum course. The daily journal entries were submitted once a week via Blackboard, an online learning management system. Each journal submission was downloaded to a secure server and initially grouped by the learner. Using the margins for each submission, I began to organize the student’s reflections based on the research questions to prepare for data analysis.

**Quantitative.** The post-event survey (PES) was administered to all undergraduate CLS student participants immediately following their scheduled session in the interprofessional simulation-based procedural training activity. The PES was created by the simulation center and electronically administered to undergraduate CLS program students to gather their feedback and perceptions regarding their simulation-based
learning experience (SBLE) during the procedural training activity. At the end of each session block, student participants were instructed to access the PES by using their personal mobile device (e.g., cellphone, tablet) to scan the quick response (QR) code provided by the simulation center. Upon scanning the QR code, the embedded link connected students to the Qualtrics-administered survey comprised of ten multiple choice questions based on the five-point Likert scale as well as seven open ended questions for a total of twelve questions (refer to Appendix C). The survey responses were anonymous and used limited identifiers for their school and academic program affiliation (e.g., School of Health Professions, CLS).

**Data Analysis**

For mixed methods research, the qualitative and quantitative results were analyzed using a convergent mixed methods approach as described by Creswell and Creswell (2018). The convergent mixed methods approach required the research to merge the qualitative and quantitative data collected to “provide a comprehensive analysis of the research problem” (Creswell & Creswell, 2018). Given that the qualitative data (e.g., observations, interviews, daily journal entries from clinical practicum experience) and quantitative data (e.g., post-simulation event survey) were collected within the same timeframe, the information gathered was integrated into an overall interpretation of the study results.

**Qualitative data analysis.** The select procedures for data analysis were intended to make sense of the data collected and to gain a deeper understanding of social phenomena that occurred within the research setting.
Observations. To prepare for data analysis, I reviewed the field notes taken during the direct observations of faculty and student participants in the simulation-based procedural training sessions. While reviewing the audiovisual recordings, I conducted simultaneous analysis procedures by transcribing additional relevant data and checking the field notes for accuracy. After completion of this review, I organized the data by hand based on the research questions related to patient safety and understanding of roles through interactions with the nurse professional. The next step performed in the data analysis process was the implementation of the coding process which helped to code the data by theme and grouping categories (e.g., patient safety, role clarity, quality of care).

As described by Creswell and Plano Clark (2018) coding is “the process of grouping evidence and labeling ideas so that they reflect increasingly broader perspectives (p. 214). The coding labels used for the field notes came from “in vivo coding” or the exact words stated by participants and the phrases I documented in my observations in the setting of simulated blood bank procedural training (Creswell & Plano Clark, 2018).

Interviews. For the semi-structured interviews, I transcribed the responses provided for the faculty and student question sets. The transcribed responses were shared via email with each interviewee who was asked to check their responses for accuracy. To organize the responses, I used coding labels on the typed transcripts from each interview and assigned code words for grouping themes that emerged in interviewee responses. To convey themes and categories, figures and tables were used
to present the interrelated themes between interview question responses and field notes collected during observations.

Daily journal entries. During the three-week clinical blood bank practicum period, students were enrolled in another clinical immunohematology course as well as a clinical immunohematology practicum course. For the clinical immunohematology practicum course, students were expected to submit daily journal entries at the end of every week as a part of the curricular requirement. Although all students were not assigned in the clinical blood bank practicum at the same time, each student was required to complete this practicum area within the sixteen-week practicum period between January 2023 through early May 2023. Throughout this timeframe, the daily journal entries were submitted once a week via Blackboard, an online learning management system. Each journal submission was downloaded and stored in a secure server and initially grouped by the learner. In total, sixteen students submitted up to five daily journal entries on a weekly basis which was the equivalent of 240 individual journal entries. The individual journal entries were compiled by week (e.g., Week 1, Week 2, Week 3) and categorized using Quirkos, a software package for the qualitative analysis of text data. Using this software, I analyzed the text data from the daily journal entries using a defined list of twenty-six text data codes (refer to Appendix I). Once I finished categorizing the student quotes from the daily journal entries by code, I had the following number of codes for each category as shown in Table 3.3 below:
Table 3.3 – Daily Journal Entries by Code

<table>
<thead>
<tr>
<th>Codes</th>
<th>Number of codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type and Screen</td>
<td>142</td>
</tr>
<tr>
<td>Quality</td>
<td>78</td>
</tr>
<tr>
<td>Gel Methodology</td>
<td>50</td>
</tr>
<tr>
<td>Crossmatch</td>
<td>41</td>
</tr>
<tr>
<td>Learner Attitudes</td>
<td>39</td>
</tr>
<tr>
<td>Patient Safety</td>
<td>29</td>
</tr>
<tr>
<td>ABO Typing</td>
<td>22</td>
</tr>
<tr>
<td>Learner Confidence</td>
<td>21</td>
</tr>
<tr>
<td>Student Laboratory</td>
<td>18</td>
</tr>
<tr>
<td>Laboratory Computer/Software Usage</td>
<td>18</td>
</tr>
<tr>
<td>Interprofessional Collaborative Practice (IPCP)</td>
<td>16</td>
</tr>
<tr>
<td>ABO Discrepancies</td>
<td>15</td>
</tr>
<tr>
<td>Orientation to the Laboratory Environment</td>
<td>14</td>
</tr>
<tr>
<td>Nurse Communication</td>
<td>13</td>
</tr>
<tr>
<td>Interprofessional Communication</td>
<td>11</td>
</tr>
<tr>
<td>Tube Methodology</td>
<td>12</td>
</tr>
<tr>
<td>Team Communication</td>
<td>10</td>
</tr>
<tr>
<td>Multitasking</td>
<td>10</td>
</tr>
<tr>
<td>Laboratory Equipment (Automation)</td>
<td>10</td>
</tr>
</tbody>
</table>
These codes and categories were assessed for interrelated themes based on the qualitative data analysis approach. The lesser numbered codes such as “laboratory safety” and “specimen acceptability” were merged into other suitable categories. The categorized text data was analyzed further for patterns and grouped together as follows in Table 3.4:

Table 3.4 – Interrelated Codes and Categories

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Laboratory Automation</td>
</tr>
<tr>
<td></td>
<td>Laboratory Computer/Software Usage</td>
</tr>
<tr>
<td></td>
<td>Orientation to the Laboratory Environment</td>
</tr>
<tr>
<td></td>
<td>Simulation Laboratory Equipment</td>
</tr>
<tr>
<td></td>
<td>Student Laboratory</td>
</tr>
<tr>
<td>Proposed Intervention (Sim-IPE)</td>
<td>Interprofessional Communication</td>
</tr>
<tr>
<td></td>
<td>Interprofessional Collaborative Practice</td>
</tr>
<tr>
<td></td>
<td>Multitasking</td>
</tr>
</tbody>
</table>
Quantitative data analysis. I used the student participant responses from the 5-point Likert scale multiple choice questions in post-simulation event survey for quantitative data analysis. The survey was administered via Qualtrics, a web-based survey software with customizable survey templates and integrated statistical tools for analysis. The data from the post-event survey were collected and stored through the registered account of the simulation center and password protected. Through Qualtrics, I downloaded the data and generated the statistical analysis of the survey responses. The validity of the study findings will be supported through triangulation of the data collected.
Rigor and Trustworthiness

Efron and Ravid (2013) stated that researchers have to be confident that their research findings are “valid in order for the results of the study to be useful” for educational practice and how to use the findings to make decisions or shape future indications (p. 70). Regarding a study’s rigor, or validity, it is important for researchers to select data collection instruments and procedures that will ensure the validity of the data collected (Creswell & Plano Clark, 2018). Although validity can differ in the use of qualitative and quantitative methods, both approaches can be used to assure the quality of study’s results and the interpretation of the data.

Qualitative. For qualitative research methods, there tends to be more of an emphasis on validity, or trustworthiness, of the study. The strategies used to establish authenticity of the research findings are triangulation, prolonged time, peer debriefing, member checking and disciplined subjectivity.

Triangulation. According to Efron and Ravid (2013), triangulation is “the practice of relying on more than one source of data by using multiple methods (p. 70).” In this study, I used semi-structured interviews to obtain perspectives from students and faculty regarding their involvement in the simulated learning activity. By using this approach, I was able to triangulate the data collected from the interviews with the responses provided in the post-event simulation surveys and the blood bank practicum journal entries to establish the trustworthiness and the validity of the study.

Prolonged time. To develop a deeper understanding of the social phenomenon of the study, I spent a prolonged amount of time with the participants in the
observational setting. As an observer during the simulation-enhanced IPE activity, I was able to be present in the same setting as participants, which assured more accurate or valid observations in the field (Creswell and Creswell, 2018).

**Peer debriefing.** Creswell and Creswell (2018) discussed the use of peer debriefing as a means of enhancing the accuracy and validity of the account. My dissertation advisor and CLS faculty participants reviewed the findings from this study with me so that the account itself would “resonate with people other than” myself as the primary researcher (Creswell & Creswell, 2018, p. 201). Through this process, I was able to add validity and authenticity to the findings of this study.

**Disciplined subjectivity.** Efron and Ravid (2013) invited researchers to acknowledge their own subjectivity and preconceived ideas in the research. As the primary researcher, it was important for me to maintain an on-going reflection of my own biases regarding the setting of the simulation-based learning activity, the faculty and learner participants involved, and the selected topic for this simulation (Efron & Ravid, 2013). By addressing my positionality in this research and relying on evidence-based practice for the intervention, it was my intention to establish trustworthiness of the study in the approaches used to analyze and interpret the data collected.

**Quantitative.** To ensure the rigor and trustworthiness of the quantitative data collected, the primary researcher opted to use the standardized post event survey used by the simulation center for all simulated learning activities. The post event survey was validated by the simulation center for the intended purpose of capturing meaningful
indicators of the construct being measured and to ensure reliability of scores provided by participants (Creswell & Plano Clark, 2018).

**Ethical Considerations**

The use of both qualitative and quantitative research methods required further consideration of potential ethical issues related to the data collection procedures and processes. Ethical considerations such as disclosing my role as the primary researcher, the handling of sensitive student information, disclosure of research purposes to student and faculty participants, and reciprocity to participants for their willingness to provide data for this study were considered as it pertained to consent and privacy (Creswell & Plano Clark, 2018). To foster reciprocity among study participants, I conveyed the purpose of this study and how their data would be used. As the primary researcher and an educator, I wanted to use the intervention of Sim-IPE as a bridge to improve student preparation from their classroom experience to their entry into a collaborative healthcare workforce with an enhanced focus on reducing medical errors to optimize patient safety outcomes (Poore & Cooper, 2020). For students, their participation in this study provided them an opportunity to practice skills they would be able to transfer from their classroom learning to their future clinical practice such as interprofessional communication, problem solving and decision making in a simulated clinical environment (Poore & Cooper, 2020). As mentioned in the data instrument section, students were asked to review and sign media consent forms for audio/video recordings of each simulation session. Additionally, I was granted approval from the
institutional review board (IRB) for human research from the Office of Research Compliance through my academic research institution (see Appendix L).

Moreover, the site and site personnel for the simulation-based procedural training activity had to be regarded with respect and handled in a manner that did not disrupt other scheduled simulation-based education activities at the simulation center (Creswell & Plano Clark, 2018). Since the post-event simulation survey was created by the simulation center, I sought approval from the leadership team of the simulation center to conduct the study through the simulation center as well as use of data collected as a part of the simulated-based procedural training sessions. Through the identification of a beneficial research problem, the leadership team of the simulation center and I agreed on the meaningfulness of this study for others, including faculty, students and collaborators from other academic programs in the use of Sim-IPE as a proposed educational intervention. This research was fully supported by the simulation center team as well as the contributing faculty to ensure the integrity of the study.

Summary

The mixed methods research design for this study involved both qualitative and quantitative data collection in response to the research questions posed regarding interprofessional practice, role clarity/professional identity, and patient safety awareness. Both forms of data collection integrated the use of data collection tools including observations, journal entries, interviews, and surveys. Following data collection, the qualitative and quantitative databases were merged using the convergent mixed methods approach to gain an enhanced understanding of the
problem of practice and the research questions posed by the study (Creswell & Creswell, 2018).
CHAPTER 4

FINDINGS

The fourth chapter begins with an overview of the problem of practice and research questions for this mixed methods research study. Following the review of the research questions, the research methodology as well as the data analyses for the quantitative and qualitative findings are presented.

Problem of Practice

The problem of practice for this mixed methods action research study was focused on a gap identified in the traditional curriculum of undergraduate clinical laboratory science (CLS) program students and the need to address the lack of exposure to patient safety concepts as well as enhance their understanding of the role of medical laboratory professionals in quality of care. Interprofessional skills, such as teamwork and communication, were not formally embedded into the undergraduate CLS curriculum to better prepare undergraduate CLS program students for their transition from the academic environment into real-world clinical laboratory practice. According to the literature, it has been deemed essential for pre-professional CLS students to gain an enhanced understanding of their future role as medical laboratory scientists on the interprofessional healthcare team in the collaborative effort to increase patient safety and quality of care for patients.
Research Questions

As previously established in Chapters 1 and 3, the research questions that were addressed in this mixed methods action research study were as follows:

1. What is the impact of simulation-enhanced IPE on an undergraduate CLS student participants’ understanding of patient safety and quality of care following participation in a simulation scenario?

2. By participating in a simulation-enhanced IPE activity, how does this immersive experience help undergraduate CLS students see themselves as contributors towards patient safety?

3. How do undergraduate CLS student participants view their role as members of the healthcare team?

Methodology

A mixed methods action research study was conducted to assess the integration of fourth-year undergraduate CLS program students into a simulation-enhanced interprofessional education (Sim-IPE) activity. The study focused on student perceptions related to patient safety, quality of care, and their future roles as laboratory professionals on the interprofessional healthcare team. The proposed Sim-IPE intervention was planned as a simulation-based procedural training activity that focused on the clinical content of the blood bank area, given its emphasis on patient safety and quality of care concepts.

The student participants were those who were enrolled in their fourth year of the undergraduate CLS program, successfully completed all didactic coursework leading
up to the clinical practicum component and were pursuant of a Bachelor of Science degree in clinical laboratory science (refer to Figure 4.1). All student participants were scheduled to begin their sixteen-week clinical practicum (also referred to as clinical rotations) at local area hospitals and clinical reference laboratories for the Spring 2023 academic semester. To prepare these undergraduate CLS program students for their transition from the student laboratory setting to the real-world clinical laboratory environment, this simulation-based procedural training activity was implemented as a bridge between the Fall 2022 semester didactic coursework, including student laboratory activities, and the start of their scheduled Spring 2023 clinical practicum.

Prior to their participation in the simulation-based procedural training activity, all sixteen undergraduate CLS program students were assigned prework to assess their level of competency in core blood bank concepts and to introduce them to other relevant blood bank laboratory practices. Student participants were required to complete clinical competency review assignments in transfusion safety and were provided additional enrichment resources for review, including educational videos related to blood bank laboratory testing procedures. Data collection occurred during the intervention in early January 2023 (simulation-based procedural training), throughout the Spring 2023 term (clinical blood bank practicum) and continued into the Summer 2023 term. In this study, qualitative and quantitative data were gathered from document analysis (16 post-simulation event survey results, 240 daily clinical practicum journal entries), interview responses from faculty and student participants (3 faculty, 4 students), and video
observations from the recorded simulation-based procedural training sessions.

**Quantitative Data Analysis**

For the quantitative data analysis, post-simulation event survey results were collected immediately following student participation in the simulation-based procedural training sessions conducted in early January 2023. The quantitative data results were compiled by the simulation center educational delivery team and shared electronically with CLS program faculty following the completion of all scheduled
procedural training event dates. The post-simulation event survey was completed at a 100% response rate, which was representative of all sixteen undergraduate CLS student participants scheduled to begin their sixteen-week clinical practicum in January 2023. The compiled post-simulation event survey results were reviewed using a question-by-question analysis because each question focused on a different component of the simulation-based procedural training experience.

![Graph showing responses to question on instructors' orientation to training environment and expectation explanation.]

**Figure 4.2: Question – Training environment**

In Figure 4.2, student participants were asked to provide their responses to how well the instructors oriented them to the training environment and explained their expectations of student participants for this simulation-based procedural training activity. The training environment consisted of the conference room, where instructors provided a pre-brief for students before the start of the simulation-based procedural training activity, the inpatient simulation laboratory where the simulation-based procedural training session took place, and the conference room where the debriefing phase was conducted after the simulated activity. In their observation of instructor
performance, 88% of student participants indicated that the instructors oriented them extremely well to the training environment and explained expectations of the simulation-based procedural training activity. The remaining 13% believed that the orientation to the training environment went moderately well. Some of the students shared that they “liked the professor being in the room for necessary questions” and having someone to rely on if they had any questions during the simulation-based procedural training session.

Figure 4.3: Question – Psychological safety

In Figure 4.3, student participants were asked to indicate to what extent did the instructors establish a safe place to practice and challenge their clinical skills. Remarkably, all the student participants (100%) marked that the instructors established a safe place to practice and challenged their skills to a great extent. In the open-ended comment section of the survey, students stated how they liked “the atmosphere of it feeling like a real blood bank” as well as “the realistic vibe” of the setting.
In Figure 4.4, student participants were asked to assess to what extent the stated learning objectives were achieved through the training. The learning objectives for the simulation-based procedural training activity were provided to the student participants during the pre-brief phase of the session. The learning objectives for the simulation-based procedural training activity were notably achieved based on the undergraduate CLS student participants (refer to Appendix J). According to the survey results, 100% of respondents indicated that the stated learning objectives were achieved ranging from “to a moderate extent” (13%) and “to a great extent” (88%).
In Figure 4.5, student participants were asked to measure the level of effectiveness by which instructors supported their learning during the simulation-based procedural training activity through coaching, feedback, and sharing their perspectives.

Regarding the effectiveness of instructors, 88% of respondents indicated that the instructors were effective in supporting their learning through coaching, feedback, and sharing their perspectives during their training session as “definitely yes” with the remaining students indicating a “probably yes.” One student expressed how the training session “wasn’t as intimidating as I imagined” and attributed the effectiveness of their learning experience to the feedback provided by the professor who remained in the inpatient simulation laboratory throughout the duration of the activity.
In Figure 4.6, student participants were asked if they believed that this training would contribute to the improvement of quality and/or safety of care in the clinical setting. Collectively, survey respondents believed this simulation-based procedural training activity (94% definitely yes, 6% probably yes) would contribute to improving the quality and safety of patient care in the real-life clinical laboratory setting. In the open-ended comments section, some of the students stated that they liked “being able to practice communication with nurses” and “learning how to better report results over the phone to other healthcare team members as well as getting to adapt to multitasking between testing and answering the phones.” Other students noted “proper procedure adherence” and the ability “to get familiar with instruments we will be using in the near future” as additional quality of care aspects they enjoyed learning about through their participation in this training activity.
In Figure 4.7, student participants were asked to assess how confident they were that they could apply what they practiced in this simulation to a future clinical event. Following their participation in the simulation-based procedural training activity, 100% of student participants felt confident with most of them feeling extremely confident (94%) and the remainder feeling very confident (6%) that they could apply what they practiced in the simulation-based procedural training event. In an open-ended comment, an undergraduate CLS student shared that they “like that this training helped me gain my confidence as a professional scientist moving forward. It was helpful to communicate and practice.”
Although students responded to this question, this survey question (Figure 4.8) did not apply to this simulation activity. As indicated by 31% of student participants, patient medical records were not used in this simulation-based procedural training. This was a standing question built into the general PES administered to all learners, including medical students, who participated in simulation-based learning activities at the simulation center. In review of the responses to this question, 56% of student participants marked “extremely effectively” regarding how effective the patient’s medical record supported the transfer of this training to their clinical practice whereas the remaining 13% selected “somewhat effective.”

Based on the students’ responses, they might have perceived the laboratory requisition form (LRF) provided with the patient sample as a patient medical record. However, medical records are documented accounts of a patient’s medical history, including diagnostic laboratory results, whereas a LRF provides information about the laboratory tests being ordered as well as patient demographic information. For some
student participants, this was their first time interacting with this type of form, which explained why they answered the question in this manner. One student mentioned in the open-ended comments section that they used the LRF to help “identify the patient before discussing laboratory results,” which supported the assertion that some students viewed this form as a patient medical record. The use of this question within the post-simulation event survey for future simulation-based procedural training events will be revisited by CLS faculty to prevent confusion of the LRF with the patient medical record.

![Graph showing the suitability of training level]

**Figure 4.9: Question – Suitability of training**

In Figure 4.9, student participants were asked to determine how suitable was the level of difficulty for this simulation-based procedural training. During the development and design of a simulation activity, instructors aim to appropriately level the training to the learners’ content knowledge and experience. In a review of the provided responses, 94% of student participants thought the training level was just right with 6% indicating that the simulation-based procedural training session was somewhat too easy for them. In an open-ended comment toward the end of the survey, one of the students offered
that “the event was somewhat too easy, but it is in a short amount of time, so the pacing was okay.” None of the student participants marked the training as too hard or much too easy.

Figure 4.10: Question – Length of time

Figure 4.10 addressed the suitability of the length of time for this simulation-based procedural training session. According to the students who participated in this activity, 100% of respondents indicated that the two-hour session was just the right amount of time for the content covered.

Figure 4.11: Question – Recommend to others
In Figure 4.11, student participants were asked to what extent would they recommend this simulation-based procedural training activity to others. Overall, 100% of respondents indicated that they would recommend this simulation-based procedural training to others to a moderate (19%) and great (81%) extent. Open-ended comments from students noted the training as a “good opportunity” and “it better represented what working will be like in real life.”

**Open-ended questions.** The remaining section of the survey was comprised of five open-ended questions, which were optional for student participants to enter their responses into open text fields. Similarly, to the analysis conducted on the first portion of the post-simulation event survey, the student responses were reviewed using a question-by-question analysis approach. In the first open-ended question, students were asked to name at least two things that they liked or learned in this training. Out of the fifteen responses provided, many of the comments highlighted communication and the ability to practice their skills in a replicated patient care environment. One of the students stated that “learning how to better report results over the phone to other healthcare team members as well as getting to adapt to multitasking between testing and answering the phones” were the two things they learned in this training. Meanwhile, other students noted how they “liked being able to use nicer equipment that we don’t have in the student lab” and learned “that nurses coordinate patient care around the times we tell them for test completion.” Additionally, students referred to “communication over the phone and multitasking” in their responses, with one student
summarizing this as “the phone calls were very realistic and helped in communication with the nurse. I learned more about pacing and setting realistic times for tasks.”

In the second open-ended question, student participants were asked to respond with two things that we should have focused on or that could be improved by the faculty who developed the simulation-based procedural training activity. There were ten total responses provided by student participants which included some students who stated that the activity “was good” and “the tasks we focused on were just right to practice.” A few students expressed that adding in other health professions students “who could train as well” or “all together had an event where we put our skills to the test” would be beneficial for interprofessional practice. Furthermore, some students suggested focusing on expectations for phone communication and “interpretation of results to nurses” as things to improve. Understandably, this was a first-time experience for many of the students to engage in phone communication and result interpretation tasks with other healthcare workers (HCWs) which may have been challenging for those without previous clinical experience.

For the third open-ended question, student participants were asked if they had any other comments to offer about the procedural training activity. In the three responses provided, students conveyed positive learning experiences with “I enjoyed it” and “nope, good opportunity” with no additional comments offered. One student summarized with “we should do more of this” and that “an IPE event would be cool for collaboration” which indicated their interest in additional simulation-enhanced IPE
events with student representation from other health professions programs including nursing.

In the fourth open-ended question, student participants were asked what aspects of their use of the medical record were most useful to their experience. As noted earlier in the analysis of the question related to Figure 4.8, patient medical records were not used in this simulation-based procedural training activity. However, it was asserted that some students considered the laboratory requisition form used in this activity to represent a patient medical record. As a result, one student responded to this question that the medical record helped them “to identify the patient before discussing laboratory results.” Based on their response, it was inferred that this students’ response was pertaining to the use of the laboratory requisition form provided with the patient sample.

The fifth and final open-ended question from this survey asked student participants what elements of the medical record would be necessary to support their learning. This follow-up question was geared toward participants who responded “only slightly” or “not at all effectively” to the question: How effectively did the patient’s medical record support the transfer of this training to your clinical practice? Although a patient medical record was not provided, one student indicated “patient history and status” as elements that would have supported their learning.

Overall, the undergraduate CLS student responses to the post-simulation event survey were positive about their participation in this simulation-based procedural training activity. Based on their responses, student participants believed that this
educational intervention contributed to their knowledge and practice of quality of care and patient safety concepts. Many of the student participants indicated that they could apply what they practiced in this simulation-based procedural training activity to their future clinical practice. Their reflections about the ability to practice in a simulated clinical laboratory environment and engage with an interprofessional member of the healthcare team (e.g., a nurse) were well documented in the open-ended responses provided by students. Notably, some student participants articulated how this simulation-based procedural training represented what working in a real-world laboratory would look like for them and that they planned to apply the skills learned through this educational intervention to their future clinical experiences.

Qualitative Results

For the qualitative data analysis, data results were collected across three stages of the clinical education process: simulation-based procedural training (video observations from recorded sessions), clinical blood bank practicum (daily journal entries), and following the completion of the clinical practicum (faculty and student participant interviews). For consistency and organizational flow, the sequence of qualitative data analyses began with the daily journal entries submitted by undergraduate CLS students during their three-week clinical blood bank practicum. Immediately following their participation in the simulation-based procedural training activity, undergraduate CLS students started their sixteen-week clinical practicum experience within a real-world clinical laboratory environment which included a three-week practicum component in the blood bank. Specifically related to the clinical blood
bank practicum, students were required to submit daily journal entries as a part of the curricular requirements for the undergraduate CLS program.

**Results from the daily journal entries.** At the start of their clinical blood bank practicum, undergraduate CLS students were provided with a set of instructions for the completion of their daily log entries, which included technical and reflective journaling components (refer to Appendix G). I compiled and reviewed their daily journal entries that were submitted during the Spring 2023 semester using qualitative data coding. The qualitative data were derived from the individual daily journal entries submitted by student participants during their three-week clinical blood bank practicum experience.

The clinical blood bank practicum provided student participants with the opportunity to bridge theoretical concepts learned during their previous educational experiences in the undergraduate CLS curriculum as well as the simulation-based procedural training activity to their clinical practice in a real patient care setting. The clinical blood bank practicum was primarily comprised of hands-on clinical training in addition to direct observations and narrative lectures provided by laboratory personnel. Based on the review and data analysis of their daily journal entries, many of the submissions included technical performance elements such as the number of laboratory tests performed and completion of other laboratory tasks such as phone calls placed to other healthcare team members as well as preparation of blood products for transfusion. Embo et al. (2014) posited that learners in clinical practice prefer to write reflections on concrete actions, also referred to as reflection-on-action, “because of the immediate perceived learning effect on performance improvement (Embo et al., 2014,
Some “conceptual, emotional, relational, ethical, and personal” reflective elements were mentioned as a part of the clinical practice experience such as perspectives about confidence and self-efficacy (Ruiz-López et al., 2015). Student quotes from the daily journal entries were coded and the following themes emerged: quality of care in the laboratory environment, student perceptions of performance and self-confidence, increased awareness of patient safety concepts, and engagement in interprofessional interactions and communication.

**Quality of care in the laboratory environment.** As described in an article published by Clinical Chemistry and Laboratory Medicine, quality indicators should be used in the laboratory “to promote the reduction or errors in the total testing process (TTP) as well as an improvement in quality and patient safety (Plebani et al., 2014, p. 952).” Accrediting agencies and certifying bodies for the blood bank laboratory, including the Joint Commission and the Association for the Advancement of Blood & Biotherapies (AABB), have worked to establish quality of care that improves patient outcomes with a focus on quality improvement. Within this data set, the technical examples of continuous quality improvement performance were heavily documented in daily journal entries.

From the students' perspectives, laboratory quality-related technical tasks included completion of daily quality control (QC) for reagents before patient specimen testing, equipment maintenance for laboratory automation used in the patient testing process, temperature checks for equipment storing blood components, and visual
inspections of blood prior to issuance of blood products for transfusion purposes. One of
the student participants recorded the prioritization of their laboratory work as follows:

It was really busy today- way more busy than it has been since I have been here! I
got right in and went straight to work with the QC and recording temperatures.

This student quote was consistent with the daily journal entries of other student
participants such as “first thing this morning I performed QC quickly anticipating the
delivery of blood components” and another student who provided additional details
about their daily QC process which involved recording temperatures as well as
instrument maintenance:

Did morning QC and maintenance checks. This involved testing the rack reagents
and recording the temperatures of the room, water bath, fridges, freezer, and
platelet incubator. I also did QC on the cell washer.

Repetitively, student participants accounted for their task performance of
laboratory quality processes in their journal entries to account for tasks observed and
performed. During their first half of the clinical blood bank practicum, a student
participant shared how “the QC process took a while since I was still getting used to
where things were, but I am confident I will be able to complete it more quickly
tomorrow” which was interpreted the student’s motivation to improve their
performance in QC with accuracy and task repetition. In a different journal entry, a
student participant expressed “QC and temperatures! Again I am feeling really
comfortable with this and I breeze through it with ease” which indicated their increased
level of familiarity with tasks performed to ensure laboratory quality.
During the clinical blood bank practicum, undergraduate CLS students were exposed to examples of quality of care in the clinical laboratory through their interactions with their clinical instructors. These laboratory professionals, who also worked as clinical instructors, had an impact on the students’ awareness of quality of care concepts which was observable in their reflections. Isabel (2016) described the role of the clinical instructor, or clinical preceptor, as “an important component of student success during clinical education learning (Isabel, 2016, p. 70).” There were instances when clinical instructors shared their professional experiences through the use of narratives to help convey pertinent information. A working definition of narrative has been described as “a sequence of events connected together in a way that gives them meaning (Easton, 2016, p. 11).” Some clinical instructors used narratives to explain laboratory processes and their impact on the quality of care. As detailed in one of the journal entries, a clinical instructor provided an undergraduate CLS student with an overview of the visual inspection process for blood products.

[The clinical instructor] also went through the visual checks she makes when inspecting a unit prior to sending it up. She explained how bacterial contamination appears in a contaminated unit as well as how clots and icterus appear. She really instilled the importance of visual checks on units that needed to be used for patient use.

Another student participant reported how their clinical instructor reviewed a situation when laboratory quality control (QC) was not performed for diagnostic laboratory tests conducted by non-medical laboratory scientists (MLS) personnel. As a
building block for quality, laboratory QC must be performed to verify laboratory testing processes operate efficiently and ensure the production of accurate test results. In this example, the student participant noted their own reflection about a clinical instructor’s description of this issue related to quality of care:

The techs trained over 5000 non-MLS which mostly included nurses and regularly check on their testing compliance. They mentioned QC was the main problem as the non-MLS who are doing point of care testing often miss doing QC. As an MLS, I understand how important this [performing quality control] is.

During the first week of the clinical blood bank practicum, a student participant provided the following account from a conversation with their clinical trainer about the role of blood bank personnel in temperature monitoring of blood products:

We started off by discussing quality control temperatures for the fridges and freezers in the lab, as well as those in the operating room and labor and delivery. The temperatures for the freezers and fridges are monitored daily and are crucial in ensuring the blood products are kept in suitable conditions.

This student was correct in their observation about the steps taken to ensure the safety and quality of blood products used for patient treatment. Like the perceptions of other student participants, their mention of this process being “crucial” demonstrated their understanding of the importance of laboratory quality in the care of patients. The impact of daily QC and temperature checks was emphasized and consistently reinforced by the clinical instructors who worked with these student participants.
In addition to their hands-on training experiences, student participants were engaged by their clinical instructors to think more critically about laboratory processes and their impact on quality of care. It was evident that the role of clinical instructors was instrumental in the reinforcement of laboratory quality concepts. Student participants were able to make the connections between their knowledge and classroom experiences to the lived professional experiences of their clinical instructors as noted by their reflections about these processes.

**Student perceptions on performance and self-confidence.** During the qualitative data analysis of the daily journal entries, student perceptions of self-confidence in connection to task performance emerged during their clinical blood bank practicum experience. Performance of profession-specific tasks, such as clinical laboratory testing or preparation of blood products for blood transfusion, were often mentioned in relation to how they perceived their level of learning and development of self-confidence in the clinical environment. As described in Chapter 2 of this study, the term “self-confidence” refers to the students’ belief in their own knowledge and their capability to apply their knowledge to the successful performance of profession-specific skills (Swift et al., 2021; Aoyama et al., 2013; Druckman & Bjork, 1994). As discussed in the second chapter, Isabel (2016) assessed the perceptions of medical laboratory science students in relation to their clinical practicum experience and how the clinical learning process prepared them for their future professional practice. The study revealed student perspectives on the impact of “personal attributes and the clinical environment as a means of building confidence and competence in laboratory procedures (Isabel, 2016, p. 67).” The
researcher compiled a summary of category findings (refer to Appendix K) which linked student self-awareness to knowledge of laboratory skills and gaining confidence in relation to task performance. Stemming from participant descriptions, the researcher presented a model of the clinical learning process that closely aligned with the clinical learning process of the student participants in this action research study (Isabel, 2016):

<table>
<thead>
<tr>
<th>Step One</th>
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</thead>
<tbody>
<tr>
<td>Clinical instructor demonstrates (explains process)</td>
</tr>
<tr>
<td>Step Two</td>
</tr>
<tr>
<td>Learner practices task(s)</td>
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<tr>
<td>Step Three</td>
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<tr>
<td>Learner performs tasks unobserved</td>
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<tr>
<td>Step Four</td>
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<tr>
<td>Learner performs tasks independently</td>
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<tr>
<td>Step Five</td>
</tr>
<tr>
<td>Learner gains confidence in performing tasks and is able to solve problems independently.</td>
</tr>
</tbody>
</table>

Figure 4.12: A Model of the Clinical Learning Process *(Adapted from CLS Education: MLS Student Perceptions)*

In this action research study, some student participants reflected on their own task performance as well as direct observations of tasks performed by laboratory professionals and how those observations shaped their perceptions about the profession. In this example that aligned with first step of the clinical learning process, an undergraduate CLS student participant was observing other laboratory professionals and
stated how “it was a fascinating experience to see the intricate processes involved in ensuring the safety and efficacy of blood products” including that they were “impressed by the level of expertise and attention to detail that the lab workers displayed in every step of the process.” This students’ reflection on action demonstrated their interpretation of the tasks performed and their understanding of how attributes, such as professional expertise and attention to detail, contributed to the laboratory professionals abilities to successfully perform laboratory tasks.

During a separate encounter, another student shared the following reflection about their observation of the laboratory teams’ response to an emergent trauma case:

I got to see how the entire blood bank works together as a team to get the blood products ready for pickup. The whole morning was really cool to see because this was really the first we had seen how chaotic the blood bank can get but everyone handled it very well and seemed to know exactly what to do.

This reflection was consistent with other students’ comments about their observations of laboratory professionals including this example where a student observed the performance of a blood bank order workup for another emergent patient case. They reported, “I tried to keep out of the way and just watch since I hadn’t done one yet, and it was impressive to see how fast everyone responded”. In congruence with the abovementioned journal entries, this student’s reflection linked the attributes of timeliness and the ability to forge their profession-related expertise in the execution of this task.
Over the duration of the three-week clinical blood bank practicum period, there was an observable pattern of increased self-confidence among student participants regarding their blood bank practicum experience. During the first week of their clinical practicum, one student expressed, “looking forward to improving my efficiency and confidence in interpreting results as I continue with the next two weeks of blood bank work” which indicated their desire to increase their level of confidence in their task performance. Other student participants shared how they “thought that the class was really interesting” and “felt that this department requires using a lot of knowledge gained from class” as well as it was “nice to be able to do the work and correlate it to the information surrounding it [blood bank] at the same time”. Considering the second step from the model for the clinical learning process (see Figure 4.12), the following student quote was based on their task performance while being observed by their clinical instructor: “By the end of today, I feel more confident in working up patient samples with a technologist’s supervision”. Another student mentioned how repetition of a task with their clinical instructor helped them increase their confidence: “we also did another fetal bleed screen today which I am feeling more confident on”.

By the second and third weeks of their clinical blood bank practicum, students noted their increased confidence in performing key tasks within the clinical laboratory environment. Following a process review, a student mentioned that it “was very beneficial, and it increased my confidence in being able to complete these tasks on my own” which aligned with the third step of the clinical learning process (see Figure 4.12) whereas another student’s quote described a situation when they were assigned the
task of donor reconfirmations on packed red blood cell units received from the blood center. In their own words, the student noted “when they arrived it was my job to do the donor reconfirmation” and further stated, “this is another thing I am feeling more and more confident about.” During the performance of a different blood bank task, this student participant reported, “I also dispensed some units all by myself today which was another thing I’m feeling more confident about” in alignment with step four of the clinical learning process, where learners begin to perform tasks independently (see Figure 4.12). Toward the end of their practicum experience, student participants attained the last step of the clinical learning process (see Figure 4.12) in which learners demonstrate gain self-confidence in task performance and their ability to problem solve on their own. A student quote stated how they felt “really confident in blood bank” and another asserted that “at this point, I am feeling comfortable with everything in the blood bank to be left alone if needed” including “I feel like I have been trained on everything” which confirmed their sense of self-efficacy and belief in their own skills to successfully perform tasks independently.

Furthermore, student participants connected their feelings of self-confidence to their perceptions of their future role as laboratory professionals in the blood bank. The following student quote was extracted from the last day of the three-week clinical blood bank practicum experience:

All in all I really enjoyed my time in blood bank. I find the theory really cool and the problem solving is very fun. Each case is so unique and has so many steps. The blood bank is somewhere I could see myself working in the future.
In a shared sentiment, another student participant remarked “after two weeks in the blood bank, I have found that I like this working environment more than the core lab” and “I could see myself working in blood bank”. Overall, the ability to apply one’s knowledge gained in the clinical learning process to the successful performance of tasks in the clinical laboratory environment impacted self-confidence and student’s perceptions about their blood bank practicum experience.

As observed by Isabel (2016) in their own study of undergraduate medical laboratory science students, the student participants in this research study linked their successful performance in the clinical practicum to their “self-awareness and the ability to identify one’s strengths and skills” (Isabel, 2016, p. 70). The use of the term, confident or confidence, in the daily journal entries by several student participants was significant in how they perceived their level of competency in their task performance as well as their ability to work as a laboratory professional. In this study, student participants self-identified their ability to increasingly perform laboratory tasks independently through gained experience and knowledge from their clinical practicum experience. The development of self-confidence was “pivotal to student performance” and enabled them “to formulate goals, engage in communication and feel valued within a team learning environment” (Swift et al., 2022; Cowen et al., 2016).

**Increased awareness of patient safety concepts.** In a statement issued by the American Society for Clinical Laboratory Science (ASCLS), laboratory professionals have the professional responsibility and ethical duty to advocate for patient safety (ASCLS, 2021). One of the student quotes was very direct in their reflection about the role of
laboratory professionals in patient advocacy by stating “as healthcare professionals we need to ensure we are always advocating for our patients.” The professional responsibility for patient advocacy was impressed upon other student participants by their clinical instructors who “emphasized double checking and calling providers to confirm that they want that [blood product] instead of the other product. Advocating!” and “sometimes it is best to use your own knowledge instead of blindly following orders”. These examples demonstrated the importance of exercising one’s ethical duties in clinical practice, such as effective communication and knowledge sharing with interprofessional healthcare team members, as a form of patient advocacy and promotes patient safety. Figure 4.13 highlights all three instances where student participants noted their reflections on the role of laboratory professionals in relation to patient advocacy to promote patient safety:
In the field of laboratory medicine, patient advocacy and patient safety concepts are connected by the professions’ focus on the patient-centered care (ASCLS, 2021). Opportunities to advocate for patient safety from a laboratory perspective includes the provision of provider education on appropriate test ordering practices, proper specimen collection, and accurate laboratory test result interpretation (Kalra & Baniak, 2016). Additionally, other ways to advocate for patient safety involve improving communication with all healthcare team members and suggesting methods to prevent errors or harm to patients (ASCLS, 2021). For each of the student quotes that promoted advocacy for patient safety (refer to Figure 4.13), there were connections to effective communication and knowledge sharing. As laboratory professionals, these students observed that advocacy reduced medical errors and increased patient safety.
Within patient safety, there were student observations regarding the established blood bank testing processes to provide safe, compatible blood transfusions for patients. An undergraduate CLS student shared their account that “sending out blood was a bit more tedious, with several steps to make sure we were issuing the correct blood and sending it to the right place”. In relation to patient safety and laboratory testing practices, another student stated, “that it’s better to check your results or to run the extra testing and have it come back negative than to miss a diagnosis because you didn’t think it was necessary”. Other learner attitudes emerged about the importance of confirming test results and the potential impact of inaccurate test results on the provision of safe, patient care. Some of the observations noted by students included how one of the laboratory trainers “explained the importance of triple-checking all patient information to deter misidentifications or clerical errors” and another example when the student performed the task which involved “checking everything over for clerical errors.”

Furthermore, student participants noted examples about the importance of confirming patient identifiers such as name, medical record number (MRN), and date of birth (DOB) throughout the testing process. An undergraduate CLS student recalled learning that “before a specimen is collected, the patient’s identity should be verified using TWO unique patient identifiers on the identification bracelet”. Moreover, students were consistent in documenting “the patient’s MRN, DOB, product type and number all matched” and “upon clerical and ABO/Rh rechecks, everything checked out properly”
indicating how the perceived the importance of documenting completion of this task in their daily journal entries.

Plebani et al. (2020) highlighted the significance of the work performed by laboratory professionals in safeguarding patients in a healthcare setting. The notion of patient safety was noted by some student participants which demonstrated their level of awareness about the potential impact of laboratory errors, such as patient misidentification or clerical errors, on the delivery of quality patient care. During the clinical learning process, it was imperative for student participants to have increased understanding of their role in ensuring patient safety. It was apparent that student participants enhanced their understanding of the impact of laboratory processes on patient safety as well as the importance of error prevention to mitigate the risk of harm to patients (Plebani et al., 2020).

**Engagement in interprofessional interactions and communication.** As practiced during the simulation-based procedural training activity, student participants detailed their observations of interprofessional communication and their interactions with other members of the healthcare team during their clinical blood bank practicum experience. The data extracted from the daily journal entries revealed that interprofessional communication occurred primarily between laboratory professionals and nurse professionals via phone, with some interactions that took place in person. These encounters were focused on the communication of laboratory test results, confirmation, and clarification of test orders, as well as the status of blood products ready for blood transfusion. Student participants mentioned opportunities to practice interprofessional
communication in their journal entries, such as “I did get more practice in answering the phone and calling nurses to let them know we had blood ready,” and another student added, “I also was able to complete the computer crossmatches and call the floor to let them know the blood was ready while [the clinical instructor] supervised”.

In other instances, the interprofessional interactions presented opportunities for laboratory professionals to share their knowledge with healthcare professionals and collaborate in the coordination of patient care. One of the students’ observations mentioned “how the techs were knowledgeable and attentive to the needs of the doctors and nurses when they got calls, providing them with relevant information and guidance”. This perception about the interprofessional collaborative practice of the healthcare team was noted in the practicum experiences of other students. In other examples, student participants documented their observations of interprofessional collaborative practice and how they perceived their role as a member of the interprofessional healthcare team. There were instances where students had the opportunity to accompany other healthcare team members in observing medical procedures being performed on patients (refer to Figure 4.14). Traditionally, undergraduate CLS students have limited experiences with direct patient care; therefore, these direct observations in the patient care environment were beneficial for these student participants to connect the work performed by laboratory professionals to the continuum of patient care.
Figure 4.14: Learner observations on interprofessional collaborative practice (IPCP)

Through this immersive clinical blood bank practicum experience, students were able to make the connection between their roles as learners and as laboratory professionals to the profession-specific responsibilities carried out by other members of the healthcare team. Their ability to go beyond the walls of the clinical laboratory into other areas of patient care areas in the hospital allowed these students to observe the impact of laboratory medicine in optimizing patient care through teamwork and effective communication. By engaging with other members of the interprofessional healthcare team, it was evident that these undergraduate CLS students were able to broaden their awareness about interprofessional collaborative practice and their contributions of their roles on the interprofessional healthcare team.

**Results from student participant interviews.** Following the completion of the clinical blood bank practicum, undergraduate CLS student interviews were conducted.

"These cases were very interesting. It was so cool to hear the different members share their input, whether it is a nurse from the trauma bay or the physician that operated on the patient."
- Observing a hospital committee meeting

"The nurse let me come see the process she takes to start the transfusion which I thought was so interesting."
- Observing a patient blood transfusion

"A medical student who came to shadow brought a book about cardiac surgery with her, and it had the type of surgery that was happening in it, I got to read about it and learn through that book. It was a great experience that I am glad I got the opportunity to participate in."
- Observing cardiac surgery in the OR

"I was invited down to go watch the [apheresis] process. It was really interesting to see the units go full circle. The apheresis nurse was very informative when explaining the process."
- Observing a patient apheresis procedure
between the months of May 2023 through June 2023. Due to scheduling reasons, four out of sixteen student participants were available to take part in the semi-structured interview. Each interview was conducted individually via Zoom where students were presented with eleven questions about their experience in the simulation-based blood bank procedural training session and their transition into their clinical blood bank practicum. The qualitative data were derived from their oral responses provided for each question during the individual semi-structured interviews. To gain an enhanced understanding of the background and experience for each student prior to their participation in this clinical learning process, I gathered the following demographic information provided in Table 4.1:

Table 4.1 – Student participant interviewee profiles

<table>
<thead>
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<th>Student Profiles</th>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>experience?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous clinical</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>laboratory experience?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes to healthcare</td>
<td>Phlebotomist</td>
<td>Phlebotomist, Laboratory Assistant</td>
<td>Pharmacy Technician</td>
<td>Contact tracer (COVID-19 Testing)</td>
</tr>
<tr>
<td>and/or clinical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>laboratory experience,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>which role(s)?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous interprofessional</td>
<td>Yes, learner</td>
<td>Yes, learner</td>
<td>Yes, learner</td>
<td>Yes, learner</td>
</tr>
</tbody>
</table>
Student participant responses were coded, and the following themes emerged: learner perspectives on the transition from simulation-based blood bank procedural training to clinical blood bank practicum, enhanced understanding of patient safety and quality of care, and the visibility of the laboratory’s role on the healthcare team.

**Learner perspectives on the transition from simulation-based blood bank procedural training to clinical blood bank practicum.** During the semi-structured interviews, student participants were asked questions pertaining to the use of the educational intervention [simulation-based procedural training] as a bridge between their student laboratory experience and their clinical blood bank practicum experience. In reflection of the simulation-based blood bank procedural training, Student EE described this educational intervention as “a really good refresher” and that “it was a good bridge” in how students were provided “the opportunity to be multitasking with those [laboratory procedures] as well which was really great”. Student DD added that the “student lab [was] very different from what a regular lab is” and “being able to have people around you who are also working in more of an environment that actually represents what a lab is going to be like, it makes it less intimidating to get there”. To further elaborate, Student FF stated the following:

> It was helpful in the blood bank practicum. Okay. Because what we have in student lab isn't as similar or isn't that similar to what you do in the hospital
blood bank lab. I mean, these tasks are the same, but the equipment you're using and stuff is different. I feel like the simulation, the equipment we use there was a lot closer to what we used in the hospital. It was like a steppingstone with that. So it felt like less of a learning curve.

Some of the student participants expressed how the simulation-based procedural training provided a realistic depiction of the day-to-day workflow of an actual clinical laboratory environment. Student GG shared that, “the simulation felt like a good representative of a normal day in the lab,” based on what they experienced during the clinical blood bank practicum experience. Student GG continued that “it was overall just a really good representation of things that I dealt with every day in the lab” such as “getting things done in a timely manner and performing the procedures properly and also the tests that we did perform”. Student EE mentioned that “it was cool to be in a different environment than the student lab” because “it [was] just neat that we got this new fresh space that was honestly more similar to the blood bank”. Additionally, Student EE appreciated that the simulation laboratory setting was “very clean and very organized and it looked more like a professional workspace” because they were able to get “more familiar with the environment that I was going to be in” for their clinical blood bank practicum experience.

In the review of the student participants’ perspectives on their transition from the simulation-based procedural training into the clinical blood bank practicum, it was apparent that they perceived this clinical learning experience as a relevant activity that prepared them for entry into the clinical blood bank practicum. Student GG said that the
simulation-based procedural training “felt very relevant” to what they would be doing for their work inside a real-world clinical blood bank setting. Furthermore, Student GG referenced the blood type and screen testing performed during the simulation-based procedural training and how they “felt like it was really typical” of the laboratory testing performed in their clinical blood bank practicum. Student EE added to this point with their perspective about the simulation-based procedural training and how they “felt like it was a really good representation of real world lab because sometimes there is a lot of communication in the blood bank when it's needed”. Regarding the focus on blood bank for the simulation-based procedural training, Student GG shared their perspective as follows:

I think Blood Bank is a good simulation to do out of all the departments. I think it's a good simulation to do because blood bank, you need to make sure that you’re doing things right because it can be one of the more, quote unquote, dangerous or risky departments in the lab where if you do make a mistake, it could have big consequences.

This student participants’ response linked their perception of the clinical learning experience to the potential impact of errors on the critical aspect of patient safety.

Enhanced understanding of patient safety and quality of care. During the interview, student participants were asked questions about their understanding of patient safety and quality of care. In reviewing the qualitative data gathered from their responses, student participants were able to articulate the importance of their role in patient safety as well as their contributions to the quality of care. Regarding the role of
the clinical laboratory in patient safety, Student FF stated that laboratory professionals “have a super important role in patient safety because the lab is directly responsible for informing clinicians of things that can’t be observed just on a physical exam”. Student FF stated further that the laboratory “plays a super important role in provided the highest quality of care” and how it was “everyone’s responsibility to keep the patient safe”. In parallel to the responses from other student participants, Student EE responded that “patient safety is honestly one of the most important things about healthcare” and that “the lab has a really big part of patient safety”.

Some student participants provided concrete examples of patient safety from their simulation-based procedural training and clinical blood bank practicum experiences. In one example, Student EE stated that the concept of patient safety “is very obvious” and involved “obvious things like checking your patient identifiers and checking which sample you’re working with and just double checking” your work altogether. Student DD emphasized that “making sure the sample integrity is good” while also ensuring that “you’re giving out the proper [blood] units” are important aspects to improving patient safety. This student participant went on to describe how “there is a very direct point A to point B correlation between where the [medical] mistake was made and patient impact”. In addition to confirming patient identifiers and double checking their laboratory work, Student GG spoke to the importance of patient safety in “the effectiveness of [a patient’s] treatment plan” and discussed how “strong communication outside of the lab” with the healthcare team can contribute to increased patient safety. Regarding the work performed in the blood bank laboratory
section, Student EE expanded on the importance of patient safety in the following quote:

I just think specifically for blood bank, it's super important to keep patient safety in mind because blood bank is just one of those areas of the lab that something could really go wrong, and it could really affect the patient. A decision that I would make in blood bank may affect a patient right away. So I think it's just as important, but also even more important in blood bank to be checking your patient identifiers and double checking your work and communicating with everybody in the lab, on the healthcare team on the floor [because] if a patient is in need of a transfusion and they receive an inappropriate unit, it can just have very bad outcomes.

In relation to quality of care, student participants linked the importance of quality of care to the impact on patient safety. When questioned about quality of care, Student GG mentioned, “correctly following procedures and making sure that you’re interpreting your test results were really important to me during the simulation that I’ve since carried over” into the clinical blood bank practicum. Regarding accuracy of laboratory test results, Student GG elaborated further that “the results we get and everything directly influence the treatment of the patient” and acknowledged how they were “supposed to follow procedures and protocols...so that the patient safety isn’t jeopardized in any way”. Student DD perceived “the huge impact” of the laboratory on quality of care in their statement that “a lot of what I feel like we do is ensuring that everything is done properly” in blood bank laboratory testing.
For one of the student participants, a lesson on the connection between quality of care and patient safety emerged during their simulation-based procedural training session. The student participant disclosed a discrepancy they encountered with positive patient identification during their phone interaction with the nurse. In this example, they were engaged in a discussion on the phone with the nurse about the testing status of a patient sample and the nurse asked for the patient’s date of birth. In accordance with the laboratory protocol, the student participant should have used two patient identifiers to positively identify the patient prior to any further discussion about the patient sample or patient laboratory results. Rather than place the nurse on hold and walk over to the testing area to confirm the patient’s date of birth on their paperwork, the student participant relied on their memory and provided the incorrect date of birth to the nurse. In their recall of this phone interaction, the student described the following:

I gave her the wrong birth date by a few days. And so that was definitely something that I still think about. And when I'm calling, if I'm working at the lab or something, and I'm calling the emergency department or just the patient's nurse, I always make sure I have it [patient demographic information] pulled up in front of me before I call them to so I have their name and another identifier if I need it.

As a key takeaway from the simulation-based procedural training session, this student gained a concrete learning experience and how this situation could have negatively impacted patient safety. The student participant stated that they “felt like it
was a safe space to do that” and they “rather would have made that mistake over the phone in the simulation than on my first day at the hospital”. One of the goals of the simulation-based procedural training was for student participants to have a psychologically safe environment where they could take risks and make mistakes so that they could learn from them and apply those lessons to their future clinical practice (Turner et al., 2023). This insight from the students’ perspective was helpful as it illustrated the impact of the simulation-based learning experience on their understanding of quality of care and patient safety. The student participant was able to transfer their enhanced knowledge of quality of care and patient safety awareness to their clinical blood bank practicum experience as well as their emerging role as a laboratory professional.

In clinical laboratory science education and training, the reiteration of patient safety and quality of care concepts are crucial to preventing harm in patient care. For these student participants, they were able to recall lessons learned from their simulation-based procedural training experience and apply those enhanced patient safety concepts to their clinical blood bank practicum. Since the mistakes were made in the simulation environment, the student participants were increasingly diligent and attentive within the real world clinical setting. Their exposure to aspects of patient safety and quality of care better prepared them to mitigate risks as well as minimize laboratory errors with patient samples. In addition to their heightened sense for patient advocacy, the student participants recognized the importance of the laboratory’s role in
ensuring patient safety and their direct impact in the effective delivery of patient-centered care.

Visibility of the laboratory’s role on the healthcare team. As discussed in Chapter 2, the contributions of laboratory professionals to patient care have been historically overlooked and underrecognized by other healthcare professions as well as the general public (Leber et al., 2022; Garcia et al., 2021). Often referred to as “the hidden profession,” the field of laboratory medicine has endured a lack of visibility even though the role of laboratory professionals is essential to optimal patient care. As noted by Leber et al. (2022), “there remains a lack of awareness that with every single laboratory test reported, there are clinical laboratorians who were responsible for performing the test and analyzing and reporting the results” (Leber et al., 2022, p. 1). A 2021 clinical laboratory workforce report indicated that higher visibility and increased awareness of laboratory professionals could be improved upon through collaboration between the laboratory and healthcare teams (Garcia et al., 2021).

Student participants shared their perspectives about lack of visibility and the contributions of the clinical laboratory to the healthcare team. Student EE stated that “with visibility, I feel like the lab struggles a lot with that in general” and they hope “to get more face to face interaction with other members of the healthcare team”. With respect to this perspective, Student GG shared a similar response and how they “feel like the lab is one of the less visible areas in the hospital”. In the transition from the simulation-based procedural training to the clinical blood bank practicum, Student GG stated:
I think after the simulation...because it really is like you're in the shadows in the back doing things behind the scenes. And then whatever you end up doing [laboratory results] just appears to the nurse.

To increase awareness of the laboratory profession, Student GG mentioned “communicating with other departments and professions helps visibility with the lab” because they believed that “people don't normally talk about or think about the lab as much as nursing”. Through communication with other members of the healthcare team, Student GG suggested that the laboratory would appear “more visible to the patients and everyone else in the hospital”. Student FF advocated for “being a face to the lab” to increase the visibility of the laboratory professionals performing these crucial laboratory tests. Conversely, Student DD thought of the blood bank as “an interesting area that has visibility because everybody knows what a [blood] transfusion is and units of blood” but noted there was still a need to “provide a lot of information to fill those gaps”. As stated by Student GG, “providing accurate data so that other members of the healthcare team can make informed – well informed decisions” about patient care can help demonstrate the value of the laboratory. Additional responses from other student participants echoed similar messages about the significance of communication and reaching out to the rest of the healthcare system to “improve patient safety and care” as well as efficiency can improve visibility of the laboratory rather than just as a “nebulous entity that you send tubes of blood to and get numbers back from”.

The attributes of the medical laboratory profession and characteristics of professionalism are acquired by students during the clinical learning process (Otto,
2018; Isabel, 2016). Attributes, such as visibility, were connected to their assumed professional identity as a laboratory professional. For each student participant interviewed, their perceptions on the lack of visibility were often connected to the lack of communication on interprofessional healthcare teams. As noted by Otto (2018) communication “is a key characteristic of professionalism” for laboratory professionals and it is a skill “that must be developed during educational and clinical practice in order to participate” on interprofessional healthcare teams (Otto, 2018, p. 145). It was remarkable that, intuitively, the student participants associated the use of professional communication with interprofessional healthcare team members to increased visibility and awareness of the laboratory’s role in patient care. Their remarks endorsed the importance of communication skills in their profession-specific work as tools to improve their visibility and “to create a culture of safety” in their interprofessional healthcare settings (Otto, 2018).

**Results from faculty participant interviews.** In addition to the sixteen undergraduate CLS students who participated in the simulation-based procedural training, there were three faculty members involved in the facilitation of the learning activity. Two of the three faculty participants were affiliated with the undergraduate CLS program, and the third faculty participant was affiliated with the School of Nursing. Additional profession-related demographics for each faculty member were gathered and presented in the faculty profiles provided in Table 4.2:
Table 4.2 – Faculty participant interviewee profiles

<table>
<thead>
<tr>
<th>Faculty Profiles</th>
<th>Faculty 1: Professor X</th>
<th>Faculty 2: Professor Y</th>
<th>Faculty 3: Professor Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department/Program Affiliation</td>
<td>CLS</td>
<td>CLS</td>
<td>Nursing</td>
</tr>
<tr>
<td>Scope of Practice</td>
<td>ASCP-certified MLS</td>
<td>ASCP-certified MLS</td>
<td>Nurse Educator</td>
</tr>
<tr>
<td></td>
<td>MLS Educator</td>
<td>MLS Educator</td>
<td></td>
</tr>
<tr>
<td>Faculty Role: Academic Curriculum</td>
<td>Taught blood bank lecture courses</td>
<td>Taught blood bank laboratory courses</td>
<td>Director of Simulation for School of Nursing</td>
</tr>
<tr>
<td>Faculty Role: Simulation-based procedural training</td>
<td>Co-facilitator (in simulation laboratory with student participants)</td>
<td>Co-facilitator (in debriefing room/delivered prebrief and co-debriefed student participants)</td>
<td>Embedded Simulated Person (ESP) – portrayed role of nurse during phone calls with student participants</td>
</tr>
<tr>
<td>Certification/License</td>
<td>MLS(ASCP)CM</td>
<td>MLS(ASCP)CM</td>
<td>Certified Healthcare Simulation Educator (CHSE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Active state RN license</td>
</tr>
<tr>
<td>Degrees Earned</td>
<td>MS in Toxicology PhD in Toxicology</td>
<td>MPH in Applied Health Informatics BS in CLS</td>
<td>BSN MSN PhD</td>
</tr>
<tr>
<td>Years of Profession-specific experience</td>
<td>9 years</td>
<td>4 years</td>
<td>20 years</td>
</tr>
<tr>
<td>Years of faculty experience</td>
<td>8 years</td>
<td>1 year</td>
<td>15</td>
</tr>
<tr>
<td>Prior simulation experience (as faculty)?</td>
<td>No</td>
<td>No</td>
<td>Yes, 9 years</td>
</tr>
<tr>
<td>Prior interprofessional education experience (as faculty)?</td>
<td>Yes, 2 years</td>
<td>Yes, 1 year</td>
<td>Yes, 2 years</td>
</tr>
</tbody>
</table>

In resemblance of the interview structure for the student participants, all three faculty participants were interviewed via Zoom using semi-structured interview
questions. Each faculty participant was interviewed separately, and they were presented with eight questions in relation to their faculty roles in the simulation-based procedural training. The qualitative data results were captured and derived from the oral responses provided for each question during each the semi-structured interview. Upon review of the coded data, the following overarching themes were noted: faculty perspectives on teamwork and communication, enhanced understanding of patient safety and quality of care, and the value of role clarity and visibility for laboratory professionals on the healthcare team.

*Faculty perspectives on teamwork and communication.* In each interview, faculty participant shared their own perspectives on the simulation-based procedural training in relation to learner performance. For faculty member Professor X, they thought that the simulation-based procedural training provided student participants the opportunity “to practice working as part of the healthcare team” because some students “may not have realized they are part of the team”. Professor X observed student participants “being able to interact with nurses and building a connection and learning how to effectively communicate” as important elements of the simulation-based procedural training experience. Professor Y continued with their perspective on the need for student participants “to connect and communicate with the other part of the healthcare team”. Professor Z spoke to the use of interprofessional simulation as a means of teaching these vital concepts of teamwork and communication:

*I think the whole idea of learning from, with, and about each other is really powerful in terms of communication, in terms of relationships, in terms of just*
understanding where other people are coming from and understanding what other people's roles and responsibilities and culture are. I think as many times as we can learn from each other in a really experiential way, some of those barriers and boundaries that get put up in between disciplines goes away with a better understanding of what each other are doing.

As noted by Professor Y, most of “these students have not necessarily worked in a clinical setting yet,” so the simulation-based procedural training helped student participants to practice how “to communicate effectively with nurses and still get the [laboratory] work done”. All three faculty participants agreed that this procedural training in a simulation environment provided students with the opportunity to practice communication while working on the interprofessional healthcare team. Based on Professor Y’s prior experience as a previous graduate from the same undergraduate CLS program, they reflected on their own transition from the student laboratory into the simulation-based procedural training and then into their clinical practicum. As a practicing laboratory professional, it was their experience that “anytime we can practice more with nursing or the medical students or even pharmacy, the better those relationships are going to be out of school”. Overall, teamwork and communication were deemed essential skills for student participants to develop a better understanding for mutual respect as well as collaborative practice on interprofessional healthcare teams.

Enhanced understanding of patient safety and quality of care. During the interviews, faculty participants emphasized the importance of teamwork and communication in working together as an interprofessional healthcare team. Faculty
participants were asked to provide their perspectives about their observations of the student participants’ understanding of patient safety and quality of care. Professor Y emphasized that patient safety was “the biggest thing that I noticed” especially “when [student participants] were communicating with the nurse”. The biggest concern for Professor Y was the student participants ability to “always have two [patient] identifiers on the tubes” but “there were very rarely two identifiers used”. Professor Y acknowledged that this may have been “their first time speaking on the phone with another member of the healthcare team, and they just are not used to speaking” but stressed the use of “two identifiers and we need to use closed loop communication” to ensure patient safety.

Professor X reiterated the importance of patient safety and how student participants practiced the steps for positive patient identification with “two identifiers for the patient” and “correctly identify the sample” then “confirm [patient identifiers] with nurse”. As a direct observer, Professor X recalled how student participants initially “almost forgot the two identifiers” but when they called the nurse back with laboratory results, they remembered to confirm the two patient identifiers with the nurse first. In their own words, Professor X stated “I think that’s a major progress” from “when they...started this procedural training” session. Professor Z added that aspects related to patient safety “would happen when we spoke on the phone, like patient name and date of birth” was “definitely something we focused on”. In their opinion, Professor Z noted “in that respect, I would definitely say that objective was that patient identifier[s]” in connection with an enhanced student awareness of patient safety.
In terms of the student participants’ increased understanding of quality of care, Professor Y stated, “overall I think the quality of care was sufficient” and “I think that they got the correct results, so that is a bonus”. Professor X elaborated further about how student participants “realized they need to report the results correctly” as well as their ability to timely “process [laboratory tests] right way” as contributing factors to the quality of patient care. From a nursing perspective, Professor Z mentioned the “really interesting conversations that I had with some of the students” about “why the nurse is calling with certain questions” or “pressuring them in terms of time or timeframes” for completion of laboratory test procedures. Following the simulation-based procedural training session, Professor Z shared that they engaged in debriefs where student participants stated, “oh wow I had no idea that the information that I can give you from the lab helps you with plan of care [or] helps you with the timeframe of plan of care”. In their perspective, Professor Z thought that “students found that to be interesting” and it helped them to connect the impact of their profession-specific work to the overall clinical picture of patient care. For Professor Z, “the one that jumps out at me the most is indeed that quality of care”. Professor Z provided the following reflection:

That, I think, comes from that interprofessional communication that happened through the entire experience. I think quality of care was improved or is improved whenever you have that type of communication between lab and nurse and nurse and lab. I would say that was definitely achieved in the fact that we all have the best interest of the patient in mind, but from very different perspectives. What that means that I have to do is very different to ensure
quality of care than what CLS has to do. But the fact that we could communicate and work together to have both of those things happen, I think was very clear and very clearly met.

Collectively, the three faculty participants concurred that the student participants achieved the learning objectives related to patient safety and quality of care during the simulation-based procedural training. The faculty participants recognized the use of proper patient identifiers by student participants while “communicating with the nurse” on the phone and reporting “the [laboratory] results correctly” as critical aspects of patient safety as well as quality of care. Through the practice of interprofessional communication, faculty participants observed a notable improvement in the student participants understanding of quality of care as well as increased patient safety by working together as a team and upholding the best interest of the patient in the work performed.

The value of role clarity and visibility for laboratory professionals on the healthcare team. Regarding role clarity and visibility of laboratory professionals, each faculty participant shared their feedback about these components of the simulation-based procedural training for students. Professor Y thought it was “nice to be able to bridge the gap” for student participants and prepare them to “maybe explain a little bit more of what’s happening” on the laboratory side of the clinical work to other members of the healthcare team. In relation to the nursing profession, Professor Z stated, “it’s hard to know what you can’t see” and “I think for them, it was an interesting window into all the things that are happening that they don’t see from the nurses’ perspective”
to better inform their clinical practice. Based on their professional experience as a nurse, Professor Z explained how this was a “really cool” experience for them and it was “really interesting for me to be able to see them working and see what are their challenges, what are their time frames, what are their communication that they have to do on their end of things, what’s their procedural things that they do”. It was apparent that the simulation-based procedural training provided enhanced clarity of profession-specific roles for student participants as well as faculty participants.

According to Professor X, the use of simulation-based procedural training gave “our students [an] opportunity to know that they are part of the healthcare team” and “they’re not working along”. Professor X added the importance of making “the profession visible for other healthcare team members” which connected nicely with Professor Z’s emphasis on students gaining a “better, deeper understanding because of the visibility of what they do and of their profession and their role”. Professor Z believed the simulation-based procedural training activity helped “tremendously” in regard to student participants better understanding of their profession-specific contributions to the interprofessional healthcare team and patient care.

To summarize the faculty participant interviews, all three faculty offered positive feedback about their participation in the simulation-based procedural training sessions and shared optimal perspectives about the potential impact of this experience for students. Professor X believed that student participants “really appreciate this opportunity” and “also appreciated this experience”. As for their personal experience, Professor X stated that they “think this is a really great curriculum for students” enrolled
in the undergraduate CLS program. Professor Z thought “it was fascinating” and appreciated being able to share knowledge from their own profession-specific lens “in the actual session with the students” as well as “being able to actually see what was happening on the lab side of things”. In reflection, Professor Y shared the following perspective:

I think there's a lot of benefits to it [interprofessional simulation], especially the ones where we do get to interact with other students in the school of health professions. I really enjoyed that, not only from the perspective of learning about their roles but seeing how the body of knowledge that clinical lab science students have an impact a clinical setting.

As noted by the faculty participants, the simulation-based procedural training provided an opportunity to bridge "different areas of knowledge and different bodies of knowledge" into a learning activity for undergraduate CLS students to learn how their future roles as laboratory professionals were a “key component to being able to properly treat a patient and diagnose the patient”. Most importantly, their responses collectively supported the notion that simulation-based procedural training helped to convey their vital contributions to patient safety and quality of care in the provision of patient care.

**Results from the video observations.** For the qualitative data analysis of the recorded simulation-based procedural training sessions, I reviewed the field notes taken during the direct observations of each undergraduate CLS program student participant. All recorded simulation-based procedural training sessions were divided into the three following components: prebriefing, simulation scenario or activity, and the debriefing.
process (INACSL Standards Committee, 2021). While viewing the audiovisual recordings, I transcribed additional notes to compare the data against the qualitative observations recorded onsite at the research study location. Based on the research questions, I reviewed relevant data related to the themes of patient safety, quality of care, and the student participants understanding of their roles through working as an interprofessional healthcare team. As noted by the INACSL Standards Committee (2021), “the evidence is clear that essential learning occurs in the debriefing phase of the simulation-based experience hence the focused data analysis on the debriefings from each recorded session” (p. 27). I started with a data analysis of the debriefing process which occurred immediately following the simulation-based procedural training activity.

**The debriefing process and learner reflections.** The facilitated conversations that occurred between faculty and student participants in the debriefings prompted learner reflection on practice and were geared toward the improvement of future clinical performance. As described in Chapter 3, a dynamic plus-delta approach was used for the debriefing process in which student participants were asked to reflect on the entire simulation-based procedural training activity and to assess their individual as well as team performance (Kainth, 2021; Cheng et al., 2021). During the opening phase of the debriefing process, student participants were invited to share their initial reactions and explore their emotions after the simulation-based procedural training activity. One of the student participants expressed “it was fun” and how the experience was “different from student lab...we were actually doing stuff”. Other student participants visibly nodded in agreement with this student’s initial reaction. In other debriefing sessions,
student participants shared similar initial reactions with statements such as “it was cool” and “it was fine”. Interestingly, the student participants began to describe their perceptions of their performance in the simulation-based procedural training activity. In the role as co-debriefers, the faculty seldom had to use probing questions to encourage students to openly discuss their clinical learning experience. The review of the data collected from the debriefing sessions revealed themes of learner perceptions of task performance, interprofessional communication, and transfer of learning into their future clinical practice.

Learner perceptions of task performance. When the debriefing process shifted from the opening phase to the plus-delta phase, some student participants expressed how they were initially nervous about their performance in the simulation-based procedural training activity. During one of the debriefing sessions, a student participant shared how they were uncertain about their abilities to accurately perform the necessary technical skills related to blood bank laboratory testing. Nonetheless, they elaborated on how their confidence level increased in the progression of the simulation-based procedural training activity:

It was much better once I got going and then I was like I can do this. I know what I’m doing but at first I was like do I even know what I’m doing...I don’t know. It was better once my nerves went down and once I got going I was like this is what we do all the time. We know how to do this!

Another student participant described a similar reflection about their interaction with the nurse on the phone. For this student, they were “nervous” about the telephone
interaction aspect and were uncertain about how to answer the phone as well as how to handle placing the nurse on hold in order to retrieve their paperwork which included the patient information. Admittedly, they stated that they “didn’t read through the phone procedure” and was not sure about the process of confirming or reporting patient identifiers to the nurse. As feedback, one of the faculty suggested the use of the notepad located near the phone to capture information provided by the nurse and to place the nurse on hold to retrieve their paperwork from the laboratory bench. In doing so, the student participant would have been able to rely on their documentation to confirm patient demographic information over the phone to ensure patient safety and quality of care. The student participants in this session agreed with the faculty members’ recommendation and one of the students responded with the following perspective which reflected their application of previous phone interaction experience to this activity:

I took notes and I used to do that when I worked at [local hospital] because I would always freak out too when I started so it helps me sometimes [to write things down]

The other students visibly agreed to this recommendation whereas one added “I would feel more comfortable doing it again now”.

An additional learner perception about their performance was related to the simulation environment and their ability to use modern laboratory instrumentation prior to their clinical practicum experience. One of the students stated how they “love the cellwasher” and went on to share “I was kinda nervous going into rotations knowing that
we will be using the cellwashers never having used one”. In the transition from the student laboratory into the simulation laboratory, another student mentioned “I like that the environment was different from our class lab so it kind of like gets you out of your comfort zone, so you’re not used to being in the exact same place”. Conversely, one of the students expressed how the transition may have been improved by repeated exposure to the simulation laboratory environment. They believed their performance would have been better had they known “where things are at” and “being familiar with the environment” as well as how the format of the procedures “was different” for them. For some student participants, they verbalized that getting “a feel for the room” and having more time at the beginning “to look at procedures” would have improved their timing as well as technical performance. Succinctly, a student participant followed this perception with “I think it was cool that we got to experience that before we go to our clinical because it’s gonna be all new there any way”.

To wrap up on this debriefing point, the faculty co-debriefed about the importance of transition into new environments and that the real laboratory setting is different from the student laboratory. In the use of the dynamic plus-delta approach, student participants were asked “what would you have done differently” and “if you were able to do this again what would you change” to prompt reflection. Several student participants mentioned that they “would be much faster” and they would “feel more comfortable doing it again now because they’ve been in there” in reference to the simulation laboratory. It was an insightful debriefing point for faculty and student participants which yielded valuable perspectives on the link between familiarity with a
laboratory environment and self-efficacy in clinical performance. Notably, this was an unexpected finding in this research study, but it contributed to the preparation of student participants for their transition from the student setting to the clinical practicum environment.

**Interprofessional communication.** For most of the undergraduate CLS program student participants, the simulation-based procedural training activity represented their first opportunity to interact with a nurse in this capacity of performing laboratory tests while effectively communicating as a team. In the debriefing conversation, the faculty co-debriefed student participants about examples of quality of care and patient safety such as the use of two patient identifiers to confirm the correct patient was being discussed with the nurse. A student participant described interprofessional communication of test results over the phone and confirmation of patient identifiers as “something we don’t usually do” in their student experience. Another student participant disclosed that the thought of communicating with other healthcare workers “terrifies me” and further explained why they felt this way about interprofessional communication:

> There is like a certain way you have to or you like should communicate working in [a] hospital like closed loop communication...and like umm I wasn’t used to saying like a patient name with another identifier and just like those kinds of specific requirements.

As the facilitation of the debriefing process shifted from CLS faculty to nurse faculty, Professor Z discussed observations from their perspective about the phone
interactions between student participants and the nurse. During this portion of the facilitated discussion, Professor Z covered potential errors that could have impacted patient safety such as incorrect patient identification. In an example, a student participant provided the correct patient name but the incorrect date of birth over the phone with the nurse. The nurse faculty framed their inquiry about the misidentification as follows:

One of the beautiful things about simulation is that you can bring little bits of experience and mistakes or things that you do in sim and learn from it and then be able to transfer that knowledge and that wisdom for next time in your clinical practice.

This statement prompted the student to discuss the self-identified mistake in guessing the date of birth rather than placing the nurse on hold while they retrieved the appropriate documentation. Through their reflection, the student disclosed to the nurse that the sheet with the patient information was across the room and in the moment, they felt like they “couldn’t set the phone down since it was cored to the wall”. When asked “what would you do differently” the student stated, “next time I just would’ve like just told them oh just give me one second to go back and get my sheet”. In doing so, the student participant would have been able to confirm they had the right patient and the right date of birth in their double check of patient identifiers with the nurse. This was not an isolated occurrence during the simulation-based procedural training as the verbal confirmation of patient identifiers was a new concept for most of the student participants. In each debriefing session when a similar occurrence was discussed, the
students were reassured by faculty that simulation is “where we can all learn a lot about” and from mistakes. This was a valuable debriefing point for the students that could be carried over into their future clinical practice.

Another component of the debriefing process was the sharing of knowledge between the nurse faculty, Professor Z, and the student participants from their profession-specific scope of practice and how the work of the clinical laboratory impacts patient care such as result reporting, testing status updates, and estimated testing turnaround times. In one example, Professor Z stated how “a lot of what you tell us as nurses in terms of timing will then end up dictating how we will plan our care.” This statement appeared to resonate with students as reflected in a student’s verbal response of “I didn’t know that you guys like planned your patient care around what we told them”. Another student participant acknowledged the importance of being “realistic” when providing an estimated time of completion in laboratory testing.

Regarding the practice of interprofessional communication and task performance, the student participant stated the following:

I think just communicating is probably the next hurdle because like we can do the lab stuff easily but like communicating...oh this will actually take this long or oh let’s confirm this patient is actually this patient like we debrifed earlier [using their] full name – I think that’s important.

As noted by Professor Z, this was the “added dynamic of interprofessional communication” in the simulation-based procedural training. Through this facilitated conversation, student participants were able to demonstrate their increased
understanding of the significance of interprofessional communication to ensure patient safety and optimize quality of care.

*Transfer of learning into future clinical practice.* During the summary phase of the debriefing process, student participants were asked to share their takeaways from their participation in the simulation-based procedural training. A few of the student participants said, “ask questions” and “not [being] afraid to ask questions or when I need help”. As one student stated we “will be with other [medical laboratory scientists] to ask questions” and this procedural training was good practice to ask questions since there was a CLS faculty member present in the simulation laboratory throughout the session.

Other student participants reflected on their pace in the performance of laboratory testing and their sense of urgency in getting the laboratory testing completed. One of the students said they will remember to “remain calm” as they were trying to go fast but recognized that they needed to “take time to read the procedure”. Additional students mentioned “read the procedure” and how they “need to work on timing” to strengthen their laboratory testing performance. During one of the debriefing sessions, a student participant discussed another aspect of timing in relation to prioritization. They reflected on previous blood bank practicaIs which were high stakes evaluations administered by faculty to assess students’ level of competency in the performance of laboratory tests. They explained “in our blood bank practicaIs there’s a lot of prioritization because [there is] a lot to get done” but they had the full student laboratory period to complete the required testing. “We never have given ourselves a time or a deadline” was stated regarding completion of laboratory testing for reporting
results out to a nurse. In this discussion, the student participants reflected on this aspect of timing and its importance in the patient care setting. Poignantly, one of the student participants stated how their participation in this simulation-based procedural training served as “a reminder to make sure I’m not feeling rushed and I continue to do what’s safe for the patient”.

In terms of transfer of learning, each student offered a takeaway related to their technical performance as well as their understanding of patient safety concepts. The intent of the simulation-based procedural training was to impart applicable knowledge gained during the experience that would transfer into their clinical practice. It was apparent that this was achieved through their participation in the simulation-based procedural training and, hopefully, their education on interprofessional practice was reinforced in their clinical practicum experience.

Overall, the debriefing sessions allowed student participants the opportunity to reflect on the simulation-based procedural training activity and to engage in a meaningful conversation with their peers. Across all six debriefing sessions, the dialogue between faculty and student participants consisted of the student actions that went well and opportunities for improvement. It was powerful to hear students share their thinking and be transparent about their critical thinking process throughout various steps of the simulation-based procedural training activity. Through this experience, each student took away newly acquired knowledge that they planned to apply to their future clinical practice.
Simulation activity recordings from simulation-based procedural training sessions. Following the review of all six debriefing session recordings, I started to review the actual SBPT activity sessions when student participants were in the simulation laboratory performing the technical procedure of blood bank laboratory testing. Although I was present for the simulation-based procedural training sessions, I wanted to review the audiovisual recordings to ensure that I did not miss any pertinent observations or additional key elements that occurred during the real-time SBPT activity in the simulation laboratory. After I reviewed the initial two out of the six total simulation-based procedural training sessions, no new data emerged from the recordings and the observations captured were redundant in comparison to the field notes already taken during the actual activity itself. It became increasingly apparent that I was able to capture the data needed to address the research questions posed in this research study and no new findings were observed. Based on the lack of new information, it was determined that data saturation was met thus ending the data collection process for this research study.

Saturation in data collection arose from the grounded theory in which the gathering of “fresh data no longer sparks new insights or reveals new properties” (Creswell & Creswell, 2018, p. 186; Charmaz, 2006). As described by Saunders et al. (2017), “when the researcher begins to hear the same comments again and again, data saturation is being reached…it is time to stop collecting information and to start analysing what has been collected (p. 1896).” In review of the recorded SBPT activity itself, I heard the same comments that were reflected in the post-simulation event
survey comments as well as the student and faculty participant interview responses. Particularly with the debriefing process recordings, the faculty debriefers were able to effectively address any field notes captured regarding what went well during the activity and areas for performance improvement. Therefore, the data collected from the post-simulation event survey, daily journal entries, and the faculty and student participant interviews were sufficient for the purpose of this action research study. Any additional data observed from the video recordings did not reveal any new findings or insights about the activities of student participants.

**Triangulation**

Creswell and Creswell (2018) described the triangulation of data sources as “a means for seeking convergence across qualitative and quantitative methods” in a mixed methods research design (p. 14). Specifically, convergent mixed methods were used as the mixed methods design to converge or merge the “quantitative and qualitative data in order to provide a comprehensive analysis of the research problem of practice including the impact of the proposed educational intervention (Creswell & Creswell, 2018, p. 15).” Collectively, the student participant responses to the post-simulation event survey, student daily journal entries, faculty and student participant interviews, and observations from the audiovisual recordings provided a broader picture on the impact of the proposed intervention on the student participants perceived understanding of patient safety in the laboratory profession. There was a convergence of the research findings as further explained in the triangulation of emerged themes from the overall study findings.
The proposed educational intervention of simulation-based procedural training provided an immersive clinical learning experience for undergraduate CLS program students to strengthen their technical skills while increasing their knowledge on patient safety and quality of care. In the triangulation of the data, the themes of patient safety awareness, interprofessional communication, and perceptions on the role of laboratory professionals in quality of care emerged. In an overwhelming response, the student participants appreciated the opportunity to participate in the simulation-based procedural training prior to their transition into the clinical practicum experience. Lessons learned, such as their role in patient safety and quality of care, were well documented in their debriefing sessions as well as their post-simulation event survey responses. Consistently, student participants connected their task performance to patient outcomes and their feelings of self-confidence in the work performed.

The data collected from the student participant interviews supported the findings about the importance of interprofessional communication to patient safety as well as to the increased visibility of laboratory professionals on the healthcare team. Faculty perspectives supported the student participants perspectives on enhanced awareness of the contribution of the clinical laboratory to advancing patient care and the critical nature of their future roles as members on the interprofessional healthcare team. The student participants’ perceived improvement in self-confidence and role clarity demonstrated the effectiveness of this educational intervention. These findings from the student participant interviews were further supported by the responses provided by the CLS and nursing faculty program participants in each of their respective
interviews. Based on their perspectives, the student participants learned how to effectively communicate through their interactions with the nurse while gaining a better understanding of the working relationship of interprofessional healthcare teams.

As noted by Creswell and Creswell (2018), this process of triangulation and examining evidence collected from different data sources provided justification for the themes that emerged from all the data collection instruments utilized in the research study (p. 200). The themes of increased awareness of patient safety and quality of care concepts as well as interprofessional communication and teamwork emerged across all the data instruments. The successful completion of the simulation-based procedural training and clinical blood bank practicum experience was proven to enhance the student participants understanding of their contributions to patient safety and as advocates for role as future medical laboratory scientists in the management of patient care. There were converging data sources among the compiled data thus adding validity to the outcomes of the study (Creswell & Creswell, 2018, p. 200).

Summary

In summary of this fourth chapter, the overarching goal of this mixed methods action research study was to assess the effectiveness of integrating patient safety and quality of care concepts into the undergraduate curriculum of the clinical laboratory science program students. The two-hour simulation-based procedural training sessions were developed using the experiential learning theory, simulation-based education, and interprofessional education approaches to ensure best practices. The use of the simulation laboratory setting as well as the implementation of an embedded simulation
person (nurse) increased the level of fidelity thus making the experience feel more real and realistic for the students. By replicating an actual blood bank laboratory for undergraduate CLS students, they believed experience itself accurately represented a patient care setting. The simulation-based procedural training proved to be useful in emphasizing the essential role of laboratory professionals in patient care.

The quantitative data were collected using a Qualtrics-administered post-event simulation survey immediately following the simulation-based procedural training activity. The qualitative data were collected during (audiovisual recordings) and after (daily journal entries, student and faculty participant interviews) the simulation-based procedural training sessions were completed. The analysis of the quantitative data showed that all student participants perceived the educational intervention as beneficial to their learning and preparation for clinical practicum. Additionally, most student participants noted an increased awareness of patient safety and quality of care concepts in the laboratory profession. Overall, the student participants provided positive feedback about the relevance of this educational intervention in their future clinical practice as laboratory professionals.

Similar findings were observed in the analysis of the qualitative data which provided deeper reflections in how these undergraduate CLS student participants perceived their contributions to patient care and the interprofessional healthcare team. In their reflections, they assessed their own technical performance which was often connected to their level of self-confidence as well as feelings of self-efficacy. Furthermore, the student participants addressed the importance of teamwork and
effective communication for increased patient safety and management of patient care.

Their perceptions were supported by the observations of faculty and their encounters in the real world clinical environment.
CHAPTER 5
FUTURE IMPLICATIONS AND RECOMMENDATIONS

This fifth chapter begins with an overview of the action research study, which will discuss the research questions in connection with the proposed intervention. As next steps, I will discuss the action plan as well as suggestions for further research. This chapter will conclude with final takeaways and reflections for this study.

Overview of the Study

This study focused on the proposed intervention of a simulation-based procedural training activity for undergraduate CLS students prior to the start of their clinical rotations at designated hospital laboratories. The aim of the intervention was to embed patient safety and quality of care concepts into the undergraduate CLS program curriculum. Additionally, it was imperative to prepare undergraduate CLS students for their future work on interprofessional healthcare teams while understanding their vital role as contributors to optimal patient care. The intervention was scheduled one week prior to the start of clinical rotations and was intended to serve as a bridge between the completion of didactic coursework and their entry into a real-world clinical laboratory environment. Due to the nature of the work, the simulation-based procedural training session focused on blood bank laboratory testing practices including a patient blood type and antibody screen. Each simulation-based procedural training was scheduled in
two-hour session blocks that included the following simulation design: prebriefing, simulation activity, and debriefing. The simulation-based procedural training sessions were co-facilitated by CLS and nursing faculty within a simulation hospital located on a metropolitan academic medical center campus.

During the intervention, I collected data from each simulation-based procedural training session, which included field observations of undergraduate CLS program student participants multitasking through the performance of laboratory tests while simultaneously answering phone calls from a nurse. In addition to field observations and audiovisual recordings of each simulation-based procedural training session, I collected data from the post-event simulation surveys completed by the student participants. After the intervention, the student participants transitioned to the start of their sixteen-week clinical practicum, which included a three-week blood bank practicum experience. During the clinical blood bank practicum, each student participant completed and submitted daily journal entries. I collected data from the daily journal entries for any pertinent findings that would indicate a transfer of learning from the intervention into the clinical blood bank practicum experience. After the completion of the clinical practicum, student participants were interviewed to assess for transfer of learning as well as their perceptions related to patient safety, quality of care, working on interprofessional healthcare teams, and visibility as a laboratory professional. Additionally, faculty participants were interviewed to capture their perceptions about student performance, transfer of learning, and their role in providing feedback to student participants.
Collectively, the data were analyzed from the post-simulation event surveys, daily journal entries from the clinical blood bank practicum, faculty and student participant interviews, and the debriefing component from each audiovisual recording of the simulation-based procedural training sessions. The findings from this research study provided me with a deeper understanding of the clinical learning process for undergraduate CLS program students in their transitional stage from the student laboratory into the clinical practicum experience. These insights prompted me to reflect on our traditional approach to the preparation and training of undergraduate CLS program students. In addition to my own thoughts for improvement, faculty and student participants offered some suggestions to be considered for future iterations of the proposed intervention. I will address these suggestions and future implications later in this chapter.

**Research Question Findings**

The research questions were proposed to effectively measure the impact of simulation-enhanced interprofessional education on the undergraduate CLS student participants level of patient safety awareness and understanding of concepts related to quality of care. Moreover, they aimed to evaluate the student participants perceptions of their role in patient safety and as members of the interprofessional healthcare team. In this section, I will use the research findings from the fourth chapter to address each of the research questions.
RQ #1: What is the impact of simulation-enhanced IPE on an undergraduate CLS student participants’ understanding of patient safety and quality of care following participation in a simulation scenario?

For this first research question, I wanted to make the connection between the undergraduate CLS student participants’ involvement in the simulation-based procedural training activity and enhanced understanding of patient safety and quality of care. It was foundational for student participants to gain knowledge about patient safety, in general, and what exactly entails quality of care in a clinical setting. This had to be distinguishable from how they viewed themselves as contributors to patient safety. In this study, I was able to measure the impact of this intervention on the student’s awareness of patient safety and quality of care.

In review of the post-simulation event survey results, I concluded that student participants were positively impacted by this intervention and found it helpful in their enhanced understanding of patient safety and quality of care. Beyond the post-simulation event survey, there was supporting commentary during the debriefing sessions that immediately followed the simulation-based procedural training activity. Student participants shared their perceptions on patient safety and their role in improving quality of care from a laboratory perspective. These learner perceptions were evident within the daily blood bank journal entries as well as the semi-structured student interviews. During the interviews, student participants were asked about their understanding of patient safety. Each student participant responded similarly in that
patients should receive the best care to ensure optimal outcomes. Additionally, they indicated the prevention of medical errors as key in increasing patient safety.

The findings from the data collected were in alignment with theoretical framework of constructivism and experiential learning. Dewey’s philosophy about learning through meaningful and engaging experiences was relevant to the realistic interactions the students encountered in the simulation-based procedural training (as cited in Beard, 2018). Based on Dewey’s theory, experiential learning promotes interactions with others to build knowledge through participation in a concrete learning experience (Kolb, 1984). For the development of the simulation-based procedural training, the basis of the theoretical framework for the proposed intervention was a necessary criterion that had to be met (INACSL, 2021, p. 50).

Paul (2018) stated that “simulation has the potential to play an increased role in improving quality and patient safety through a deeper understanding of potential capabilities, and integration into the healthcare efforts (p. 225).” Nearly ten years ago, Levine et al. (2013) described how experiential learning through simulation was attributed to the improvement of technical skills and clinical competency as well as increased patient safety awareness. One of the faculty participants shared how they had some interesting conversations with the student participants following the simulation-based procedural training activity. During the debriefing sessions, the faculty participant described how student participants demonstrated their enhanced understanding of patient safety through their dialogue in the group. Some student participants were surprised to learn how information from other areas, including the laboratory, helped to
inform plan of care. Candidly, some student participants shared their perceptions with faculty about their increased awareness about the impact of effective communication on patient safety. It appeared that the simulation-based procedural training was effective in the increased understanding of patient safety and quality of care among student participants in connection with their technical skills.

RQ #2: By participating in a simulation-enhanced IPE activity, how does this immersive experience help undergraduate CLS students see themselves as contributors towards patient safety?

For the second research question, the findings in the study connected the profession-specific perceptions of undergraduate CLS students to the contributions of the clinical laboratory to patient safety. This research question was intended to shift from the students understanding of patient safety concepts to how they saw their role as laboratory professionals in increasing patient safety. As noted by Swift et al. (2022), the development of profession-specific skills among students is influenced by the educational environment as well as the selected teaching modality. The situated learning theory encourages students to learn through participation in an authentic learning environment that involves the application of content knowledge to authentic tasks (Lave & Wenger, 1991). The theoretical framework of situated learning corroborated well with the modality of Sim-IPE which has been proven to increase patient safety awareness among participants (Beard et al., 2015). Aspects such as increased awareness of patient safety and enhanced role clarity in patient care have been indicated in the effective design of a simulation-enhanced interprofessional education activity (INACSL, 2021).
During the literature review, I came across a clinical laboratory workforce study which stated, “there needs to be an appreciation for the contribution of the lab” to the healthcare team as well as a raised awareness about the “value of the lab to the outcomes and impacts on patient welfare” (ASCP, 2020, p. 31). This statement from the workforce report was substantiated by the assertion of Bayot and Naidoo (2019) in that the most important value for each laboratory professional to recognize is their role in patient welfare. Within the open comments section of the post-simulation event survey and the daily journal entries from the clinical blood bank practicum, these connections were well documented by student participants as they often linked task performance to patient safety. Some of these examples included their profession-specific responsibilities such as the confirmation of positive patient identification of patient samples (e.g., right patient, right sample, right specimen label) and accurate reporting of laboratory test results to other members of the healthcare team.

During the follow-up interviews, the student participants further emphasized the important contributions of the clinical laboratory to safe and effective patient care. The student participants provided concrete examples of how the work performed by laboratory professionals was integral to “uncovering and providing laboratory information from laboratory analyses that assist physicians in patient diagnosis and treatment, as well as in disease monitoring or prevention” (ASCLS, 2021). The student participants emphasized the importance of their role in generating the results used in diagnosis and treatment of patients. They viewed their profession-specific contributions, such as diagnostic accuracy and efficiency, as essential to patient safety.
Based on the student participants who were interviewed after the clinical practicum, each participant connected their enhanced understanding of patient safety from the simulation-based procedural training to their overall perceptions of the laboratory’s role in patient safety. Their perceptions were supported by the feedback provided by faculty participants. In the faculty participants interviews, they all shared examples of student contributions to patient safety through their reporting of laboratory results and their communication of patient identifiers over the telephone with the nurse. Although there were some instances when two patient identifiers were not used, student participants realized the error and were able to talk through the patient case during the debriefing sessions following the training activity. Furthermore, the faculty participants mentioned how this was the first time undergraduate CLS students engaged in telephone interactions and were expected to multitask laboratory testing along with practice of interprofessional communication. The faculty participants expressed that the undergraduate CLS students understanding of their contributions to patient safety was achieved through their participation in simulation-based procedural training.

**RQ #3:** How do undergraduate CLS student participants view their role as members of the healthcare team?

For the third research question, I observed a link to participation in the Sim-IPE activity in relation to their role as members of an interprofessional healthcare team. Following their participation in the simulation-based procedural training, the undergraduate CLS student participants expressed to faculty and through the data collection instruments how they enjoyed this clinical learning experience because it
provided them an opportunity to function from their professional scope of practice. During the debriefing process immediately following the SBPT activity, the undergraduate CLS student participants differentiated their student laboratory experience from the SBPT experience as a more realistic portrayal of the work they will be expected to perform as laboratory professionals in a healthcare setting. Through their participation in the SBPT activity, the undergraduate CLS student participants were able to “develop, refine, and apply knowledge and skills in a risk-free, but immersive and realistic environment” (Levine et al., 2013). According to the faculty participants, the SBPT activity provided the undergraduate CLS student participants with a deeper understanding of what it is like to work as on an interprofessional team with other health professions such as nurses. As observed by one of the faculty, these undergraduate CLS students may not have realized that their role contributed to overall work of the healthcare team. In their faculty interview responses, the faculty thought the students were able to effectively practice in their role as laboratory professionals on the interprofessional healthcare team.

By the time the student participants completed their clinical blood bank practicum, they had a clearer understanding of their role as a member of the healthcare team and the importance of collaborative practice among healthcare professions in patient care. In the student interviews, one of the student participants mentioned how they will increase the visibility of their role by engaging in face-to-face interactions with other members of the healthcare team. Another student participant shared a similar statement about the significance of fostering relationships with other healthcare
professionals in the collaborative spirit of learning from and about each other. As emerging laboratory professionals, they recognized the importance of making themselves available to answer questions and address concerns as a resource for other healthcare professionals. The struggle with lack of visibility and lack of awareness of the clinical laboratory roles on the healthcare team has been a pressing concern over the years (Garcia et al., 2021). Nonetheless, the student participants in this study appeared to have an optimal outlook about their role and the opportunity to increase visibility through their interactions with healthcare teams.

As described in the Healthcare Simulation Standards of Best Practice™ Simulation-Enhanced Interprofessional Education, interprofessional learning opportunities should “promote professional trust and respect, role clarity, and effective collaborative relationships” (INACSL, 2021, p. 49). In constructivism theory, knowledge sharing is encouraged in the interactions of students and peers (Beard, 2018). The application of situated learning to this study was relevant as well in its promotion of relationships between learners in communities of knowledge and practice as practiced between the undergraduate CLS student participants and the nurse professional (Lave & Wenger, 1991). In both theoretical frameworks, knowledge sharing among participants was deemed an essential component to the overall learning process.

Specifically related to the laboratory profession, Otto (2018) stated that the foundation of professional identity should be acquired during the academic preparation of clinical laboratory science students. Exposure to clinical competencies such as “work in interprofessional teams” and “provide patient-centered care’ were covered in the
simulation-based procedural training to improve understanding of patient safety among undergraduate CLS students (Otto, 2018). Effective team practices, such as collaboration and communication, between laboratory professionals and medical teams have been noted to improve the visibility of the role of the laboratory profession in patient care (Garcia et al., 2021). Through their participation in the proposed intervention, the undergraduate CLS students were provided an opportunity to explore their professional identity and dimensions of visibility while working as members of the healthcare team.

Action Plan

Regarding a longitudinal action plan for this study, I suggest continuing the simulation-based procedural training as a bridge between the didactic coursework and the clinical practicum experience for fourth-year undergraduate CLS students. Nonetheless, for this simulation-based procedural training to evolve into a longitudinal simulation curriculum, additional support will be needed to ensure the success of this activity. As an initial step, I would present the research findings to the department leadership and faculty affiliated with the undergraduate CLS program. It will be crucial to share this pertinent information with this key audience as I will seek buy-in and ongoing support in integrating Sim-IPE into the undergraduate CLS program curriculum. During this presentation, I will invite the faculty involved in co-facilitating the simulation-based procedural training to add their insights about their participation in the study.

The next step in the action plan will require a review of the current undergraduate CLS program curriculum to evaluate the appropriateness of the simulation-based procedural training as a part of the clinical competency review course.
During the review process, we may discover that the simulation-based procedural training should remain in the noncredit course or be transitioned into a credit course such as the clinical immunohematology practicum course. This decision must align with the updated National Accrediting Agency for Clinical Laboratory Science (NAACLS) standards for educational programs as well as the academic course requirements set forth by the university system and the state board of regents.

The third step in the action plan addresses faculty development for participation in Sim-IPE activities. In a recent study, it was noted that health professions faculty are still reluctant to participate in interprofessional activities due to the perceived barriers involved such as scheduling conflicts and the time required to develop events (Ashe et al., 2023). To address some of these concerns, I will follow up with the simulation center to learn more about the training courses provided to faculty involved in simulation-based education. Some of the training sessions offered included how to establish a safe container and the debriefing process. I will explore additional resources to address the concerns related to time dedicated to Sim-IPE design and development. Furthermore, I will work with the faculty team and simulation center team to ensure that the scheduling of Sim-IPE related activities meets the needs of the CLS faculty participating in the facilitation of simulation-based procedural training activities.

At this time, I would suggest improving the design of the current simulation-based procedural training rather than jumping into the design of another simulation-based procedural training activity. By focusing on one simulation-based procedural training activity, this will allow faculty time to become acclimated with the development
process and increase their level of comfort with roles and responsibilities in IPE. There are opportunities to integrate undergraduate nursing students into the simulation-based procedural training and increase the complexity of the laboratory testing component by adding additional patient samples for testing. Once the key faculty have been identified and they are comfortable with the simulation-based education process, then it will be ideal to expand the simulation-based procedural training into other areas of the clinical laboratory curriculum.

Moving ahead, I plan to disseminate the findings from this action research study outside of my organization through conference presentations and journal publications. It is my understanding that an essential element of educational practice and innovation is the dissemination of action research to communities of practice including those with similar interests in the pedagogical approach to healthcare simulation and interprofessional simulation. To conduct widespread dissemination of this research study, I plan to present this information to other health professions in addition to those directly involved in clinical laboratory science education. The outcomes of this research study may benefit other educators and learners in their preparation of future healthcare professionals for the paradigm shift in patient care as well as interprofessional collaborative practice in clinical settings.

Limitations

During this action research study, there were some limitations including the number of student participants and scheduling conflicts. For the first limitation, I had a total of four undergraduate CLS students complete the interview portion of the research
study. The simulation-based procedural training was integrated into the undergraduate CLS program curriculum as a part of the clinical competency review course. The review course was delivered as a noncredit course to prepare students for clinical rotations; however, it was a mandatory component of the undergraduate CLS program. As an integrated part of the undergraduate CLS program, all sixteen students completed the simulation-based procedural training prior to their transition into the sixteen-week clinical practicum. All student participants were strongly encouraged to participate in the interviews, but their participation was not mandatory as a graded component for the noncredit clinical competency review course. Though the sample size was lower than expected for the student participant interviews, the students interviewed provided similar responses that were very insightful and coincided with the perceptions analyzed from the other data collection instruments.

For the second limitation, the scheduling issue was connected to the first limitation regarding the number of participants. Once the student participants moved into the last stage of the undergraduate CLS program, there were conflicting schedules due to the short window of time between the end of the clinical practicum and preparation for their overall competency exam. For this reason, most of the students studied and prepared for this competency exam rather than schedule an interview. Some of the student participants had plans to take their board exam immediately after the clinical practicum, which further narrowed the pool of students available for an interview. If I was able to revisit the interview scheduling process, I would have
collaborated with the CLS program director to identify the most appropriate time to interview the students to prevent any potential scheduling conflicts.

The third limitation was related to the inability to create additional simulation-based procedural training sessions for other relevant CLS curriculum sections such as clinical microbiology, hematology, and chemistry. Based on participant feedback and the research findings, it would have benefitted students to practice their technical skills in the remaining core competency skill areas in preparation for the other clinical rotation sections of the clinical practicum experience. Due to challenges in scheduling and constraints in faculty resources, I was not able to design procedural simulation training activities beyond the clinical blood bank section into other core competency areas.

**Recommendations for Practice**

Based on the faculty and student participant feedback provided, there are additional opportunities to integrate simulation-enhanced interprofessional education activities into the undergraduate CLS curriculum. For other health professions programs considering approaches to incorporate patient safety concepts and interprofessional collaborative practice into their respective curricula, I would recommend the integration of simulation-enhanced interprofessional education into the clinical education process. As noted by the findings in my research study, the student and faculty participants provided positive feedback about their participation in this intervention. Undergraduate CLS students appreciated the opportunity to practice their profession-specific skills in a simulated laboratory environment. They felt more prepared for their transition from the student learning environment into the real-world clinical environment.
Furthermore, the modality of simulation-enhanced interprofessional education provides the opportunity to engage learners with other members of the medical team prior to their entry into the healthcare workforce. As recommended by one of the faculty participants, they were a previous graduate of the same undergraduate CLS program and were involved in two to three immersive simulations with nursing and medical students. The faculty participant reflected on that experience and their transition into their clinical practice as a medical laboratory scientist. As a working laboratory professional, the faculty participant recalled direct interactions with other healthcare workers in the hospital who participated in similar simulation-enhanced IPE learning experiences in their academic programs. Based on their experience, they stated “that anytime we can participate more with nursing or the medical students or even pharmacy, the better those relationship are going to be out of school”. This statement aligned with the design of simulation-enhanced interprofessional education to enable participants to “learn about, from, and with each other to enable effective collaboration and improve health outcomes (INACSL, 2021; WHO, 2010, p. 31).”

**Recommendations for Future Research**

For future research, I would like to include a tool that measures the effectiveness of simulation-enhanced interprofessional education on self-confidence of undergraduate CLS students. Although this study captured some aspects of increased self-confidence among student participants, there is an opportunity to build a stronger case for the integration of Sim-IPE, particularly simulation-based procedural training, into clinical laboratory science education. A noted limitation of this study was lack of opportunity to
develop additional simulation-based procedural trainings for other laboratory sections such as urinalysis and hematology. Based on the positive feedback from student and faculty participants, the integration of multiple simulation-based procedural trainings throughout the undergraduate CLS curriculum would allow learners to gain additional practice and skill development in the simulated laboratory environment prior to their transition into the real-world clinical environment. As described by Stewart et al. (2023), “future interdisciplinary planning should include multiple sessions to solidify the improvement in communication and collaboration among the students (p. 112).”

Additionally, it would be beneficial to conduct a similar action research study with the inclusion of other health professions programs such as fourth year nursing students. By exposing undergraduate CLS students to other health professions and vice versa, this will promote learning about each other’s healthcare roles and their profession-specific responsibilities in the management of patient care. It would be interesting to compare the impact of interprofessional collaboration on pre-certification CLS program students with pre-licensure nursing students against the simulation-based procedural training experience with a licensed healthcare professional.

Furthermore, I would like to expand on the social justice lens in relation to additional dimensions of diversity beyond identity. As we discuss advancing health equity and the lack of diversity in the clinical laboratory workforce, it is important to recognize the need to explore the impact of intersecting identities such as race and gender on one’s visibility in this healthcare profession (Garcia et al., 2021). In this research study, I was able to continue the discussion about the role of professional
identity and visibility for undergraduate CLS students to gain a better understanding of their role as contributing members to the interprofessional healthcare team and in their work to improve patient care. By capturing other demographic data that aligns with the primary dimensions of diversity such as age and ethnicity, there is an opportunity to build onto this research by studying how the intersection of different identities may or may not exacerbate the sense of visibility as a laboratory professional and as a member of the healthcare team (Loden and Rosener, 1991).

**Reflection**

As I reflect on this action research journey, I realize that I have grown so much as a scholar and a researcher. I had the opportunity to take a deeper dive into research methodologies and apply what I learned to my own educational practice. It was such a rewarding opportunity to immerse myself in diversity, equity, inclusion and social justice aspects of the program. It prompted me to consider the impact of identity and how identity develops through the clinical learning process. I grew as a qualitative researcher and evolved as an educator. Moving forward, it is my intention to influence the lives of my students in the same way that my USC faculty impacted me. It was a multi-faceted process with its myriad of obstacles and challenges. I am grateful for the experience and excited for what the future holds.

I feel immense gratitude and respect for the undergraduate CLS program students for their determination to become medical laboratory scientists. I did not know at the start of my doctoral studies that our world would drastically transform with the emergence of the unprecedented COVID-19 pandemic. Amid a national workforce
shortage, the COVID-19 pandemic increased the visibility of lesser-recognized healthcare professions, such as medical laboratory scientists, while further exacerbating recruitment and retention into the laboratory workforce. The student participants from this study endured massive disruption to their lives including the trajectory of their collegiate careers. Despite the COVID-19 pandemic and changes in the healthcare sector as well as on the higher education system, these students still opted to pursue their studies in clinical laboratory science. They made the decision to press forward in their CLS program studies and overcame insurmountable obstacles to become medical laboratory scientists. Their resilience was remarkable and their willingness to explore innovative methods, such as simulation-based procedural training, was refreshing for me as an educator.

Although it was not a focal point of this study, I would be remised if I did not believe that their perspectives on patient safety and quality of care could have been influenced by their observations of patient care during the COVID-19 pandemic. They understood the impact of their task performance in laboratory testing and how the data generated by the laboratory mattered to quality patient care. Their perceptions about the laboratory profession and their enhanced awareness of their contributions to the healthcare team were so empowering and insightful to me as an experienced laboratory professional. It was worthwhile to be a part of this shift in the paradigm of undergraduate clinical laboratory science education. Hopefully, this educational intervention made a lasting impression on the student participants involved and may they continue their work in the improvement of patient safety.
Moving forward, I hope additional undergraduate and graduate CLS programs will continue to integrate simulation-based education and interprofessional education into their respective curricula. There are some notable CLS programs who have been actively engaged in Sim-IPE activities, but there are opportunities for more CLS programs to integrate patient safety concepts into their curricula using Sim-IPE. The literature supports the introduction of patient safety concepts into the undergraduate CLS curriculum as a means of better preparing new laboratory professionals for their vital work as contributing members of an interprofessional healthcare team. I believe this is a viable approach for our CLS educational programs to adequately prepare students to develop into change agents and advocates for patient safety.

Summary

In summary, the focus of this mixed-methods action research study was on the preparation of undergraduate CLS students for their transition into the modern healthcare environment. This study explored the best practices for implementing patient safety and quality of care concepts into the undergraduate CLS curriculum which led to the proposed intervention of simulation-enhanced interprofessional education. The research questions investigated crucial aspects of the study which included increased awareness of patient safety, quality of care, contributions of laboratory professionals to patient care, and working collaboratively as an interprofessional healthcare team.

The integration of the proposed intervention, simulation-based procedural training, proved to be beneficial for undergraduate CLS students and their transition into the real-world clinical environment. The student participants increased their knowledge
in patient safety and quality of care while improving their self-confidence in their clinical laboratory skills. The transfer of learning into their future clinical practice included their enhanced understanding of their crucial role in the provision of patient care and their valuable contributions as members of the healthcare team. It was a rewarding experience to observe their transition into medical laboratory scientists and we welcome them as influential laboratory advocates in the promotion of the profession.
REFERENCES


Agency for Healthcare Research and Quality (2014). *University of Kansas Medical Center uses TeamSTEPPS® to educate future clinicians.*

http://www.ahrq.gov/policymakers/case-studies/201423.html


https://www.aauw.org/resources/member/governance-tools/dei-toolkit/dimensions-of-diversity/


https://ascls.org/how-do-i-become-a-laboratory-professional/


https://dx.doi.org/10.4135/9781483381411


*Dimensions of Critical Care Nursing, 34*(6), 356-361.

https://doi:10.1097/DCC.0000000000000150


https://www.ncbi.nlm.nih.gov/pmc/articles/PMC164393/#


https://doi.org/10.3928/01484834-20150916-07

https://doi.org/10.1111/j.1744-1609.2008.00108.x

https://doi.org/10.1128/jcm.00241-22


https://doi.org/10.5860/choice.28-6323

Makary, M. A., & Daniel, M. (2016). Medical error—the third leading cause of death in the US. *BMJ*, 353. [https://doi.org/10.1136/bmj.i2139](https://doi.org/10.1136/bmj.i2139)


http://dx.doi.org/10.3109/13561820.2013.869198


https://doi.org/10.1097/sih.0000000000000332


https://doi.org/10.1007/978-3-030-59403-9_24


https://doi.org/10.1515/cclm-2014-0142
https://doi.org/10.1891/0739-6686.39.105


https://doi.org/10.1016/j.ecns.2020.03.002


https://doi.org/10.29074/ascls.28.4.224

[https://doi.org/10.1097/sih.0000000000000047](https://doi.org/10.1097/sih.0000000000000047)


[https://doi.org/10.1007/s11135-017-0574-8](https://doi.org/10.1007/s11135-017-0574-8)


The University of Kansas. (2023). *Credit/No credit*. Office of the University Registrar. Retrieved from https://registrar.ku.edu/creditno-credit

Watson R. (2015). Quantitative research. *Nursing standard (Royal College of Nursing (Great Britain): 1987), 29*(31), 44–48. [https://doi.org/10.7748/ns.29.31.44.e8681](https://doi.org/10.7748/ns.29.31.44.e8681)


### APPENDIX A

SIM-IPE CASE DESIGN DETAILS
SIMULATION-BASED PROCEDURAL TRAINING: BLOOD BANK

<table>
<thead>
<tr>
<th>Case Stem for Undergraduate CLS Students</th>
<th>Each undergraduate CLS learner will be provided one patient sample to work up for anticipated blood transfusion purposes. Type and screen testing must be performed using the standard operating procedures and modern blood bank testing equipment provided. Prior to testing the patient sample, learners must ensure specimen acceptability and confirm positive patient identification (e.g., review patient identifiers). Learners should expect to receive phone calls at any time from a nurse inquiring about the status of the test request for the patient sample. The laboratory is in downtime (computers not in service); therefore, learners are expected to use the downtime forms to document test reactions and final test results.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Sessions</td>
<td>6</td>
</tr>
<tr>
<td>Length of Session</td>
<td>2 hours</td>
</tr>
<tr>
<td>Number of patient cases per session</td>
<td>1 patient specimen</td>
</tr>
<tr>
<td>Laboratory tests performed</td>
<td>Type and Screen Crossmatch (add on test request by nurse via phone)</td>
</tr>
<tr>
<td>Number of CLS learners per session</td>
<td>2-3 learners (Total of 16 participants)</td>
</tr>
<tr>
<td>Structure of procedural training</td>
<td>Each session will be structured to include up to three (3) undergraduate CLS learners. There will be a total of 4 workstations (3 tube testing, 1 gel testing) and the sample accessioning area for the management of incoming/outgoing telephone calls. One dedicated CLS faculty member will be present in the laboratory for each session. Another faculty member will be in a separate conference room where they can observe learners (via live video feed) and manage phone calls.</td>
</tr>
<tr>
<td>Overarching Goal</td>
<td>To provide the opportunity for participants to recognize a patient requiring urgent or emergent care due to sepsis and initiate evaluation and management as an interprofessional team.</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Learning Objectives** | 1. Compare the patient information from the test requisition against the information on the patient sample to ensure sample acceptability criteria have been successfully met.  
2. Test the patient sample for an ABO/Rh blood type and antibody screen utilizing automation in the tube agglutination and gel testing methodologies.  
3. Demonstrate multitasking abilities by answering and placing phone calls in the laboratory while performing blood bank testing procedures.  
4. State their name and location upon answering the phone call.  
5. Explain the status of the patient sample in the testing process including the observed blood type (if test results available).  
6. Demonstrate multitasking abilities by answering and/or placing phone calls in the laboratory while performing blood bank testing procedures. |
Patient: (Duplicate 3-4 times with each patient’s name)

<table>
<thead>
<tr>
<th>SCRIPT: Call from yellow phone – 4209.</th>
<th>IDENTIFY THE PERFORMANCE GAP:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1st phone call) “This is [first name] from the ICU calling to check on the type and screen for [patient name]. Can you tell me the status of their type and screen?” “Can you call me back when you get the screen completed? Call back number is – ____.”</td>
<td>What did you expect to observe?</td>
</tr>
<tr>
<td>(2nd phone call 20 minutes after) “This is [first name] from the ICU calling to add on a crossmatch for one unit of red blood cells for [patient name]. Call back number is ____ when the unit is ready.”</td>
<td>What did you observe as the Phone Call Faculty?</td>
</tr>
</tbody>
</table>

The learner should call back for a 3rd phone call to let you know that the blood is ready

<table>
<thead>
<tr>
<th>What did you expect to observe?</th>
<th>What did you observe as the Phone Call Faculty?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Answer in less than 3 rings</td>
<td></td>
</tr>
<tr>
<td>• Answer introducing self and lab location</td>
<td></td>
</tr>
<tr>
<td>• Uses 2 patient identifiers (name &amp; DOB) to confirm patient identity prior to giving results</td>
<td></td>
</tr>
<tr>
<td>• Offer assistance to the caller</td>
<td></td>
</tr>
<tr>
<td>• Provide appropriately estimated time (ETA) for results</td>
<td></td>
</tr>
<tr>
<td>• Interpret correct blood type for patient (if available)</td>
<td></td>
</tr>
<tr>
<td>• Calls nurse back with results of antibody screen &amp; crossmatch</td>
<td></td>
</tr>
</tbody>
</table>
IDENTIFY THE PERFORMANCE GAP:
What did you expect to observe?  

| • Removes gloves before answering phone. | What did you observe as the Lab Faculty? |
| • Refers to patient downtime form to communicate patient results with nurse. | |
| • Dons fresh gloves before continuance of laboratory testing. | |
| • Documents information using pen and paper (e.g., name of nurse, add on test). | |

COACHING FRAMEWORK

PREVIEW: By the end of this telephone interaction, learners should be able to:
1. State their name and location upon answering the phone call.
2. Explain the status of the patient sample in the testing process including the observed blood type (if test results are available).
3. Demonstrate multitasking abilities by answering/placing phone calls in the laboratory while performing blood bank testing procedures.

Clinical Facts of Case

Today we wanted you to be able to practice multitasking in a clinical laboratory setting. In professional practice, you will be expected to communicate with other patient care team members to discuss patient status and care strategies while carrying out the technical responsibilities of your role. Today, you were asked to perform a type and screen for a patient and then were given added responsibilities when the nurse called to inquire about the testing, add additional testing, and request a unit of blood. We are going to take 10 minutes to discuss both communication with other members of the care team and multitasking. Leah and I could see and hear what you did, but we don’t know what your thoughts were behind the actions and that is what I want to take a few moments to discuss.

POPIE

Preview: I want to take you to the moment when (the nurse called to discuss lab results) (you called the nurse to discuss lab results)

Observation: “Faculty on the phone heard...” “Faculty in the lab saw...”

Point of View: “I think the manner in which we handle telephone calls in the clinical setting has the potential to affect healthcare outcomes, communication as a team, and patient satisfaction.”

Inquiry: Tell me what was going on for you? Tell me what that was like for you?

Explore: “I see, tell me more” “I hear you saying this, it sounds like... name the frame.”

CLOSE THE PERFORMANCE GAP (or Reinforce Performance).

<table>
<thead>
<tr>
<th>FRAME</th>
<th>STRATEGY to CONSIDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worried about impact on others (e.g., stepping on toes) or</td>
<td>Broaden discussion to include the viewpoint of others</td>
</tr>
<tr>
<td>Unsure of the diagnosis (e.g., fear of being wrong).</td>
<td>Brainstorm <strong>Group Solutions</strong>; Compare and contrast approaches.</td>
</tr>
<tr>
<td>Competing priorities (e.g., between current care tasks or perhaps with priority inspired by a past experience).</td>
<td><strong>Generalize</strong> to other clinical situations or the ‘real’ world</td>
</tr>
<tr>
<td>Doesn’t apply to my practice or circumstances; Objection to features of the simulation environment.</td>
<td><strong>Teach</strong> – Share information, theory, principles. Or <strong>elicit</strong> expertise of a participant.</td>
</tr>
<tr>
<td>Knowledge gaps regarding best practices, treatments...</td>
<td></td>
</tr>
</tbody>
</table>

**Optional questions**
- What could you do next time?
- What would you do if you could start again?
- What worked well and why?
- What behaviors were most effective?

**Will (Goal Setting) Encourage accountability and learning mindset**
- What specific actions will you take when you are expected to address clinician concerns over the phone while accurately performing clinical laboratory testing?
- What is one take-away from today that you will apply in your clinical environment?

**RECAP**
*If these items were not addressed during the debrief, you can bring them up as additional takeaways that you want to ensure that each learner walks away knowing...*
- Identify yourself and location when answering the phone
- Confirm patient identity with name and date of birth prior to discussing patient information
- Confirm with the provider that you have adequately addressed their needs prior to hanging up the phone
APPENDIX C

POST-EVENT SURVEY QUESTIONS: SIMULATION BASED PROCEDURAL TRAINING

Five-Point Likert Scale Multiple Choice Questions

1. How well did instructors orient you to the training environment and explain expectations?
   o Extremely well
   o Moderately well
   o Somewhat well
   o Not sufficiently well
   o Not at all

2. To what extent did the instructors establish a safe place to practice and challenge your skills?
   o To a great extent
   o To a moderate extent
   o Somewhat
   o Very little
   o Not at all

3. Do you believe this training will contribute to improve quality and/or safety of care in the clinical setting?
   o Definitely yes
   o Probably yes
   o Might or might not
   o Probably not
   o Definitely not

4. How confident are you that you could apply what you practiced in this simulation/training to a clinical event?
   o Extremely confident
   o Very confident
   o Somewhat confident
   o Only slightly confident
   o Not at all confident
5. How effectively did the patient’s medical record support the transfer of this training to your clinical practice?
   - N/A – medical records not used in this training
   - Extremely effectively
   - Very effectively
   - Somewhat effective
   - Only slightly effectively
   - Not at all effectively

6. How effectively did the instructors support your learning through coaching, feedback, and sharing their perspective?
   - Extremely effectively
   - Very effectively
   - Somewhat effective
   - Only slightly effectively
   - Not at all effectively

7. How suitable was the difficulty of this training?
   - Much too easy
   - Somewhat too easy
   - Just right
   - Somewhat too hard
   - Much too hard

8. How suitable was the length of time for this session?
   - Way too long
   - Somewhat long
   - Just the right amount of time
   - Somewhat short
   - Way too short

9. To what extent were the stated learning objectives achieved through learning?
   - To a great extent
   - To a moderate extent
   - Somewhat
10. To what extent would you recommend this training to others?
    - To a great extent
    - To a moderate extent
    - Somewhat
    - Very little
    - Not at all

**Open-Ended Questions**

1. What would be at least two things that you liked or learned in this training?

2. What two things do you wish we had focused on that could be improved?

3. Do you have any other comments to offer?

4. What aspects of your use of the medical record were most useful to your experience?

5. This follow-up question is asked if a participant responds with “extremely effectively” or “very effectively” to the question: How effectively did the patient’s medical record support the transfer of this training to your clinical practice?

6. What elements of the medical record would be necessary to support your learning?

7. This follow-up question is asked if a participant responds with “only slightly” or “not at all effectively to the question: How effectively did the patient’s medical record support the transfer of this training to your clinical practice?
### APPENDIX D

**ISBARR: COMMUNICATION TOOL TO REPORT LABORATORY RESULTS**

<table>
<thead>
<tr>
<th>I</th>
<th>I am _________ (your name, title, and location). I am calling about ________________ (patient name, MRN, location).</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>The <strong>SITUATION</strong> is related to (critical, abnormal) lab results.</td>
</tr>
<tr>
<td>B</td>
<td>Are you familiar with the <strong>BACKGROUND</strong> on this patient __________? (pertinent history, admitting diagnosis, reason for lab study)</td>
</tr>
<tr>
<td>A</td>
<td>On my <strong>ASSESSMENT</strong> of the lab results: this patient has a __________ (pertinent/ abnormal lab values -- read off actual lab results).</td>
</tr>
<tr>
<td>R</td>
<td>I would like to <strong>RECOMMEND</strong> (add on reflex / confirmatory / additional test or assay, monitoring the lab values). What are your thoughts?</td>
</tr>
<tr>
<td>R</td>
<td>Please Read-back or <strong>RECAP</strong>, the __________ (test or assay name) critical lab value to me for clarity and confirm your name, title/role.</td>
</tr>
</tbody>
</table>

- **Identify** = Identify yourself, your title, and your team.
- **Situation** = I am calling about Patrick Smith in room 4210. The problem I am calling about is related to critical lactic acid result of 4.5. I believe this is an emergent situation.
- **Background** = Are you familiar with the patient?
- **Assessment** = The patient had MRSA isolated from his wound culture. I am concerned about this patient.
- **Recommendation** = The antimicrobial susceptibility test (AST) shows that the organism is sensitive to vancomycin.
- **Read-back or Recap** = Please repeat back the critical lab value to me for clarity.

*Adapted from the Agency for Healthcare Research and Quality (2014)*
APPENDIX E

INTERRELATIONSHIP OF THE SIMULATION AND THE ACADEMIC MEDICAL CENTERS

The mapping diagram provided below represents the different components of the system as it relates to the interrelationship of the healthcare system, the adjoining academic medical center, and the simulation center (Baker, 2021):

**Description of Each Component of the System**

- **Simulation Center**: The simulation center provides advanced healthcare education through its simulation activities for education to ensure optimal education and patient outcomes at the healthcare system. The center is a collaborative initiative between the healthcare system and academic medical center.

- **Healthcare System (Hospital)**: The healthcare system shares its brick-and-mortar location with the academic medical center. This teaching hospital bridges the expertise of medical researchers and educators while allowing opportunities for experiential learning among future healthcare professionals.
- **Academic Medical Center:** The academic medical center is comprised of the schools of medicine, nursing, and health professions. The medical center campus is healthcare driven and represents one of three campuses of the entire academic institution.

- **School of Health Professions:** The School of Health Professions (SHP) is comprised of undergraduate, graduate, and certificate programs. SHP students participate in simulation-enhanced interprofessional education activities on campus.

- **Clinical Laboratory Sciences Department:** The Department of Clinical Laboratory Sciences (CLS) is actively seeking routes for the integration of undergraduate CLS program students into simulation-enhanced interprofessional education activities into its own pre-certification curriculum.

**Describe Each Human Component and its Role**

- **School of Health Professions (Dean):** The CLS Program Director reports all updates and forwards department requests directly to the SHP Dean.

- **Clinical Laboratory Sciences (Program Director):** The role of program director for the undergraduate CLS program within the Department of Clinical Laboratory Sciences is held by one individual who reports directly to the SHP Dean.

- **CLS Program Faculty:** CLS program faculty is comprised of full-time faculty members with teaching responsibilities in undergraduate and graduate programs. A small number of faculty have participated in one training session (or more) for faculty facilitators in debriefing simulation-enhanced interprofessional education activities.

- **Students (Undergraduate CLS Program participants):** The undergraduate CLS program students are in their fourth and final year of the Bachelor of Science program. They have completed one and half years of didactic and laboratory coursework within the undergraduate CLS program curriculum.
APPENDIX F

UNDERGRADUATE CLS STUDENT INTERVIEW QUESTIONS

Name:
Date of Interview:
Start Time:
End Time:

1. Prior to your entry into the CLS program, did you have any previous healthcare experience?
   • If so, what was your role on the healthcare team?

2. Prior your participation in this simulation-based education experience, did you have any other experiences in simulation or interprofessional education?
   • If so, can you share the details of those previous experiences?

3. Since participating in the simulated blood bank procedural training, have you been able to apply any lessons learned from that session to your current clinical practicum experience?
   • If so, in what way(s)?

4. After participating in the simulated blood bank procedural training, do you think you have a better understanding of your role on the healthcare team? Why?

5. What is your understanding of patient safety? How does your role support (or not support) patient safety?

6. How does your contribution to the interprofessional healthcare team help with visibility of your profession?

7. How did your participation in this procedural training prepare you for your clinical practicum experience?

8. Do you think your participation in this activity was helpful as a bridge between your student laboratory experience and your current clinical practicum experience? Why or why not?
9. By participating in this activity, did you feel more confident in your interpersonal skills (e.g., communication, teamwork)? Why or why not?

10. What are some lessons learned about patient safety and quality of care that you will transfer over into your future clinical practice as a medical laboratory scientist?
APPENDIX G

FACULTY PARTICIPANT INTERVIEW QUESTIONS

Name:
Department:
Professional Title:
Role in Procedural Training:
Date of Interview:
Start Time:
End Time:

1. Prior to your participation in this simulation-based education experience, did you have any other experiences in simulation or interprofessional education?
   • If so, can you share the details of those previous experiences?

2. Since participating in the simulated blood bank procedural training, what were key takeaways as a faculty participant in this activity?

3. After participating in the simulated blood bank procedural training, do you think the undergraduate CLS students gained a better understanding of their role on the interprofessional healthcare team? Why?

4. What is the value for undergraduate CLS students to participate in a simulation-enhanced interprofessional education activity?

5. Do you think the participation of undergraduate CLS students in simulation-enhanced interprofessional education activities will help with the visibility of their profession? How?

6. How did your participation in this procedural training better prepare undergraduate CLS students for their transition from the student laboratory to their clinical practicum experience?

7. In your opinion, were key concepts about patient safety and quality of care accurately covered in this training activity? Why or why not?
8. Do you have any additional comments or feedback that you would like to share about this procedural training activity or your experience as a faculty participant in this event?
### APPENDIX H

**QUALITATIVE DATA ANALYSIS: CATEGORIES FOR DAILY JOURNAL ENTRIES**  
(CLINICAL BLOOD BANK PRACTICUM)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ABO Discrepancies</td>
<td>Examples of when learners had to work through ABO blood typing issues during the testing process.</td>
</tr>
<tr>
<td>2. ABORh Typing</td>
<td>Learners report completion of ABORh blood typing test only (not performed with antibody screen test request) excluding weak D testing.</td>
</tr>
<tr>
<td>3. Blood Bank Documentation</td>
<td>Use of laboratory order requisitions and other related paperwork (e.g., EHR) for patient identification.</td>
</tr>
<tr>
<td>4. Crossmatch</td>
<td>Learners report instances of performing a crossmatch on patient samples for transfusion purposes.</td>
</tr>
<tr>
<td>5. Gel Methodology</td>
<td>Learners report instances when then performed blood bank testing experience with the use of gel testing method during the blood bank practicum.</td>
</tr>
<tr>
<td>7. Interprofessional Communication</td>
<td>Examples of communication with other healthcare workers (HCWs) besides nurse professionals such as physicians.</td>
</tr>
<tr>
<td>8. Laboratory Computer/Software Usage</td>
<td>Learner observations of the role of computers in the blood bank and for patient care.</td>
</tr>
<tr>
<td>9. Laboratory Equipment</td>
<td>Blood bank equipment used in the clinical laboratory setting.</td>
</tr>
<tr>
<td>10. Laboratory Safety</td>
<td>Examples of laboratory safety training and practices mentioned by learners.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>11. Learner Perceptions</td>
<td>Learners’ descriptions of &quot;how they feel&quot; about the various aspects involved in blood bank laboratory practices.</td>
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<tr>
<td>12. Learner Confidence</td>
<td>Examples of when learners refer to their confidence level in performing any given tasks related to the blood bank and patient care.</td>
</tr>
<tr>
<td>13. Multitasking</td>
<td>As one of the three learning objectives from the blood bank procedural training, learners noted their performance of multitasking in the blood bank environment.</td>
</tr>
<tr>
<td>14. Nurse Communication</td>
<td>Examples of interprofessional communication between undergraduate CLS students and nurse professionals in the clinical environment.</td>
</tr>
<tr>
<td>15. Orientation to the Laboratory Environment</td>
<td>Similar to the blood bank procedural training -- the process of students becoming familiar with the blood bank environment and the resources available.</td>
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<tr>
<td>17. Patient Safety</td>
<td>Learners share concerns or statements related to patient safety.</td>
</tr>
<tr>
<td>18. Phone Calls</td>
<td>Mentions of learners handling or placing phone calls during the blood bank practicum.</td>
</tr>
<tr>
<td>19. Positive Patient Identification</td>
<td>Mentions of patient identification as it pertains to appropriate specimen collection, tube labeling, laboratory testing and result reporting through all testing phases to ensure safe blood transfusion.</td>
</tr>
<tr>
<td>20. Quality</td>
<td>Examples of quality of care and quality control/maintenance in blood bank testing.</td>
</tr>
<tr>
<td>21. Simulation Laboratory Equipment</td>
<td>Mention of equipment used in simulation laboratory during the blood bank procedural training.</td>
</tr>
<tr>
<td>22. Specimen Acceptability</td>
<td>Mentions of proper specimen collection techniques and procedure including tube types used for testing purposes (e.g.,</td>
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<td><strong>23. Student Laboratory</strong></td>
<td>Transfer of learning from student laboratory to clinical practicum experience.</td>
</tr>
<tr>
<td><strong>24. Team Communication</strong></td>
<td>Examples of the importance of effective communication as a laboratory (blood bank) team.</td>
</tr>
<tr>
<td><strong>25. Type and Screen</strong></td>
<td>Learner reports instances when a type and screen was performed during their blood bank practicum.</td>
</tr>
<tr>
<td><strong>26. Tube Methodology</strong></td>
<td>Learners report instances when then performed blood bank testing experience with the use of the tube testing method during the blood bank practicum.</td>
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</table>
APPENDIX I

UNDERGRADUATE CLS STUDENT INSTRUCTIONS FOR BLOOD BANK JOURNAL ENTRIES

The purpose of the daily log is to capture the following information:

1. gain a sense of the technologies and methodologies used by affiliates and a sense comprehensiveness of the experience you are receiving in blood bank

2. get a feel for the volume of work and variety of procedures your affiliate performs

3. gather information that helps us provide you with a student lab experience that adequately prepares you for the practicum experience

4. assess what changes need to be made to future aspects of the CLS 544/545 lecture and student lab courses.

Please include the following content in your daily logs:

1. A daily summary of your activities
   ◦ Note: You do not need to account for every individual step of each testing procedure.

2. Any questions you may have about what you are doing or what you are being instructed to do in the blood bank.

3. Your impressions of your daily activities that may include all or some of the following:
   ◦ any new thing you may have learned
   ◦ a new perspective you may have gained
   ◦ a positive or negative learning experience
   ◦ an "a-ha" or "light bulb" moment
   ◦ any interesting results you may have seen (ensuring compliance with all HIPAA and confidentiality rules) or troubleshooting you may have performed
   ◦ any occurrences or encounters that was reflective of concepts learned in interprofessional or simulation activities
APPENDIX J

LEARNING OBJECTIVES FROM SIMULATION-BASED PROCEDURAL TRAINING ACTIVITY

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<tr>
<td>1.</td>
<td>Compare the patient information from the test requisition against the information on the patient sample to ensure sample acceptability criteria have been successfully met.</td>
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<tr>
<td>2.</td>
<td>Complete testing a patient sample for an ABO/Rh blood type and antibody screen utilizing automation in two different testing methodologies: tube agglutination and gel.</td>
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<tr>
<td>3.</td>
<td>Use multitasking abilities by answering phone calls in the laboratory while performing blood bank testing procedures.</td>
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APPENDIX K

SUMMARY OF CATEGORY FINDINGS – ADAPTED FROM CLINICAL EDUCATION: MLS STUDENT PERCEPTIONS (ISABEL, 2016)

Summary of Category Findings

Student self-awareness facilitates learning through
- knowledge of strengths in laboratory skills and critical thinking
- recognition of areas for improvement
- knowledge of how learning occurs and how learning styles can be recognized

Factors of the clinical environment and physical setting that affect learning include
- heavy workload that disrupts the ability of the student to ask questions
- unique interactions with patients such as phlebotomy

Student preparation for clinical education can depend on
- how the student organizes materials from preclinical learning
- types of relationships with instructors
- student understanding of methods of evaluation

The preceptor has an effect on student learning
- through socialization that helps build student confidence
- through demonstration of professionalism and teamwork as a mentor
- by demonstrating effective communication with other professionals

How students can discover MLS as a profession is linked to
- visibility of the profession
- good program information on websites
- evidence of career success in healthcare serving the community
Re: Pro00128365

Dear Mrs. Dana Baker:

This is to certify that the research study The Integration of Simulation-Enhanced Interprofessional Education into Undergraduate Clinical Laboratory Science Curriculum was reviewed in accordance with 45 CFR 46.104(d)(1), the study received an exemption from Human Research Subject Regulations on 4/17/2023. No further action or Institutional Review Board (IRB) oversight is required, as long as the study remains the same. However, the Principal Investigator must inform the Office of Research Compliance of any changes in procedures involving human subjects. Changes to the current research study could result in a reclassification of the study and further review by the IRB.

Because this study was determined to be exempt from further IRB oversight, consent document(s), if applicable, are not stamped with an expiration date.

All research related records are to be retained for at least three (3) years after termination of the study.

The Office of Research Compliance is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). If you have questions, contact Lisa Johnson at lisaj@mailbox.sc.edu or (803) 777-6670.

Sincerely,

Lisa M. Johnson
ORC Assistant Director and IRB Manager