2017

Decision-making, tacit knowledge, and motivation in semi-professional practice: Humanizing the environment through anthropomorphism in clinical laboratory science

Teresa Mortier

Decision-Making, Tacit Knowledge, and Motivation in Semi-Professional Practice: Humanizing the Environment Through Anthropomorphism in Clinical Laboratory Science

by

Teresa Mortier, MS, MT (ASCP)

Dissertation

Submitted to the Department of Educational Leadership and Counseling

Eastern Michigan University

in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

Educational Leadership

Dissertation committee:

David Anderson PhD, Chair

Jaclynn Tracy, PhD

Elizabeth Broughton, PhD

Peggy Liggit, PhD

May 2017

Ypsilanti, Michigan

Acknowledgements

This project would not have been possible without the support of many people. Many thanks to my adviser, Dr. David Anderson, who listened, guided, and helped, making some sense of the confusion along the way. In addition, thanks to my committee members, Dr. Elizabeth Broughton, Dr. Jaclynn Tracy, and Dr. Peggy Liggit, for their guidance and support.

I would like to remember my friend, Pam Rich, who died this year. She told me I was her mentor, but in actuality, she was an inspiration to me because she was so energetic and passionate about educating laboratory science students.

I would like to thank my colleagues for listening to me for countless hours regarding this project, especially, Dr. Jane Yatczak and Dr. Lynne Shetron-Rama.

I would like to dedicate this dissertation to my family: my husband, Paul; my children, Matthew, Megan, Madeleine, and Mitchell; and my daughter-in-law, Laura, for their love and support in completing this project. This has been an arduous yet rewarding process and I hope my children will continue to learn as they have seen their mother do.

Abstract

The clinical laboratory science field requires an abundance of technical knowledge; however, the importance of implicit or tacit knowledge gained through observation and practice is often discounted in this field, even though it is a critical part of reflective thinking, critical thinking, and reflective practice. The "de-skilling" of laboratory practitioners may be a result of limited training opportunities in an overtaxed system. A deeper analysis of the decision-making skills by interviewing practicing medical laboratory scientists in this study may illuminate, for practitioners and the public sector, the complexity of the profession. This study adds to the body of knowledge in clinical laboratory science by specifically observing practitioners for behaviors that reflect the use of specialized technical knowledge in decision-making in the context of the laboratory. In addition, this research provides insight for medicine, nursing, and other allied healthcare disciplines to enhance their processes in the context of clinical training.

The study used interview and observation techniques in a phenomenological approach to understand decision-making. A purposeful sample of five medical laboratory science practitioners was obtained. They have an average of 20 years' experience and varying levels of technical and administrative experience and responsibilities in their current positions. The research question was as follows: How do medical laboratory scientists go about making decisions when confronted with problematic or unique situations in the clinical laboratory?

Major findings included balancing the work environment, which contains routine and high-stakes decisions through strategies such as anthropomorphism. The use of anthropomorphism provides a new lens to look at the tension between decision-making as art (as opposed to "science") for many different "semi-professional" fields. The results provided support that trainers and faculty should allow "gut intuition" to be a legitimate choice for trainees and students. Providing more time in practice for "pause" or reflection, and asking students to

listen to their inner voice during problem-solving and express that explicitly in the moment, would build on reflective practice and the motivation to perform during stressful and routine situations.

Table of Contents

List of Figures

Chapter 1: Introduction

History and Nature of the Clinical Laboratory Science Profession

Medical laboratory testing, initially recognized in 1896 with the first hospital laboratory established at Johns Hopkins, became a more formal science in 1926 with accreditation standards from the American College of Surgeons (Delwiche, 2003). By 1928, laboratory professionals were undergoing a certification process through the Board of Registry (BOR) created under the auspices of the American Society of Clinical Pathology (ASCP), which continued laboratory control by physicians. The demands for increased education and practice skills in laboratory science continued, and laboratory scientists searched for autonomy from the pathologists' governing body for recognition of their own abundant technical knowledge. In the 1970s, laboratory scientists created the National Certifying Agency (NCA) to certify new scientists independent of ASCP. In 2009, the credentialing bodies merged and created new titles for laboratory scientists. The profession has suffered from an identity crisis over the years and has spent many years clarifying credentials, creating a sense of autonomy, and making the role of the laboratory known to other parts of the healthcare team and the public.

Even though laboratory scientists have struggled with a professional identity and autonomy, the work of the medical laboratory scientist (MLS) is an integral part of quality healthcare. For example, the Lewin Group National Status report (2008) referred to laboratory medicine as "…an essential element of the healthcare system. It is integral to many clinical decisions, providing physicians, nurses, and other healthcare providers with often pivotal information for the prevention, diagnosis, treatment and management of disease" (p. 10). U.S. News and World Report (2012) identified medical laboratory science as one of the most in-

demand professions and described practitioners as “the unsung heroes of the lab” and “the glue that holds hospitals together” (p. 3).

Ever-expanding laboratory testing menus offered to clinicians and the need to consolidate testing and increase automation for efficiency have dramatically risen, shifting the decision-making role of the MLS to provide interpretations, algorithms, and diagnostic significance data to clinicians (Kenimer-Leibach, 2011). While the entire healthcare system has emphasized improving patient outcomes, patient safety, testing efficiencies, and decreasing cost, these have long been ongoing goals of the laboratory (TJC, 2017). Accurate patient identification, increased automation, and quality assurance procedures in the laboratory achieve good patient outcomes. The practitioners in the hospital laboratory provide laboratory results in a highly technical and complex testing environment. Efficiency and patient safety have influenced the laboratory to have well-defined policies, processes, and procedures. The codified technical knowledge procedures provide the scheme to perform the tests, minimizing errors or variation in technique. With procedures in place, workers may be simply following standard rules of practice and procedure in order to make routine decisions, without the need for deeper theoretical understanding or complex critical thinking skills (Littler, 1982).

However, the current nature of clinical laboratory practice suggests that the MLS practitioner performs complex decision-making in their various roles. The roles, such as prioritizing patient samples, evaluating new test methodologies and instrumentation, running instrumentation, providing accurate and precise data through the implementation of quality assurance programs, reporting results, troubleshooting technological and instrument malfunctions, and communicating with laboratory colleagues or other healthcare professionals

responsible for the care of the patient, are varied and highly complex. It is a dynamic environment due to constant technological advances of instrumentation and laboratory information systems.

Performance of laboratory tests fall into the pre-analytical, analytical, and post-analytical phases that encompasses the total process of clinical laboratory testing. Wians (2009) illustrates the phases in his simplified diagram of diagnostic decision-making within the laboratory (Figure 1).

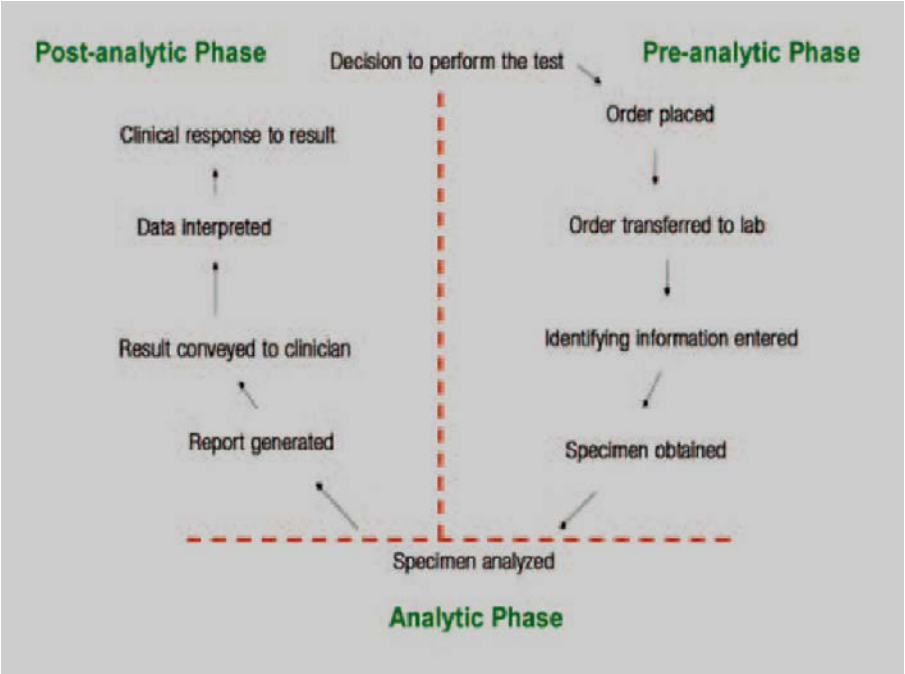

Figure 1. Diagnostic decision-making. Reprinted from "Clinical Laboratory tests: which, why and what do the results mean?" by F. Wians, 2009, *Laboratory Medicine*, *40*, 105.

The process in Figure 1 represents a visual model of the three segments of testing routinely occurring in the clinical laboratory. Analysis of patient results requires that the MLS perform decision-making in the pre-analytic, analytic, and post-analytic phases. Imagine that an MLS is reviewing patient results generated from instrumentation (post-analytic). Several of

the results are “out of range” for a normal healthy patient, and before reporting the results, the MLS must evaluate whether this reflects the patient’s true clinical state or is the “out of range” result due to a possible error in specimen collection (pre-analytical), testing (analytical), or within the laboratory information system reporting software (post-analytical). More specifically, let us imagine an abnormally low red blood cell count, low hemoglobin, and dramatically low hematocrit for a patient. At first glance, these results may represent severe anemia in the patient. A part of the laboratorian’s specialized technical knowledge is to do a quick mental check of the “rule of three,” where the hematocrit result is typically 3 times the hemoglobin result, whether the values are high or low. In this scenario, both the hemoglobin and hematocrit are low, but not within the expected “rule of three” relationship. The MLS must decide the next steps for the best patient outcome. What other checks can be performed that may validate this discrepant result as a true evaluation of the patient’s status? What method is used to measure these parameters? Is that a factor in the discrepant results? In what clinical disease states could these results be possible, and does that fit the clinical information available? Is it possible there is an error? If yes, in what phase of the process did the error occur? In addition, the MLS may be making these decisions within the context of a highly technical and complex laboratory, namely, a 400-bed hospital on a particular night shift, with only three other colleagues working. Add to this that the patient’s doctor has called for the complete blood count results multiple times and is growing very impatient. As evidenced in this example, the MLS may have many opportunities for decision-making within the highly technical context of the laboratory. Many different levels of practice exist in a diverse context.

Clinical laboratories employ medical laboratory scientists (MLSs) and medical laboratory technicians (MLT), phlebotomists, pathologists, and administrative staff to perform, evaluate, and report laboratory results. The medical laboratory profession includes various levels of education and training, requiring on-the-job training and an associate, bachelor, and/or graduate or professional degrees, depending on the duties performed. At the associate level, the practitioner is referred to as a technician, whereas the practitioner is referred to as a technologist or scientist at the bachelor level. Typically, a medical laboratory technician will work under the supervision of the MLS in the acquisition of laboratory results and their interpretation.

Medical laboratory scientists perform laboratory tests in hospitals, reference testing laboratories, private laboratories, physician offices, and research laboratories, providing laboratory data to physicians and other healthcare workers to support the best patient outcomes. Within the hospital context, many different disciplines or departments exist in the clinical laboratory where patient blood and body fluids are tested, namely, hematology and coagulation, chemistry, transfusion medicine, microbiology, immunology, urinalysis and body fluids, and molecular and genetic testing. The MLS can work each of these laboratory disciplines in a specialist role or move among several laboratory disciplines as a generalist. In addition, they are responsible for everyday business and personnel functions such as creating budgets, short- and long-term goal planning, and supervising other laboratory personnel. MLSs ensure that the right blood and body fluid tests are performed on the right person, at the right time, with emphasis on providing the most cost-effective procedures supporting aspects of patient care like safety and length of stay. Efficient patient care has mandated educators to

examine the process of creating healthcare professionals within constraints of healthcare reform.

Educators' Call to Action

Healthcare professionals function in a complex and changing workplace, especially with the added pressures of a declining workforce in all healthcare professions, increased numbers of chronically ill patients, and increased need for blended roles between the professions. According to the *Preparing the Workforce for a Reformed Healthcare System: Toward a Research Agenda* (Rutgers Center, 2011), healthcare reform will add additional challenges for educators to increase the numbers and types of career-entry professionals. Healthcare reform will have an overall effect on different aspects related to healthcare administration and practice. Healthcare reform goals include increasing access to healthcare with more equitable costs to consumers for this access. Recent national conferences and reports with a focus on best practices in higher education call for educators and the workforce to examine current training, pedagogy, and course content to ensure that programs meet the "challenges of reform…to increase the both the quantity of different types of health professionals and the quality of their pre- and post-employment training" (p. 1). According to the 2014 report, *Building a Laboratory Workforce to Meet the Future: American Society of Clinical Pathology (ASCP) Task Force on the Laboratory Professionals Workforce*, the laboratory workforce needs to embrace change to improve efficiency and effectiveness of workforce design. In addition to the need to increase the number of professionals in the workforce, the challenge facing educators is to examine the processes that guarantee a properly trained workforce. Particularly noted are "sustainable advances in educational curricula, continuing education, ongoing competency assessments, and credentialing

requirements" (p. 3). The ASCP report further concludes that the laboratory environment within the healthcare system is complex. In light of increasing technology, the MLS's role is changing in a complex work environment (McClure, 2009). The challenges presented by the Patient Protection and Affordable Care Act (PPACA) and ASCP taskforce inform medical laboratory science educators, particularly focusing on the quality of current preparation and training of practitioners.

Currently, training programs in clinical laboratory science typically include didactic instruction in either in a hospital or university-based program, accompanied by an internship/practical experience within a clinical laboratory. Medical laboratory students secure a place in a clinical laboratory where they receive one-on-one instruction from the clinical staff during the internship portion of their training. Most recently, clinical internship takes place in sites with a reduced workforce, further necessitating the need to examine pre- and post-employment training for best practices. Two factors affect laboratory practitioner training: namely, an overall reduced number of training programs and reduced workforce to provide the clinical training part of the curriculum. Considering the added pressures of a reduced workforce to support the education of students becoming MLSs and an emphasis to prepare all healthcare practitioners to meet healthcare reform expectations, examining the current laboratory clinical experience of practitioners surrounding decision-making may illuminate these best practices.

There is little or no research done in the clinical laboratory field regarding decision-making at the laboratory testing "bench." Kenimer-Leibach (1999) elicited the critical thinking behaviors from experts in the field; however, a gap remains in understanding how critical thinking skills integrate from theory to practice. Kenimer-Leibach (2011) compiled 65

critical thinking behaviors in clinical laboratory science (CLS) and asked experts to narrow down those behaviors based on their experience. The top 25 behaviors spanned various learning/knowledge domains. As Kenimer-Leibach (2011) identified, many behaviors were of a cognitive nature, supporting the need for technical knowledge required to practice. Other critical thinking behaviors constituted the psychomotor and attitudinal domains, within a situated context. Kenimer-Leibach (2011) then compared her results to expert nursing behaviors elicited by Benner (1984). While this is important work and shows the importance of critical thinking behaviors in the fields of clinical laboratory practice and nursing, there remains a gap of corroborating by observation of the critical thinking behaviors in clinical laboratory practice. A gap remains between interview and observation of critical thinking behaviors in clinical laboratory science studies that may unveil the decision-making skills of MLSs. Examining the decision-making process for laboratory professionals may illuminate the process that is required in training of laboratory professionals.

In his book, *The Reflective Practitioner,* Schon recognized the need to describe this theory-practice gap with his description of reflective practice in science-based professions. He described how it was more than defining a problem; it included searching through known problem-solving techniques within a practitioner's repertoire. Reflective practice encompasses different forms of knowledge, namely, personal knowledge, knowledge as problematic, and knowledge as process. Reflective practice within a laboratory context is the integration of theory and practice as practitioners are able to apply technical skills, revise their knowledge in uncertain situations, and make decisions surrounding laboratory testing for good patient outcomes. A common set of situations present themselves, and "knowing in practice tends to become increasingly tacit, spontaneous, and automatic" (p. 60). MLSs do

practice repetitive tasks in the everyday laboratory. In addition, as practitioners become more expert, tasks performed may become automatic. When practitioners exist in a static environment, task execution may not require deep reflection. Schon (1983) described a sort of "practice his practice" occurring when the practitioner is not asked to perform outside a relatively static environment (p. 60). However, Schon recognized that there must be other elements present as the practitioner "constructs a manageable problem from a problematic situation," hence, the term *reflection-in-action* or *contextualized reflection* (p. 170). Both tacit and explicit specialized technical knowledge is previously internalized, in all situations; however, in situations of uncertainty and ambiguity, the application of (implicit) tacit knowledge becomes paramount.

My research sought to understand the nature of decision-making in the clinical laboratory context by understanding how MLSs go about making decisions when confronted with problematic or unique situations in the clinical laboratory.

Problem Statement

The clinical laboratory science field requires an abundance of technical knowledge; however, the importance of implicit or tacit knowledge gained through observation and practice is often discounted in this field, even though it is a critical part of reflective thinking, critical thinking, and reflective practice (Gustafsson & Fagerberg, 2004; McClure, 2009). The suggestion is that these practitioners have been subjected to a sort of "de-skilling," where the need for deeper theoretical understanding or complex critical thinking skills is downplayed, as a result of practitioners simply following standard rules of practice in order to make routine decisions (Littler, 1982). The "deskilling" of laboratory practitioners may be a result of limited training opportunities in an overtaxed system (Woest & Barham, 2006). We do not

know enough about the nature of decision-making confronted by MLSs in the field, and this limits the ability of educators to prepare MLSs to deal with unique or problematic situations. Understanding the decision-making processes, with relationship to critical thinking and reflection, may support laboratory educators' enhancement of pedagogical approaches in training of new professionals.

Purpose of the Study

A deeper analysis of decision-making skills, accomplished by interviewing practicing medical laboratory scientists in this study, may illuminate, for practitioners and the public sector, the complexity of the profession. Systematic observations surrounding decision-making in the laboratory in the clinical practice context are lacking. This study adds to the body of knowledge in clinical laboratory science by specifically observing practitioners for behaviors that reflect the use of specialized technical knowledge in decision-making in the context of the laboratory.

Potentially, this research could provide insight for medicine, nursing, and other allied healthcare disciplines to enhance their processes in the context of clinical training.

Nature of the Study and Research Questions

The study employed a qualitative approach to illuminate the decision-making of laboratory professionals. The purpose of this study was to understand how individual MLSs make judgments or decide on a course of action when confronted by situations outside the standard operating procedures or processes, by conducting interviews and observations in the workplace using a phenomenological design. Even though processes and procedures are defined for much of the work, examining the decision-making process of the MLS is

warranted. Procedures and standards of operation (SOP) do dictate the "rules" to be followed in the clinical laboratory. However, Ribeiro (2012) posited that:

> "No rule is absolute in its interpretation and/or application" and in his probing of an experienced industrial supervisor, extra rules written into procedures and SOPs for every scenario possible still would not allow the practitioner to know how to manage the 'if this, then do that' (p. 344).

How laboratory professionals make judgments, frame and reframe problems, experiment with solutions, and internalize knowledge for the next episode within the culture of the laboratory is the purpose of the study. The decision-making process for the following research question and specific aims were explored by conducting interviews and observations with laboratory professionals:

- ➢ How do medical laboratory scientists go about making decisions when confronted with problematic or unique situations in the clinical laboratory?

Specific Aims

- What do laboratory professionals view as significant problems or unique events in the workplace?
- How do the participants describe how they deal with problematic or unique situations they encounter?

Operational Definitions

At the bench: a term used to describe medical laboratory scientists performing laboratory tests in the context of the laboratory.

Clinical laboratory science: an allied health profession in which members perform medical

laboratory tests for the purpose of assessment of health and diagnosis of disease. Also known as medical laboratory science and, historically, as medical technology.

Critical thinking: that mode of thinking—about any subject, content, or problem—in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing, and reconstructing it.

Significant or critical incident: incident of a specific activity, as described by participants as out of the ordinary or observed by the researcher.

Double loop learning: espoused theories are challenged, digs into tacit knowledge made explicit, paradigm shift of espoused theories.

Encultured knowledge: knowledge that comes from socialization within a certain profession. It is the "way we do things around here." Professions possess a culture that participants can choose to embrace, full of attitudes and beliefs acceptable to the group.

Explicit knowledge: knowledge that can be easily articulated, usually part of a formal curriculum such as the cognitive and psychomotor skills of specialized technical knowledge.

Laboratory: a medical laboratory where patient tissue, blood, and body fluid samples are analyzed for use in the diagnostic, prognostic, and basic health status of patients.

Medical laboratory scientist: a baccalaureate-level allied health professional who performs medical laboratory tests, supervises, and/or does research. Abbreviated MLS; also known as a medical technologist or clinical laboratory scientist.

Medical laboratory technician: an associate-degree level allied health professional who performs medical laboratory tests and works with medical laboratory scientists; abbreviated MLT. This level is not included in the study.

Practitioner: generally refers to any professional performing within their profession; often used in the healthcare literature.

Professional socialization: Socialization encompasses the mastery of knowledge, skills, attitudes, and behaviors to satisfy basic competency standards of an entry-level practitioner. It is not linear. Students become part of a collective group (cohort); undergoing the same set of experiences, they learn the laboratory "language," professional expectations, beliefs, and etiquette as they evaluate their capacity to be a part of the profession. Further socialization occurs in clinical experience as students experience realities of the workplace.

Practice: sequence of actions; in health professions, as a service to others (clients).

Procedural knowledge: subset of tacit knowledge usually considered as the knowledge that comes from observation and doing, that is, practice. It is not always easily articulated, but it can be made explicit. For this study, it does not represent the written documents typically referred to as procedures.

Professional competence: Professional competence stems from the ability of a student to integrate theory and practice as the student moves through a professional program. Competency implies that the student has mastered the knowledge, skills, and attributes of an entry-level practitioner.

Reflection in action: refers to the reflective thinking one is doing while one is doing the action.

Reflection on action: refers to the reflective thinking one does after the experience has taken place.

Single-loop learning: espoused theories are not challenged.

Tacit knowledge: knowledge that is inherently implicit, not easily articulated, usually the curriculum surrounding affective behaviors, critical thinking skills, attitudes, and beliefs.

Significance of the Study

A study of individual medical laboratory science practitioners' decision-making processes described in interviews and observed in the laboratory context is important for several reasons. First, understanding the decision-making processes, with relationship to critical thinking and reflection, may support laboratory educators' enhancement of pedagogical approaches in training of new professionals. Second, examining the decision-making process within the clinical laboratory may illuminate the complexity of the job. In addition, it may enhance awareness of the laboratory role and skills necessary for quality patient outcomes. For example, practitioners are required to troubleshoot discrepant data by analyzing pre-analytical, analytical, and post-analytical phases of testing before communicating results to clinicians and other healthcare team members. As technology innovations increase, there is a need for MLSs to provide more interpretation and explanation of laboratory data. Kenimer-Leibach (2011) called for more research to confirm that the critical thinking behaviors identified were corroborated by observation. According to Kenimer-Leibach, "Making critical thinking explicit is the key, I think, to effectively being able to observe it, teach it, and build it into job descriptions" (personal communication, 2014). It is timely and pertinent to understand the decision-making skills of MLSs. Understanding the decision-making process in the laboratory workplace may further define differing roles for MLSs as interdisciplinary healthcare approaches continue to increase.

This research will add to the body of knowledge of reflective practice in the health sciences, particularly in the decision-making process. Understanding decision-making in

medical laboratory science may help educators and clinical preceptors/mentors identify the skills and processes that are necessary to build reflective practice in the training of medical laboratory scientists in a constantly changing laboratory environment.

Chapter 1 contains the introduction, the nature of laboratory work, how laboratory work is situated within the healthcare system, the problem statement, the research question, and specific aims and operational definitions. Chapter 2 contains the contextualization of the study with background literature and a suggested theoretical framework. Chapter 3 explores the methodology and a review of the researcher's positionality. In addition, Chapter 3 contains statements of how referential adequacy, structural corroboration, and consensual validation is ensured.

Chapter 2: Literature Review

The literature review contains exemplars of research in health professions, specifically clinical laboratory science surrounding pieces of reflective practice such as critical thinking skills, professional socialization, and decision-making. The early constructivists' theories of reflective practice to applications of reflective practice in the health professions is explored. The reflective thinking framework may provide a way to make sense of the decision-making for this laboratory group. A focused review of Polanyi's (1967) theory of tacit knowledge, highlighting the difficulties of "capturing" or identifying the tacit piece of the decision-making process, is included. In addition, a visual representation of the "degrees of tacitness" to illustrate the practitioner's social construction of practice, which may or may not be articulated, is included (Ambrosini & Bowman, 2001). This further highlights the difficulty of naming tacit knowledge used in the exploration of the practitioner's decision-making. In addition, Argyris and Schon's (1978) theory in use emphasizes the attitudes, beliefs, and schema present in the reflective practice process. This literature review explores the background and significance of reflective practice, of which decision-making is a part. The proposed conceptual framework is a combination of reflective thinking and the externalization/internalization of knowledge. Exploring the reflective practice process surrounding a problematic situation in the clinical laboratory science (CLS) field may reveal the links between tacit and explicit knowledge and the internalization/externalization of professional knowledge.

Professions, Semi-Professions, and Apprenticeships

The evolution of training in professions, semi-professions, and apprenticeships impacts today's current context of work. The study of professions is largely embedded within occupational sociology (Hearn, 1982). A common thread is that professions provide services

and possess commonly accepted core characteristics. Core characteristics of professions include control over the knowledge and service they provide, autonomy in their decision-making, commitment to a calling to provide their services, and prolonged training within an organization that controls entry. Autonomous professions can typically request a fee for their services and act upon perceptions of the clients' needs. Historically, professions that possess the core characteristics are law, clergy, and medicine.

Many of the service professions, such as teaching, nursing, clinical laboratory science, engineering, and numerous allied health professions, "score" lower on the list of the core characteristics of a professional. Semi-professionals generally have jobs that have multiple paths to entry, require less extensive training, and have lower levels of decision-making control over the core of their work. Labeling these professions as "semi" seems to be pejorative, legitimizing deskilling. The deskilling of the semi-professions occurs when they are described as simply following standard rules of practice in order to make routine decisions, without the need for deeper theoretical understanding or complex critical thinking skills (Littler, 1982). Professional knowledge is the collective term for the technical and practice knowledge and consists of tacit and explicit knowledge. Increased technology has created a paradigm that this will guarantee quality and efficiency and reduce error. We have the ability to script the professional knowledge to perform the job. The work environment is changing with the increase in artificial intelligence, automation, and availability of training opportunities, blurring the core characteristics between professions and semi-professions. Physicians now have access to software that can enhance their recall and interpretation of their professional knowledge using algorithms to aid in decision-making about diagnosis, treatment, and monitoring of disease. Teachers are encouraged to script their professional

knowledge and performance in the classroom with lesson plans that ensure they meet core standards of practice. Likewise, in the clinical laboratory, the use of enhanced software, automation, and middleware is captured in procedures and processes to anticipate every solution to problems encountered. This brings to the forefront the realization that professions and semi-professions are undergoing changes that continue to blur the distinction between a profession and a semi-profession.

The apprenticeship model was used in professional training for the medical, clergy, and legal fields. Apprenticeships were a coveted, privileged route for the training of new workers. The apprenticeship guilds restricted entry and provided extensive training. Trainees learned professionalism by abiding by social norms of the profession. However, with the advent of the industrial age, training became a by-product of work as the needs to supply new workers grew. It seemed that there was no obligation to ensure that trainees were socialized into a profession, but rather to concentrate on their work productivity. Training and learning opportunities shrank. Later, Schon (1987) was concerned that artistry originally associated with apprenticeships is less nurtured in professional training and viewed as a less important constituent of professional knowledge. Today, apprenticeships exist in an abbreviated form as internships, externships, and cooperative educational experiences. Although professions and semi-professions have organizational standards, certifications, licensure, and training internships to ensure the socialization of new workers into the professions with the professional knowledge needed, the work environment has changed. For clinical laboratory science, the work environment has changed to a focus that the lab is a “commodity, mass-produced, evaluated by cost containment and not quality” and we are indoctrinated to overlook (Plebani & Lippi, 2010, p. 940). Laboratory resources are consolidating, reducing

the availability of training sites. The mini-apprenticeship model, known as an internship, has less one-on-one training. Much of tacit knowledge development is pushed to the workplace, and that can be problematic. We need to understand the development of professional knowledge (explicit and tacit) and work environments, so we can do a better job in our constrained educational and training world. The development of tacit and explicit knowledge and its roles in the development of professional knowledge must be explored through understanding constructivist theories.

Early Constructivism

Constructivist theory was influenced by the work of Piaget and Vygotsky, who formulated cognitive theories that discussed how children construct their own understanding of reality. Piaget (1977) described early childhood development of intelligence that involved the organization of schemas that constructed sensorimotor intelligence and were dependent on relationships between the child and his/her environment. Vygotsky (1978) was deemed a social constructivist, suggesting that learning is dependent on the social context. He described the "zone of proximal development" as an experiential space where the child/student is challenged by more experienced peers/adults to construct a deeper understanding or extend understanding as part of future development. In the "zone," certain interactions within the environment and with a child's peers stimulate child development, and the child begins to internalize the learned concepts (p. 90). Dewey (1933) also posited that knowledge is experiential and constructed in a social context. In other words, a situation that is problematic creates uncertainty. The individual learner begins to make meaning and frame the problem. The stage is set for problem-solving influenced by external changes to the situation. Dewey defined reflective thinking as "active, persistent, and careful consideration of any belief or

supposed form of knowledge in the lights of the grounds that support it and the further conclusion to which it tends" (p. 9). Therefore, he advocated that learners should be active, not passive.

Later Reflective Practice Theorists

Mezirow (1991) built upon constructivist theories of reflection. To him, all reflection involves some sort of critique. The reflection is intentional, with the opportunity for corrections made in presuppositions. He defined critical reflection as involving "the critiques of assumptions about the content or process of problem solving" (p. 105). In addition, he described the value of "problem posing" as raising questions for validity of a solution. Therefore, increasing opportunities to put the student in situations of "problem posing" would increase the student's ability to reflect-in-learning. This built upon Schon's (1983) work surrounding reflective practice. In Schon's work to understand how professionals ultimately acquire knowledge from reflection-in-action, he suggested that the technically rational professional utilizes problem-solving skills within a certain constraint. When the problem is outside a certain context, the practitioner constructs a "manageable problem from a problematic situation" (p. 169). Important tenets of Schon's theories are knowing-in-action, reflection-on-action, and reflection-in-action. Schon called for a study of knowledge and practice that examined how practitioners used experiences and technical knowledge to inform their actions in a situation (knowing-in-action).

The reflective practitioner brings to any phenomenon encountered in practice knowing-in-action techniques based on previous experience and specialized technical knowledge. His or her decision-making and problem-solving are the application of the empirical science of the profession. When faced with uncertain situations, the practitioner

returns to prior experience and uses trial/error/intuition and reflection-in-action to adjust his or her activities in response. If the uncertain situation is, in fact, unique to the practitioner, he/she may reframe a problem by testing a new approach, therefore questioning/challenging a tacit norm. Reflective thinking, critical thinking, and reflective practice have contributed to professional knowledge development. The roles of explicit and tacit knowledge in the creation of professional knowledge are explored next.

Tacit Knowing

Professional knowledge is a collective term encompassing the explicit and tacit knowledge needed to practice. It implies that as a practitioner integrates this combination of theory and practice knowledge moving through a professional program, the result will be an entry-level practitioner with increasing levels of both explicit and tacit knowledge. Neither explicit nor tacit knowledge should be discussed without considering the other. Typically, explicit knowledge has been described as the knowledge formally learned and relatively easy to articulate (Ambrosini & Bowman, 2001). Conversely, implicit or tacit knowledge tends to be the knowledge gained through observation and practice that suggests a somewhat unconscious acquisition for the learner and is more difficult to articulate. Ambrosini and Bowman (2001) posited that the researcher can visualize knowledge on a continuum, a "degree of tacitness" to explain knowledge which is explicit to knowledge that is deeply ingrained (tacit; Figure 2).

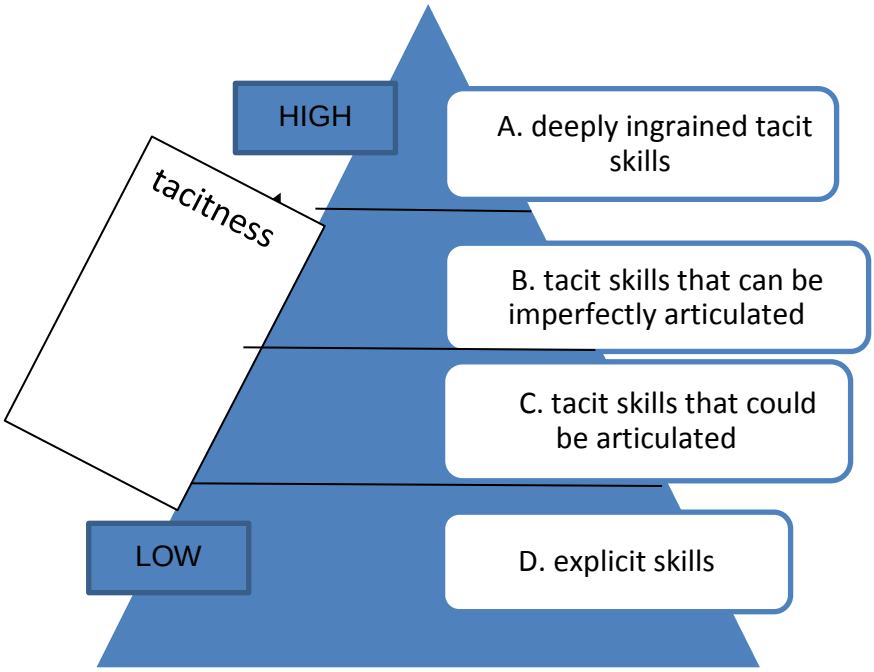

Figure 2. Degree of tacitness. Adapted from "Tacit knowledge: some suggestions for operationalization" by V. Ambrosini & C. Bowman, 2001, *Journal of Management Studies*, 38(6), 811–829.

Ambrosini and Bowman (2001) took the stance that knowledge is socially constructed, and a phenomenological approach is appropriate to get at the socially constructed meaning; as participants make meaning surrounding them, it will include the tacit knowledge that is present whether clearly articulated or not (p. 816). Knowledge comes in the forms of "know-what" and know-how" (p. 813). The "knower" is developing his or her theory of practice that is demonstrated in practice.

Polanyi (1967) posited, "We can know more than we can tell," meaning that some knowledge cannot be easily expressed in words (p. 4). In reflective practice, we are attempting to make known that part of knowledge that is difficult to articulate, to prepare practitioners for professional competence. Polanyi described two parts of knowing: that which we "attend from" and that which we "attend to" (p. 10). According to Polanyi, the attend to is that part which we can focus on and assign meaning. However, attend from implies a reliance

on the awareness of that for which we want to attend to. It may follow that the attended to may be observable, and the attend from may lend itself to articulation by practitioners through interview focusing on decision-making. Asking practitioners to share examples of decision-making in an interview may reflect the norms, rules, and assumptions espoused by the collective group of the profession and not the actual practice or theories in use.

Espoused Theory in Practice

The espoused theory of the laboratory practitioner reflects the norms and collective professional knowledge of "how we do things around here." Policies, procedures, and job descriptions serve the practitioner well in this sense to allow routine practice and preserve the espoused theories of the profession. Practice becomes routine, completing tasks according to prescribed procedures. Performance of repetitive tasks does not challenge the existing norms or espoused theory of the profession (Argyris & Schon, 1978). However, when a practitioner encounters a technically uncertain situation, he/she will use strategies gained from reflection-on-action of similar previous experiences. If there are not sufficient strategies in the practitioner's "toolbox," he/she may feel conflicted. Double loop learning occurs when conflict has caused the practitioner to seek new solutions that may challenge norms set forth by the profession. Solutions reflect the explicit and tacit knowledge in the practitioner's professional knowledge. Argyris and Schon (1978) termed these new solutions *theories in use*. Theories in use reflect the tacit knowledge that practitioners may find difficult to articulate, or are not reflected in the espoused theories protected by the profession. Theories in use are learned in context and informal, and not all of them can or should be made explicit. If the theory in use is impacted in such a way as to change espoused theories of the practitioner, then it is an example of double-loop learning. Combining interview and observation

surrounding a critical incident requiring a decision will elicit from practitioners the reflection-in-action and reflection-on-action that inform their theories-in-use.

Relationship of Decision-Making, Critical Thinking Skills, Reflective Thinking, and Reflective Practice

Examining decision-making may illuminate the intersection of theory and practice. Many terms have been associated with reflective practice that illuminates the process of decision-making. Therefore, a brief description of how they were defined for this study is warranted. The Foundation for Critical Thinking, (n.d.) defines critical thinking as "that mode of thinking—about any subject, content, or problem—in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing, and reconstructing it. Critical thinking is self-directed, self-disciplined, self-monitored, and self-corrective thinking. It presupposes assent to rigorous standards of excellence and mindful command of their use ("Critical Thinking Community," para.2). The development of critical thinking skills is paramount in the development of individual reflective practitioners. It is a term that describes a stage of critical thinking as the professional begins to reason through a problem using current information, analyzing assumptions, and recognizing consequences of various solutions. Reflective thinking and the development of reflective practice are parts of the larger topic of critical thinking skills. Studying the reflective thinking process in the context of practice has led to the term *reflective practice*. Schon's (1983) definition of knowing-in-action, or reflective practice, seeks to account for the complementary actions of "doing and thinking" (p. 280). Schon wrote:

Doing extends thinking in the tests, moves, and probes of experiential action, and

reflection feeds on doing and its results…it is the surprising result of action that triggers reflection, and it is the production of a satisfactory move that brings reflection temporarily to a close. (p. 280)

Theoretical Frameworks

The reflecting thinking model (Taggart 1995, Figure 3) outlines a cyclical process for solving problems. It satisfies the definition posited by the Foundation for Critical Thinking (n.d.), as it provides a visual format that may illustrate the "mode of thinking" ("Critical Thinking Community", para. 2).

Drawing on the work of Dewey (1933), Pugach and Johnson (1990), Schon (1983), Clark (1995), Schon, (1987), and Taggart (1995) described a model that provided a visual picture of the reflective thinking process at an individual level for teachers.

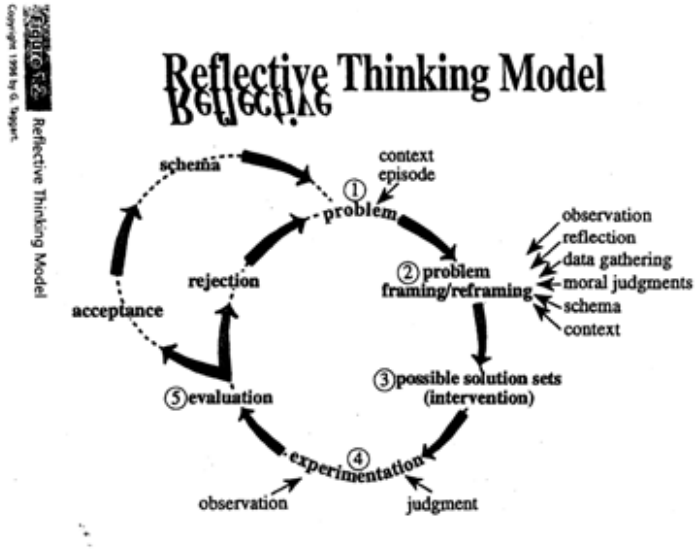

Figure 3. Reflective thinking model, Reprinted from "Reflective Thinking: A guide for Training Preservice and In-service practitioners," by G. Taggart, 1995. Retrieved from UMI: 9637212.

Taggart's model (1995) begins with defining and framing a problem through data gathering, considering the context, observing, and reflecting on previous schema and moral judgments. The reflective thinker determines possible solution sets, and if after testing and observation the decisions made prove successful, these solutions are stored for future use and may become routine. Likewise, the nature of laboratory work includes the "know what" using procedures, automation, and other explicit knowledge artifacts. The "know how" is typically termed *procedural knowledge* and is attained by practicing the skills until these skills can be done automatically, typifying a sort of routinization or unconscious performance (Taylor, 2007). Taggart's (1995) model can help explain the decision-making process for laboratory practitioners. When the laboratory scientist encounters a problem or technically uncertain situation, he/she will reflect on similar previous experiences. The practitioner may be searching through a sort of mental toolbox to employ the best possible theory in use built from previous decision-making. At the points "possible solution sets" and "experimentation" in the cycle, the practitioner is testing the theories in use and forming a decision. This researcher is not interested in naming the tacit knowledge that is difficult to articulate within the laboratory context, but rather in illuminating and analyzing decision-making through qualitative interviews and observations in a laboratory context.

At an organizational level, MLSs create (make explicit) written procedures to capture the tacit and technical knowledge that can be made explicit with the goal of instructing practitioners on how to solve a problem with a sound decision. However, an individual may find that the procedure does not solve the problem at hand. The MLS must utilize the tacit and explicit knowledge that has been internalized through practice. Informal knowledge acquisition is described and classified by four processes of knowledge creation—

socialization, externalization, combination, and internalization (SECI) by Nonaka and Takeuchi. The model shows how people are socialized to new knowledge and trained to work. The model places tacit knowledge at the core, emphasizing that organizations not minimize the importance of capturing tacit knowledge and communicating it to others within an organization. The spiral illustrates the relationship of tacit and explicit knowledge in the creation of new knowledge.

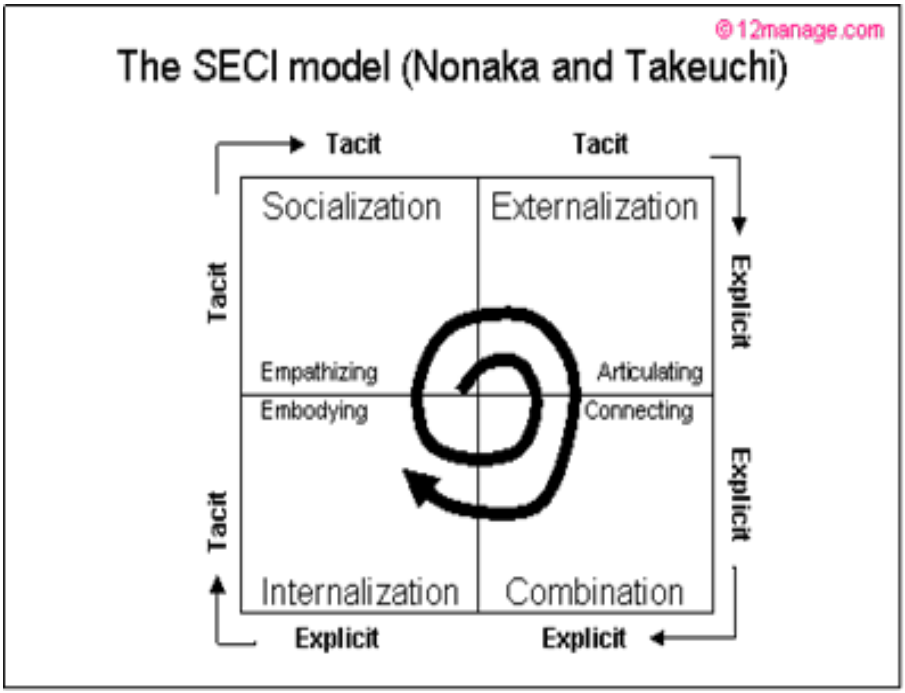

Figure 4. The SECI Model. Reprinted from "The knowledge-creating company," by I. Nonaka & H. Takeuchi, 1995, New York: Oxford University Press.

The SECI model illustrates knowledge creation by managing the relationship between tacit and explicit knowledge. In the combination phase, practitioners are data gathering, exploring their current schema related to the problem, and experimenting with solutions. They have a problem, but our current solutions are not solving it. Once a solution is found and a decision is made, the practitioner will internalize this as new tacit knowledge. Practitioners may internalize this tacit knowledge as a new procedure or a new mental model (theory-in-

use). Then we can socialize new professionals to use these solutions. The transfer process of tacit knowledge to explicit knowledge occurring in externalization can occur through the use of stories, analogies, models, and metaphors to convey meaning (Choo, 1995). A composite model incorporating the four stages of knowledge creation and the reflective thinking process is illustrated in Figure 5.

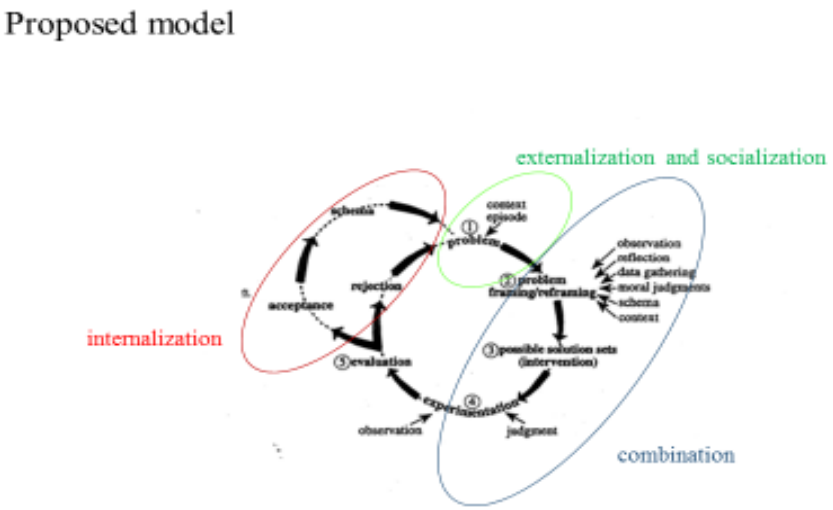

Figure 5. Proposed conceptual framework. Adapted from the reflective thinking model & the SECI model.

In problem-solving and subsequent decision-making, the practitioner recognizes that current explicit and tacit knowledge schemata will not solve the problem. Problem solving occurs in combination as the practitioner works through the problem, using explicit knowledge from many sources such as observation, reflection, data gathering, judgments, and schema available in this context. Experimentation of problem solutions begins to create new knowledge that is evaluated and internalized. The new tacit knowledge becomes internalized

as a new routine as it is performed repeatedly. In the externalization and socialization phase, practitioners can make explicit the tacit knowledge solutions internalized to new professionals available for the next episode in this context.

Motivation in Decision-Making

The conceptual framework of reflective practice helps us to understand the decision-making process of practitioners. The tacit-to-explicit and explicit-to-tacit knowledge process requires a driving force to persevere through problem-solving. As practitioners move through the loops of identifying a problem, gathering data, and evaluating possible solutions, internalization of new tacit knowledge takes place. The tacit knowledge may be made explicit at another context episode. Creating schema, internalizing tacit and explicit knowledge, and subsequently applying possible solution sets must be driven by motivation to continue reflection and action. Practitioners may have their self-efficacy raised as they realize they can move through a decision-making process and solve a problem (Bandura, 1986, 1988).

Self-efficacy and higher order satisfiers can be met only if basic needs are met (Maslow, 1943; Herzberg, 1959). Herzberg (1959), recognizing the work of Maslow, agreed that basic needs or "hygiene factors" must be present before higher order satisfiers are obtained. However, he believed presence of "hygiene factors" did not contribute to the motivation to work harder. If the "hygiene factors" (like Maslow's physical needs) were not present, then it leads to dissatisfaction. Herzberg (1959) thought that the "motivators," such as responsibility, recognition, and promotion, would influence practitioners to work harder.

Expectancy theory proposed by Vroom (1964) emphasized positive outcomes rather than satisfying needs. Vroom's "valence, instrumentality, and expectancy" theories align with Herzberg's and Maslow's, in that people "expect" they have the knowledge and skills to

perform; they believe that the process (instrumentality) will allow them to value the greater purpose (valence).

The proposed conceptual framework was used to understand tacit and explicit knowledge creation and the role of motivation in the laboratory context. The following sections of this review of literature explore the gaps in reflective practice research in professions and semi-professions, specifically clinical laboratory science.

Reflective Practice in Health Professions

Decision-making, reflective thinking, critical thinking, and reflective practice contribute to professional knowledge development in many health professions (Kinsella, 2009; Leibach, 2011; Mamede & Schmidt, 2004; Gustafsson & Fagerberg, 2004). Reflective practice theory has been researched across many disciplines in medicine, nursing, social work, and health professions. Reflective practice components, such as tacit and explicit knowledge, reflective thinking, and critical thinking have been operationalized differently across studies. Context is important as evidenced by a study performed by Gustaffson (2004) in which different contexts (psych and surgical units) resulted in a different perception of how reflection impacts their duties.

Strategies aimed to identify and enhance reflective practice varied across disciplines as well (Burton, 2000; Jolly, 1999; Teekman, 2000; Shepard & Johnson, 1990; Sobral, 2005; Dunn & Musolino, 2011). Creating reflective journals in nursing and medicine was an attempt to capture the episodes where reflection in action and reflection on action may have occurred, but it was not evident that the necessary reflective practice skills were supported (Jolly, 1999). Teekman (2000) examined reflective thinking among 10 registered nurses. One of the interesting findings was that the nurses exhibited “sense-making” and “reflective thinking” (p.

1134), but critical inquiry was not exhibited due to the nurses' description of "unwritten rules" that prohibit input on patient decision-making (p. 1132). This seems to suggest that there may be some knowledge that was difficult to articulate (tacit) to the researchers (espoused theory).

In the interest of making reflective practice teachable, Mamede and Schmidt (2004) suggest that a "better understanding of the thinking process" is warranted (p. 1307). The importance of practitioners moving between theoretical and practical knowledge was mirrored in the study by Klemola and Norris (1997), which examined the practice of anesthetists. Within a group of anesthetists, the researchers found that the participants exhibited two orientations when confronted with a technically uncertain situation: "communicative" and "authoritative" (p. 452). These terms described their practice approaches, "psychophysiological" or "reactive," respectively.

Shepard and Jensen (1990) reviewed a physical therapy (PT) curriculum for the explicit and implicit pieces needed to prepare reflective practitioners in PT. Clinical educators inquired most about the nature of the explicit pieces but were most concerned with supporting practitioners who can navigate the "everyday skills related to professional responsibilities" (p. 570). The educators conducting the study did recognize the differences in implicit and explicit knowledge in the clinical setting; however, the study did not include an observation piece through which they may have elucidated this implicit tacit knowledge.

Reflective Practice in Clinical Laboratory Science

Most medical laboratory scientist (MLS) educators would agree that cognitive, psychomotor, and affective behavior skills are necessary in this field. Work environment pressures and clinical experience issues have been reviewed in clinical laboratory science.

Beck and Laudicina (1999) surveyed CLS staff practitioners to ascertain the knowledge, skills, and attitudes needed for current practice. Respondents reported that interpersonal skills, flexibility, and ability to learn were as important as technical and scientific skills in their current work setting. As interdisciplinary healthcare approaches continue to increase, understanding the reflective practice process in the laboratory workplace is warranted. Woest and Barham's (2006) study of clinical laboratory educational program data emphasized supporting the need to keep the essential elements of clinical laboratory pedagogy that support the development of a laboratory professional in light of the changing pressures in the healthcare fields. They posited that the clinical piece "offers an intense applied delivery where the student can begin to develop the skills and form the dispositions needed to become a successful entry-level professional when they graduate" and should be "protected, preserved, and promoted." (p. 591). Students gain clinical application of theory, but they also experience bench instructors' modeling ethics, professionalism, and life experiences so that they may transition to a professional role. Most clinical laboratory scientist educators would agree with this statement. However, a gap exists that warrants further study into understanding how the clinical piece supports reflective practice to ensure the acquisition of these skills. Kenimer (2011) advocated for the doctorate level in CLS (DMLS) by referring to her earlier dissertation work (1999) surrounding critical thinking (CT) identified by expert laboratory professionals. Given the changing healthcare environment, she foresees the increased need for practitioners who can participate in "systems-level outcomes like diagnostic algorithms, care paths, and nationally-monitored quality indicators" (p. 43). Kenimer posited that continued evaluation of CT behaviors is warranted, especially in the "social/contextual orientation" (p. 43). Expert practice development theory provides a framework for further study. Kenimer

states, “Educators in all MLS sub-disciplines should work to identify CT practice behaviors…and build curriculum supporting their development at each level of practice” (p. 43). While listing behaviors that are desirable in the workplace context is crucial to support the creation of practitioners, it does not illuminate the reflective process that supports or solidifies these behaviors.

This review of healthcare practitioner research supports the continuation of studying professional knowledge. Other healthcare fields have focused on components of reflective practice such as reflective thinking and critical thinking. While clinical laboratory educators and practitioners recognize that allowing time for theory and practice integration have identified critical thinking behaviors and skills and some strategies to support, there has not been an empirical study looking at the nature of decision-making in clinical laboratory science. The extent of research in the clinical laboratory science field is minimal surrounding reflective practice and its components. This research strives to understand the decision-making that supports reflection-in-action and on-action and is internalized by practitioners.

Reflective Practice as “Art” or “Science”

In the *Reflective Practitioner* (1983), Donald Schon described a type of competence that practitioners display in times of uncertain situations or conflicts encountered in practice. This type of competence is described as “artistry” (p. 18). This subjective and “artistic” dimension of decision-making also reflects the increased value of tacit knowledge. Making sense of practitioners’ practice, particularly the decision-making process in uncertain situations, may reveal the artistic component that draws on and builds on tacit knowledge. This deviates from the purely prescriptive procedures of “science.” Professional knowledge, consisting of art and science, must be created at the juncture of theory and practice. Therefore,

the focus of teaching professional knowledge should not consist of only science and technical concepts, as that may obstruct our view of artful competence in practice (Kinsella, 2009).

Professional Socialization

Recognizing the fact that decisions are not made in isolation, a description of the impact that professional socialization may have on decision-making is warranted. Bragg (1976) defined professional socialization as a process through which "the individual acquires the knowledge and skills, the values and attitudes, and the habits and modes of thought of the society to which he belongs" (p. 9). According to Bragg (1976), socialization encompasses the mastery of knowledge, skills, attitudes, and behaviors to satisfy basic competency standards of an entry-level practitioner in a desired profession. Competency in a field can be determined by attempting to measure all the cognitive, psychomotor, and attitudinal skills to practice. Achieving professional competence suggests that the practitioner has knowledge of all problems that need to be solved, albeit a finite number. However, it does not take into account a more situated learning context (Kenimer, 2011). Obtaining professional competence is not linear, but rather a process of socialization that is ongoing (Wediman, Twale, & Stein, 2001). Norms and standards of a profession exist in its professional societies and organizations. Socialization is based on expectations and norms, or the espoused theories that are present in the profession.

The field of clinical laboratory science is no exception to professional socialization. By committing to the field, professionals in clinical laboratory science adopt the code of ethics and professional pledge of the organization. Initial commitment to the field leads to being exposed to an encultured knowledge learned during socialization in didactic and clinical experience and the realities of the workplace contribute to "how things are done around here" (Weidman et al, 2001). Practitioners become part of a collective group, undergoing the same

sets of experiences, whereby they learn the laboratory "language," professional expectations, beliefs, and etiquette as they evaluate their capacity to be a part of the profession. Professional socialization literature in the clinical laboratory science field is limited. Schill (2012) included the professional socialization piece in her study of the clinical laboratory field, for understanding retention of novice practitioners. Schill (2012) posited that professional socialization does not occur in just one part of the education of laboratory professionals but is built upon as professionals become a part of the workforce. Professional socialization leads to some part of shaping the attitudes and beliefs of laboratory practitioners. New graduates and novice professionals in the study noted a theory-practice gap emphasizing the need for mentorship and a positive work environment, creating a sense of belonging. Schill (2012) conducted qualitative interviews and focus groups to uncover some aspects of professional socialization as it related to the attitudes and beliefs of new graduates and novice practitioners; however, a deeper analysis of professional socialization through observations of decision-making may uncover the use of reflective practice. A gap exists in the understanding of how professional socialization plays a part in the decision-making skill building of MLSs.

Recognizing that professional socialization is in play when decisions are made and noting its relationship to the theories-in-use of the practitioner is valuable when building an understanding of decision-making in the laboratory context. Professional socialization may be the process of internalization of tacit and explicit skills for use in a situated context. This study will lead to an understanding of professional socialization through interview and observation of MLSs in the laboratory context.

My conceptual framework in Figure 5 provided a basis to analyze the data surrounding reflective practice for my participants as they described significant events and routine

practice. Specifically, asking the participants how they go about decision-making in uncertain situations and to describe their routine work environment elicited the process of reflective thinking in the context of the clinical laboratory.

Chapter 3: Methodology

This chapter describes the rationale for a phenomenological approach to research, using participants' descriptions of significant events. Emergent themes were coded and analyzed in order to build an explanatory framework addressing the nature of decision-making for medical laboratory scientists (MLS). It details the expected number of participants, the criteria for selection, the method of recruitment, and the research design methods of interview and observation used in this study. Finally, a description of a design for referential adequacy, consensual validation, and structural corroboration is included, along with a discussion of researcher positionality/reflexivity.

Research Tradition

In this study, a qualitative approach, specifically a phenomenological mode, was appropriate to answer my research questions. Phenomenology is rooted in the philosophical perspectives of Edmund Husserl (Creswell, 1998). Husserl described an "intentionality of consciousness" by the participants as they critically reflect on their experiences and make meaning. Therefore, reality is not a separation of subjects and objects; rather it is "inextricably related to one's consciousness of it" (Creswell, 1998, p. 53). A phenomenological mode was appropriate for this study, given the nature of my research question asking how MLS go about making decisions when confronted with problematic or unique situations in the clinical laboratory. I sought to understand the essence of the phenomenon of decision-making as evidenced in the behaviors and shared experiences revealed through participants' interviews and observations. I am interested in the rich descriptions of individuals in the context of the laboratory through the participants' voices as they describe memories, meanings, and images. The strength of this research tradition was

that the description of decision-making experiences and observation of decision-making surrounding a significant event within the context of the laboratory might reflect and add to the understanding of reflective practice in this field.

Drawing on the grounded theory approach to coding, data was initially coded and termed '"in vivo" or open codes from the participants' telling (Strauss & Corbin, 1990; Charmaz, 2006). These initial codes were gathered into categories and assigned axial codes. Axial codes were determined from grouping the open codes in the data, and they begin to form themes that reflect an understanding of the phenomenon. Finally, a larger selective code may emerge as a theory of explanation of the phenomenon.

Interview

Seidman (2006) posited that conducting only one interview could cause the researcher to "tread on thin contextual ice" (p. 17). He suggested a three-interview approach as a means to establish context, construct participants' experiences within the context, and allow them to reflect on the meaning of their experience. In addition, according to Munhall (1991), a phenomenological approach allows the researcher to explore the "intersubjective space" that participants experience in context that is "embedded in time, space, embodiment, and relationships" (p. 148). The rhythms of the laboratory consist of intertwined individual experiences, between-subject experiences, housed in time and space.

Eliciting the process of decision-making required some creative techniques. Flanagan (1954) originally described the critical incident technique (CIT) as a job analysis tool, which provided the United States Army Air Force (USAAF) with a means to determine job requirements, prepare competencies, and improvements to training. In that sense, Flanagan (1954) proposed CIT as an exploratory and investigative tool to investigate helping and

hindering factors in the performance of something, collecting descriptions of behavior, and examining success and failures of performance. Steps outlined by Flanagan (1954) include the following: decide on the critical incidents to be studied, design the research question and aims, use qualified observers, collect critical incident data with semi-structured interview and observation, analyze the data, and disseminate. Flanagan (1954) used CIT to improve work performance by eliciting workplace incidents that could be described as dramatic and life-threatening. I used the term *significant* to elicit the decision-making process from my participants.

Butterfield, Borgen, Amundson, and Maglio (2005) conducted a review of Flanagan's (1954) original method and recognized that the critical incident method has provided some new directions for researchers. They reminded researchers that paying attention to credibility checks is paramount as in all qualitative research methods; however, the method can be flexible enough for future researchers to uncover contexts, capture participants' meanings, and analyze participants' behaviors. Participants were asked to share significant events out of the norm of daily work. Due to the complexity of the interaction of tacit and explicit knowledge, getting practitioners to tell a story surrounding a significant event with an ambiguous decision that they faced will cause them to reflect on action and describe the reflection in action that occurred. A potential weakness to the method was described by Argyris and Schon (1974): "We cannot learn what someone's theory-in-use is simply by asking him" (p. 7). The practitioners may have used explicit knowledge and trial and error and reframed the problem, and through this process, they elicited different aspects of tacit knowledge that may or may not be made totally explicit until the time the story is told. Another weakness of the interview method is that the participants may introduce bias when

self-reporting or miss pieces of the event due to recall issues. However, the participants' reflections can be corroborated with other artifacts or observations. Available research studies into the clinical laboratory are missing the use of methods that facilitate rich descriptions and insights into effective clinical experiences and are generally not sufficient to create a list of competencies to be incorporated into clinical teaching and assume that the process of internalization has taken place (Tiffin, 2008).

Nursing researchers have used CIT in research studies as an evaluation tool for clinical practicums and written review articles on the proper use of the method (Dachelet, Wemett, Craig-Kuhn, Kent, & Kitzman, 1981; Norman, 1992). Although *critical incident* is the term originally used, I used the term *significant event* to illuminate a defined event in which the participant may have made a decision and/or judgment.

Sternberg, Forsythe, Hedlund, Horvath, Wagner, and Williams (2000) used the critical incident technique to conduct interviews that sought to illuminate decision-making skills. Sternberg et al.'s studies focused on revealing knowledge that is difficult to articulate using storytelling/critical incident. They concluded that tacit knowledge was learned by experience since the study looked at both novice and experts. Sternberg et al. suggested that future studies should have the emerging themes judged by experts. The present study sought to obtain rich description surrounding significant events from the participants' observations of these decisions made in the laboratory context.

Observation

Schon (1983) posited that observed behaviors represent theories in use by the practitioner. The theory in use may not represent the tacit pieces of theories in use or incorporate the espoused theories of the individual or professional group. When asking people

about their theory in use, they may give the espoused theory, or the collective "the way we do things around here." Observation of reflective practice in context may allow researchers to observe a conflict between espoused theories and theories in use. Jordi (2011) called this conflict a sort of "dissonance," where one needs to give attention to the "process of integration that reflective practices make possible when people are able to listen to themselves, or be listened to, or share in a collective" (p. 185). Argyris and Schon termed it an "incompatibility" (p. 7). They warned of a sort of paradox for researchers studying artifacts, knowledge, and the collective group that the only way to assign meaning is to observe behaviors. However, the ability of the participants to state or behave according to their theories in use and espoused theories may be difficult.

Therefore, combining findings from the interviews and observations illuminated the espoused theories (description of decision-making in interview) and the theories in action (observations in laboratory settings) that practitioners use. An analysis of this qualitative data added to the body of knowledge surrounding the reflective thinking model for this context. I used it as an exploratory and investigative tool to elicit elements of the reflective practice process.

Data Collection: Research Sample and Instrumentation

I sampled several bachelor-level MLSs with at least 5 years' experience in a clinical laboratory setting. I limited the participants to be of an MLS educational level because given the use of critical incident method, this group was more likely to be involved in the uncertainty within the laboratory. This group was more likely to have to search for solutions outside the given policies and procedures. Institutional Review Board (IRB) approval was given by Eastern Michigan University Human Subjects Review Committee and the hospital

workplaces where I conducted the research (Appendix A). To begin the recruitment, I emailed at least a couple different hospital laboratory managers for admission into their laboratory. After permission was given, I asked for volunteers for the study and used the snowball effect for the rest of the participants (Glesne, 2006). Participants signed an informed consent before interview and observations. I conducted the interviews within their workplace in a quiet and private space deemed appropriate by the clinical laboratory. At another opportunity, I observed normal laboratory operations within these same workplaces. It was my goal to reveal decision-making experience in order to illuminate the reflective practice process in the laboratory context. Using a semi-structured interview guide, I interviewed all participants and included follow-up interviews based on emerging themes and observations. The following question guide was used for the initial interview:

- Tell me a story of a problematic or unique situation in the clinical laboratory.
- Tell me how you felt.
- What led to the situation?
- Tell me about any questions you may have asked yourself.
- What was the outcome or result of the situation?
- What made this decision effective or ineffective?
- Under what circumstances might you seek out a co-worker or peer for advice or suggestions? Provide examples of a time you did that.
- What did other practitioners do or not do that had an effect on your decision?

I did not attempt to classify the participants' levels of competency, practice, or expertise but rather allowed the themes surrounding decision-making to emerge. Benner (1984) commented that her research about expert/novice nurses was "not a search for the

omnicompetent individual who could perform equally well, regardless of circumstances or educational preparation" (p. 15). This study did not seek to define expert versus novice laboratory work but rather to illuminated the decision-making process. The participants had differing job duties within the laboratory disciplines, which may affect the range of complexity of their decision-making opportunities. It was not possible to lay out a single complete experience in a technical field such as clinical laboratory science, especially given the differing complexities of each laboratory discipline's duties within the larger laboratory. Similarly, Rigeiro (2012) expressed the same conundrum within his study of a large industrial plant where the experienced maintenance worker had differing opportunities for decision-making in certain areas due to the complexity of tasks.

I was the key instrument of data collection, asking open-ended questions in semi-structured interviews. Follow-up interviews were based on emerging themes from the initial transcripts. Observations took place in the context of the laboratory, and data analysis allowed themes to emerge from the participants' verbatim and my observational notes.

Research Limitations and Assumptions

The focus of this research was predominantly to understand the decision-making of MLSs with a bachelor's degree; therefore, other practitioner educational levels were not included. The researcher assumed that a convenience sample of baccalaureate level practicing medical laboratory scientists in a clinical setting was accessible.

Clinical laboratory science was the only healthcare discipline represented in this research; therefore, findings were not generalizable to all semi-professions and professions. I did expect that the observation and interview themes might be applicable to other fields that use a similar clinical context in training.

Another assumption was that the use of interviews and observations would reveal a greater understanding of decision-making for medical laboratory scientists. It may have been difficult for participants to verbalize or recall the complexity of decisions made in the interview; however, triangulating with observation data strengthened the findings (Charmaz, 2006).

Data Analysis: Referential Adequacy/Consensual Validation/Structural Corroboration

Due to the nature and organization of the clinical laboratories in the study, each of the data collection sites had different laboratory automation and manual testing layouts, and I documented these differences. Data from the first interviews were coded into tentative categories. Making the qualitative data informative to the reader was accomplished by organization of emergent themes. Geertz (1973) recommended "thick description" of both the context and the participants. During the second interview, participants were asked whether the initial categories were appropriate for the data they shared. They had an opportunity to amend, delete, or add as needed. This is consistent with Maxwell's (1992) concept of interpretive validity using participant crosschecking. This added validity to the findings. Maxwell further suggested that categories be checked for support in the literature, with the perception that if it is not, it may not be a valid category. However, it may be a new category just uncovered. There is a relatively short list of researchers in clinical laboratory science studying behaviors and competencies in practice (Beck & Laudicina, 1999; Kenimer-Leibach, 1999; 2011) so there was the possibility of new categories. This study filled a gap because the initial categories came from qualitative interview and observation of practitioners in the field, contrasting previous studies that asked experts for their input of needed clinical practice behaviors.

Eisner (1991) stated that structural corroboration is a process of "looking for recurrent behaviors . . . theme-like features that inspire confidence that events interpreted . . . are characteristic of the situation" (p. 110). There were artifacts such as notes, documents, and logs that corroborate the critical incident described. These were examined for alignment with participants' descriptions. I expected a commonality in their images and memories with my own laboratory experience. However, their voices told their stories. Flanagan (1954) suggested that a few criteria should surround the inclusion of a critical incident, adding to the overall trustworthiness. Participants described what led up to the incident, the incident itself, and outcomes of the incidents. This ensured that the critical incident was included in the findings and was not missing key factors. Intersubjectivity was achieved when the participants' narratives built consensual validation for the reader. Therefore, concrete description, intertwined verbatim, and observations provided triangulation to support the validity of the emerging themes (Glesne, 2006).

Researcher as Data Collection Instrument: Positionality/Reflexivity

Before deciding to further my education with a master's in postsecondary education, I spent 20+ years in clinical settings as a bachelor-degreed MLS. Throughout my clinical career I had many different technical experiences, including rising to the level of technical specialist in the laboratory discipline of chemistry. During my clinical experience in the 1980s, 1990s, and early 2000s, I experienced increases in automation and expanding testing options. I witnessed the closing and consolidation of medical laboratory science educational programs. I taught students one-on-one at the bench. I believe that I used the specialized technical knowledge I had learned from my own training to facilitate my decision-making, but I have always wondered about the other "something" that supports practitioners to practice "the way

we do things around here," a phrase I have heard time and again over the years. Reflecting on my experience in the laboratory, I think a sort of reflection-in-action occurred as I gained experience working through problems (Schon, 1984). I became a good problem solver. For example, laboratory automation "hums" and "makes sounds" routinely when the instrument is functioning properly. Anticipating an instrument breakdown was facilitated by noticing a different sound the instrument was producing. It was not explicitly written in a procedure, "If you hear this, it could be the probe malfunctioning." Changing the probe at an opportune time was warranted and required me to plan for an interruption in testing, therefore avoiding a significant downtime and delaying turnaround of patient results. In my experience of teaching in the clinical laboratory, students are not aware that we are introducing to them "the way we do things around here," but when a problem arose, I attempted to make explicit my decision-making process for the solution. I believe medical laboratory scientists need to understand how best to support students. This is one goal with this research.

My connection to the field reflected a real desire to investigate the clinical process and to understand the reflective process of medical laboratory scientists. It reflects the passion to conduct the arduous tasks of interviewing and observation. I put aside my preconceived notions of lived laboratory experiences. The fact that I am a member of the profession allowed participants to share incidents that are more complex because they recognized that I understand the workings of the laboratory. On the other hand, my involvement in the profession may have caused the participants to hold back information they might think is obvious to me. I needed to remember that although this connection to the field exists, it was important that I remained "perplexed" about the phenomenon and did not seek to "corroborate my own experience" (Seidman, 2006, p. 32). I distanced myself from the participants so as

not to succumb to proving or disproving any of my preconceptions about the reflective practice process in this area. Creswell (1998) stated that in phenomenology, it is necessary "to suspend all judgments about what is real…until they are founded on a more certain basis…and this suspension is called epoche" (p. 52). Thoughts and attitudes surrounding the interview and observation process were recorded in a research journal as I documented my thoughts during the process. Self-awareness continued throughout the analysis of the data, as I continued to be "meaningfully attentive" to my participants (Peshkin, 1988, p. 17). As a former MLS, I needed to "bracket" my preconceptions of how individuals might describe decisions and elucidate the participants' meanings by exploring emerging themes.

Chapter 4: Themes

The participants in the study are medical laboratory scientists (MLSs) working in two different hospital clinical laboratories. They have an average of 20 years' experience and varying levels of technical and administrative experience and responsibilities in their current positions. They represent various educational paths to their profession. For example, Mary (not her real name; all subjects have pseudonyms) obtained an associate's degree in the field, worked for some years, and then pursued a bachelor's degree in the field. She worked her way up to her current position as lead scientist in chemistry. Mary is proud that she was able to balance family obligations while she obtained degrees and worked to support her family over these past 40 years. Another participant, Penny, had a very traditional path to the profession, obtaining a bachelor's degree and internship and remaining at the workplace that provided the internship. Penny has more than 30 years' experience in the field, particularly in hematology. She enjoys teaching new hires and students because it stimulates her to keep up to date. She stated:

> I like working with young people. Most of the people we've trained, it's been fun to work with them. You know, they are perky, they know a lot too because they are fresh…They may not have any experience, but you know they are pretty up on stuff and so, it's refreshing to work with the young people.

Eve is the youngest participant, having just graduated with her MLS degree in 2011. She took her certification exam the day after graduation and has not looked back since. She has achieved her current status as operations manager. Her long-range plan is to teach in a clinical laboratory science academic program.

Tess had a unique path to laboratory science. She started out in culinary school but decided that laboratory science would be a more consistent career path. We discussed how much laboratory work is similar to cooking. There is the need to multitask and get things done at the same time. She has worked in many different laboratory situations and that reflects her current flexibility. She enjoys working as a team with her colleagues.

The most non-traditional path was a participant, Ted, who completed a bachelor's degree in science, worked various non-laboratory jobs, and then landed in the laboratory as a phlebotomist. Phlebotomy is the process of obtaining blood from patients. Ted was invited to "join up" in the laboratory and, as a result, experienced a significant amount of on-the-job training. Ted has received extensive training on the automation line and machines in chemistry because he is recognized for his ability to "think like a machine" and make repairs onsite. He credits himself with being efficient and having found "the best way to do things." According to Ted, new hires and students just need to listen to him and they will do the job "perfectly."

Although all the participants work within a hospital laboratory setting, they work in various clinical areas or departments. Mary and Ted work in the highly automated chemistry department; Mary is responsible for administrative and bench work and Ted mainly bench work. Penny and Tess work in the hematology department, where there is more of a mixture of automation and manual testing. Eve works at another hospital where MLSs do more rotating between the laboratory clinical departments that are configured in one open laboratory concept. In addition, Eve has administrative duties.

Each initial interview lasted approximately one hour, and follow-up interviews were conducted to explore the emerging themes. The semi-structured interview questions included,

but were not limited to, a description of a significant event (i.e., "critical incident") that they may have encountered in the laboratory where a decision was made, how the practitioner felt during this time, how they collaborated with others, and the outcome of the situation. Follow-up interviews lasted approximately thirty to forty-five minutes. The follow-up interview probed some emerging themes and, in contrast, explored the participants' descriptions of routine work. In addition, at the follow-up interview I shared the first interview transcript with each participant individually. I asked the participants if they agreed that I had captured their "voice" and whether the emerging themes were beginning to "tell their story." I used "member-checking" to ensure interpretive validity in addition to cataloging "recurrent behaviors" for structural corroboration (Maxwell, 1992; Eisner, 1991).

At a time that was convenient to my participants, I observed them at their work. The time in the laboratory setting varied with participants, but on average, I spent three hours with each participant. The date and time were randomly chosen and was not conducted for special procedures performed. In other words, the observation reflected a typical day in the clinical laboratory. I compiled field notes about the types of work performed, the participants' attitudes and behaviors towards work, and general atmosphere in the work environment (Seidman, 2006).

The emergent results led to a framework that synthesized elements from reflective practice theory (Schon, 1983; Argyris & Schon, 1978), the reflective thinking model (Taggart, 1995), levels of tacit knowledge (Ambrosini & Bowman, 2001), and the SECI model (Nonaka et al., 1995). The research uncovered powerful emergent themes, linking reflection-in-action, reflection-on-action, espoused theories, and theories-in-action to explain the role of tacit knowledge in decision-making in semi-professional work. These themes fall into two areas:

(a) the MLS work environment and (b) strategies for productivity within the work environment.

Theme Area #1: The Environment—the Challenges of Routine Decisions, High Stakes Decisions, and Collaboration

The first thematic area was how the participants described their work environment. In this work environment, participants described facing both routine decisions and the more high-stakes decision-making that is required to be timely and efficient for good patient outcomes. The decision-making environment was categorized by the participants as involving about 80-90% routine and 10-20% of decisions that "demanded their attention." Participants described both highly problematic events and routine work that revealed how they think and feel about their work environment. The term *demanding* can be defined as a task "requiring much time, effort, or attention" (Demanding, n.d). Demanding situations involved verifying anomalous patient results, dealing with problems with the machines, filling a different work role for the day, and navigating the interactions with coworkers and other healthcare providers. This part of the work calls on practitioners to be critical thinkers and problem solve, and participants described this part as sometimes demanding of their attention that can lead to stress. Therefore, stress seems to result from the demands of the job and adverse events in the laboratory that may be out of the practitioner's control. *Stress* for these practitioners follows a basic definition: "a state of mental or emotional strain or tension resulting from adverse or very demanding circumstances" (Stress, n.d).

Theme 1a: Routines-The challenge of boredom and repetitiveness. Similar to most jobs, the laboratory workplace has a sort of code of accepted conduct or "the way we do things around here." Participants describe arriving at the workplace and beginning their

routine, which typically includes grabbing coffee (before they enter the laboratory), reading their emails for updates on policies and procedures, checking the posted daily work schedule for changes, and cleaning their work areas. Routine tasks are prescriptive, highly repetitive, and are performed every day in the exact same way. Technology and automation affect the routine tasks MLS need to perform. Routine tasks in a specific area included preparing the machines for patient samples by performing instrument cleaning procedures, emptying biological waste, printing or archiving the previous day's results, restocking supplies, and preparing fresh reagents before daily calibrations on the machines. In addition, manual methods require organization and preparation, such as preparing stains and reagents, duplicating worksheets, and other general laboratory preparations for manual testing. All MLS participants experienced the boredom but shared different strategies for coping with the routinized tasks.

Theme 1b: Critical incidents-The stress of high stakes. An effective, quality outcome for the patient means that the laboratory is committed to getting the *right* patient result for the *right* patient at the *right* time. Medical decisions are made for the patient based on laboratory results provided by MLS for diagnosis, treatment, monitoring, and prevention of disease. Consequently, when faced with anomalous results, critical incidents, and significant events, MLSs must evaluate quickly and correctly for accuracy.

In contrast to the repetitive routines of 80-90% of the tasks, the participants described many situations that demanded immediate and swift decision-making. For example, Ted described a situation in which his quick action to call the nurse on the floor about a very high glucose result on a newborn saved that child's life. Ted reflected on this situation and stated that he knew, based on technical knowledge that it was not possible for a newborn baby to

have this high a glucose result because of disease, but he relied on “intuition” to vary the protocol and respond quickly:

> The baby had a low glucose and they were giving it, they got dextrose or fructose of some kind of sugar solution from the pharmacy and they mixed it up 10 times higher ... concentration higher than it should have been. She (nurse) said, you probably saved the baby’s life. Not following protocol. Protocol you know you get a dilution then you call it up. But alarm bells go off and you are saying no, something is screwy here so you have to use common sense. That’s my best story. The human element in here and the decision-making that humans can do, not the protocol when you vary protocol, it’s very important at times. You know, the protocols are probably 70-80% of the time it’s perfect, the exact thing you should do, but there are a lot of times you have to step out and say hey, this is not right and do that.

MLSs who must decide whether to deviate from standard protocol experience stress. Eve described a decision that did not vary from protocol and that caused a lot of stress. Accepting an unlabeled specimen into the laboratory must include paperwork on which the collector of the specimen verifies the patient identification and for which he or she is willing to take responsibility. This is the one department where MLSs issue a blood product to be transfused into the patient, and ignoring written procedure is never allowed. Any error from a misidentified sample could result in a serious reaction or even death for the patient. The MLS who received an unlabeled specimen in the transfusion medicine department refused to accept this, even with the proper paperwork. The administration thought the MLS should have made an exception for this outpatient baby sample. Nevertheless, the MLS requested a new sample per protocol, which outraged the physician and parents. The decision made by this MLS did

not satisfy the most participants in the scenario, but the MLS believed that this decision would avoid "doing harm." Eve said:

> It didn't satisfy the most people, but they did what they thought was right and I would never fault someone for doing what they thought was the correct thing… two different people tell you two different things, how do you make your decision? Go to the procedure, every time.
>
> Decision between other departments I think is, would probably be a good one to focus on in some ways mostly because policies, that's sometimes difficult too to convey to the floor, different policies for different departments and the laboratory.

Participants described that the stress associated with a procedure or protocol happened in two instances: (a) when the decision to deviate from standard procedure "will do the most good" and (b) when the decision to deviate from standard procedure "will do harm." The latter situation led to the most stress. Not all decisions were as dramatic as the previous example; however, the decision-making in these critical incidents presented a very different kind of stress from the type present in routine situations. MLS worked through their technical knowledge to problem-solve and quickly prioritize which direction to investigate an anomalous result. These anomalous results were related to problems with specimen collection, the machine, the procedure, and the patient's condition. Problems with the machinery raised the stress level since the laboratory was highly automated, requiring that the MLS interact and problem-solve those issues quickly as well. For example, one participant described a situation where an accidental click of the mouse within the software caused the machine to stop accepting patient specimens. Since efficiency and timely reporting of results is of the utmost priority, having a machine not run any specimens was quite stressful for the MLS. One

participant who mainly works with the "automated line" (which brings the patient specimens to the machines) shared the idea that one must "think like a machine," meaning that understanding all the nuances of the machinery is important to problem-solve. Another participant claimed that the dependency on computers for timely patient result reporting leads to prioritizing in decision-making:

> We are so related to computers. It was a computer problem, maybe that was what it was and making the decision: do you call all results, get them faxed, go to the right channels to get the results out as quick as possible to, you know separate them according to stat, nonstat, any time there's any type of machine issues where you have to hold specimens when, you know, you know there's all these people you have to go to when they come in. Okay, go to the people in central specimen processing (CSP) to have them receive them in or have them not bring them over, only the stats, you know you, it's like it's almost every day there's something.

High-stakes decision-making skills are required when troubleshooting the machinery. When the machine breaks down, the MLS has various resources at his/her disposal. The MLS can read the troubleshooting guide for the machine, use previously gained technical knowledge to fix the machine, or call the manufacturer for service. While the machine is down, the MLS must find a workaround for the situation since accurate patient results must continue to be reported. All of the participants spoke of the need for practitioners to possess some "mechanical inclination" to work in this field. There is no need to fear "picking up a screwdriver," but the stress lies in making the decision to discontinue the in-house repair process and "cut your losses" and call for service. Mary described the stress this way:

> You know, I'm not super mechanically inclined, but what I do know I take for granted and then, you know a new person will start and they're afraid of a screwdriver. It's like, come on! You can't be afraid of the screwdriver. That's another decision-making process. If you're working somewhat alone and you have problems with an instrument, there's a balance. You have to, you have to make an attempt to fix it, but you can't take all day trying to fix something… It's stressful. But, you know, you don't want to waste other people's time. You want to save time by being able to fix something, but you don't want to waste time or patient care by spending too much time on it.

It becomes stressful when no patients' results will be reported and you have to explain to healthcare providers the reason for delayed results and approximate repair time.

Theme 1c: Collegial relationships--The stress of collaboration. Communication is a key part of collegial relationships, and MLSs indicated that constant communication was an important part of their work environment. Information was shared in various ways, depending on the need. Communicating with the floor nurses and physicians should not be difficult if one makes a mistake. Tess described it this way:

> Just call the nursing unit, speak to the nurse, just be upright, forthright with them. It's my fault. I spilled it or dropped it or the tube broke and you know, I'm sorry, it's my responsibility... I have found that 100% of the time when you are forthright and honest with them, they are understanding.

Receiving a call from another healthcare provider can elicit stress until it is resolved, and Tess described the physical feeling associated with this stress:

> Hum. Well when I, when somebody calls to question a result like a nurse or a physician, my stomach sinks. Most of the time it will, we will repeat it and we will get the same thing that we got before. But every once in a while there will be that time we don't know what happened. Um, sometimes we can figure out what happened.

Senior scientists shared new procedural issues via email or daily "work huddles." This type of communication seemed to be one-sided, meaning the information was told to colleagues and documentation was recorded that all colleagues have been informed. However, other communication between colleagues was a necessary part of problem-solving and decision-making during times of uncertainty. Working in an open laboratory concept allows MLSs to "seek advice" from colleagues regarding a technical situation in their work area of an anomalous result, procedural problems, or machine malfunctions. In addition, they asked one another to confirm identification of an abnormal cell type, brainstorm why a patient's result may seem inconsistent with his/her diagnosis, troubleshoot a machine problem, confirm steps of procedures and policies as written, and ask pathologists for advice about an anomalous result for a particular patient, as described by Tess:

> There's been, you know you get going in your daily routine and you just do things because you've been doing it for so long and finally you think about something and it's like, this is the way we do this, right?... Or … sometimes there are cells that [if] you are doing differentials that I [will] have no problem calling somebody else back do you think this is a blast, it's looking a little immature to me. So, some people are too prideful to ask, but I'm like, I don't understand that. We are all here to help each other; just ask. Have somebody come back and get a second opinion.

Participants shared that they feel comfortable asking colleagues for technical help that they respect as knowledgeable and that they feel they can trust. One participant stated, “A lot of our day is determined by the performance of the machines and who you are working with.” The trust was typically based on long-time work relationships and recognition of expert technical knowledge. Trusting and respecting technical knowledge between colleagues sometimes occurred without a long work relationship. For example, one participant described that teaching and working with “young people” improved motivation and respect for adequate knowledge to solve problems and was a source of “good stress.”

Conversely, the process of routine communication between colleagues was stressful when colleagues were perceived as “incompetent,” “creating drama,” “lazy,” “unmotivated,” and/or “abusing policies.” For example, Penny described a colleague who had to be retrained every time he crossed over to a less familiar department. This colleague needed to be “babysat” and was not someone who could be trusted to help with the routine work, let alone participate in problem-solving and/or decision-making. Penny said, “So when you have to train somebody, to show them what you do, there’s just a lot of steps that you do without even realizing it, and it makes you think about why you do things.”

When the MLSs confirm their assignment for the day, the routine tasks are performed in their area, but sometimes reluctantly. A participant spoke of performing these routine tasks and helping another colleague as the “right thing to do” instead of filling the downtime with “book reading or surfing the Internet.” All the participants emphasized their frustrations when they work with other MLSs who do not take responsibility for these tasks and avoid the boredom associated with these routines by reading on their personal electronic devices,

playing computer games, and so on. They needed another colleague to "cover" their area for breaks and lunch.

Theme Area #2: Strategies for Productivity Within the Work Environment

The second overarching thematic area consists of the strategies that participants employed to address the stressors inherent in routine tasks, high-stakes decision-making, and collaboration in this work environment. MLSs have strategies to maximize their productivity across these various situations. The participants described their strategies to balance the tediousness of the work and yet be ready for an anomalous situation or critical incident requiring a higher stakes decision.

Theme 2a: Balancing routine and high stakes. Participants elaborated on the prescriptive tasks as routine; they admitted, "Some days it feels like the same thing over and over...monotonous filing or filling stock." One of the key strategies used by participants to not be overcome by boredom was to remind themselves how important these tasks were to the efficiency and productivity of the laboratory. Keeping up on stock, for example, avoided a situation of running out of something at a crucial time. Their descriptions included the importance of the routine tasks as crucial to being prepared for the anomalous. The preparatory routines seem to give the participants a sense of accomplishment and balance. Mary explained that even the routine of cleaning up "spatters and spills" on a machine may lead to diagnosing a machine problem. If one cleans up the machine and it is dirty an hour later, "Then you know the spatter might be part of your (machine) problem." All the participants expressed their frustrations when they work with other MLSs who do not take responsibility for these routine tasks. The participants described colleagues who instead fill

downtime and avoid the boredom associated with these routines by "reading on their personal electronic devices, playing computer games, and surfing the internet."

During a lull in the work, Tess stated, "I can choose to take a moment and sit and talk to my friends." These breaks became comfortable routines in themselves. In fact, these self-created personal routines outside of the prescribed activities helped participants distance themselves from stress of boredom with routine tasks *and* the high-stakes decisions and smoothed the contrast of these two dimensions of their work. Associated with these "personal routines" were the themes of personalizing their environment through valuing their own intuition and relating to their machines.

Theme 2b: Valuing intuition as art versus science. MLSs evaluated anomalous patient results (before release to the patient record) by questioning themselves as to whether or not "this makes sense" for this patient, with this diagnosis, at this time of sample collection. The participants rejected a purely "scientific" approach by describing a type of "art" needed in the more complicated and ambiguous cases, involving "imagination," "gut intuition," and "getting a feel" for the interpretation of results for good patient care in a decision-making situation. The MLS made quick reflections using his/her technical and tacit knowledge acquired at the time of the decision. This reference to intuition and "getting a feel" is a clear reference to the use of tacit or implicit knowledge built upon technical knowledge, drawn from experience. During the interviews, participants became animated when they described their abilities to "use their brain" in a complicated decision and "filter out stuff that's not important." Tess described the identification of blood cells as "getting a feel for it [the patient's cells]." In this scenario, MLSs with more experience immediately classified a patient's cells as being consistent with previous leukemic cells identified consistent with the

patient's diagnosis. However, the MLSs with less experience with leukemic cell identification stressed that these cells appeared to be precursor cells from a different cell line. That seemed very inconsistent to the more experienced MLS. As confirmation, flow cytometry was performed to identify the cells by surface markers. This test confirmed the cells were precursors from another cell line and needed to be reported as that. The MLS attributed this disagreement to lack of experience, which caused more problem-solving based on an intuitive notion that something did not seem right.

Quality assurance in the laboratory is an important part of delivering quality results to the patient records. Part of quality assurance includes the evaluation of quality control testing. Quality controls are treated exactly as a patient sample; however, unlike the patient samples, we know the values of these controls. Evaluation of the quality control results follows very prescriptive statistics rules. However, Mary described the statistical analysis as an "art," meaning that it required the MLS to assign meaning to the statistics in such a way that it was much like "fine tuning" this part of quality assurance.

> Well, I think it's, because you kinda' get a feel for looking at things when something's, when there is something wrong with the instrument versus the need for calibration versus something is wrong with a reagent. You know what I'm saying?

Ted described multi-tasking and completing the laboratory work as analogous to "performing like a ballerina or a musician." Synchronizing the completion of the technical work required "art" to come together much like a "dance or performance." Ted equated changing reagents on a machine and performing calibrations to the work of a contractor mudding drywall. The routinization of performing these tasks played a part in problem-solving and building the tacit knowledge of doing it just right. Penny said, "I didn't sign up to be an engineer," implying

that her ability to provide a subjective approach to decision-making is highly valued and requires art.

Theme 2c: Relating to their machines through anthropomorphism. The participants described building a "relationship" with their machines. The machines and tools of the laboratory work environment served as an extension of the MLSs' hands. MLSs worked intimately with technology and large duplicate machines that handle the testing workload. To feel a connection to the technology, the MLS often assigned them human-like, animated names and characteristics such as "Bonnie and Clyde" or "Bert and Ernie." This served to identify each instrument, but in addition, it allowed MLSs to "feel" a connection to the technology. This process is *anthropomorphism*. The concept of anthropomorphism is not new, and in previous studies, the treatment of "real or imagined nonhuman agents" within the context of human interaction with animals and computers is described (Epley, Nicholas, Waytz, Akalis, & Cacioppo, 2008, p. 144). Research has shown that anthropomorphizing an inanimate instrument serves three primary purposes: (a) effectance motivation; (b) sociality motivation, and (c) stress reduction. Effectance motivation refers to the desire to gain a certain internal competency and control (or agency) in a situation. Sociality motivation refers to the basic human need to have connections with others in a social group (Epley et al., 2008). These elements of agency and social connection are important in reducing feelings of stress in uncertain situations. In this study, a sense of agency was clearly a motivating factor for using anthropomorphism similar to these earlier studies. Penny shared that working with technology was difficult for some workers and required that one must learn the "idiosyncrasies" of the machines:

> It drags on you, you can't sit for a second because you have alarms going off or you have to babysit a machine or you have to try to troubleshoot it… it's frustrating because it's constant, just constant, like nagging at you and you get really run down by it, you know, and stressed and then. ... you are hoping to make sure you are catching everything that's stat, critical, etc.

The "idiosyncrasies" of the machines seemed to translate to each machine having a personality, which had to be handled with human-like interaction. MLSs took the time to "treat the instruments nice" and not "abuse them," for they believed that would lead to higher productivity. The interaction with the instrument was described as "babysitting," and much like babysitting, participants described listening for, and interpreting, certain "sounds" that the instrument made to understand how it was "doing." Penny described her approach to the machines, stating, "You can't slam things in it and you know, bend things because people do that, slam doors. These racks are fragile, the whole automation part is really fragile."

The instrument names seemed to give them a human aspect as if they had "become part of your work family." Participants commented, "The instrument knows," seemingly assigning cognitive skills to this inanimate object. If the machines were particularly temperamental, participants called them derogatory names such as "bitch" to describe their temperament for the day. The parts of the instrument were described with human-like characteristics, such as defining the robotic mechanisms as "the arms" of the instrument. These appendages were described as "limping along." These anthropomorphized relationships with the machines even extended to the service personnel who came to the laboratory for repairs. One participant said that a certain service person had a particularly antagonistic

relationship with a machine, where the machine "resisted" repairs from them, again suggesting the machine had a mind of its own.

Ted described all the technical work as requiring "art" and used analogies of "performing like a ballerina or a musician," meaning everything has to come together in a certain "dance or performance." This MLS equated changing reagents on a machine much like the work of a contractor mudding drywall. Routinization of performing these tasks plays a part in building the tacit knowledge of doing it just right.

Chapter 5: Humanizing the Environment

Today's clinical laboratory is a highly complex technical environment for analyzing human blood and body fluids. As evidenced by the words and observation of the participants, medical laboratory scientists (MLSs) operate sophisticated laboratory machines and automated line equipment and perform highly complex manual procedures and interpretations. MLSs described, and I observed them, performing a number of tasks at the same time. They used their technical knowledge of computer applications, diagnostic equipment, and pathophysiology to provide patient results in a timely manner. The participants described unexpected situations that occurred and needed to be critically examined and solved to release patient results to other healthcare providers. I observed the participants discuss results and findings of laboratory tests and procedures with physicians and other healthcare providers, most importantly when an anomalous patient result was obtained and a timely investigation needed to be made as to the accuracy of that result. Participants were aware that they exist in an "unseen" environment, where the public (and even other medical professionals) are unaware of the complexity of this work. They experience a perception from outsiders that laboratory work is consistently technical, routine, and tedious and does not require higher levels of professional judgment and problem-solving.

The proposed model for this study, Figure 5, which combined the elements of the reflective thinking model (Taggart, 1995) and the SECI model (Nonaka & Tageuchi, 1995) was useful in beginning to understand the use of explicit and tacit knowledge for this group of laboratory professionals. However, the findings of this study, surrounding the work environment and participants' strategies for productivity within the work environment, led to the larger selective code of humanizing the environment. The use of anthropomorphism

created an emotionally rich environment, despite the largely technical aspects. The anthropomorphism created a social space that allowed tacit knowledge to be gained and shared when possible. The implicit or tacit knowledge or "know-how" is knowledge gained from practice and refers to intuitive, hard-to-define knowledge that is mostly experience-based. The laboratory environment is a highly structured environment in which routinization led this group of highly technical individuals to internalize the routine tasks as tacit knowledge. The participants externalized the new solutions when they socialized other practitioners to "how we do things around here." The prescribed laboratory procedures did not address all necessary aspects of training, so practitioners had to model for new hires "how we do things around here" to enhance problem-solving. It suggests an unconscious acquisition and use for the practitioner. Participants described quickly running through their technical and tacit knowledge while making decisions. Participants described how they relied on reflection (examining schema/tacit), data gathering (talking to colleagues, making phone calls/explicit and tacit), schema available (procedures, current tacit and explicit knowledge), and made judgments based on context (laboratory situation/tacit). Through interactions with colleagues, the machines, and codified technical knowledge, explicit knowledge was gathered and shared as in the combination phase of Nonaka and Takeuchi (1995). However, in the combination phase of the SECI model, there is a large emphasis put on the explicit transfer of knowledge. I originally laid the combination phase over the framing/reframing, possible solution sets, judgment, and evaluation steps of the reflective thinking model. My research shows that we can look at the reflective thinking model differently in relation to explicit and tacit knowledge. Many of the components of the reflective thinking model are represented by concrete, explicit, and objective terms. For example, in the problem framing/reframing step,

observation, reflection, and data gathering may be more objective and more easily shared as explicit knowledge, whereas the moral judgments, schema, and context reflect tacit components. The reflecting thinking model seems to describe decision-making with rational terms; however, there are key places all around the model where tacit knowledge encroaches.

Revised model

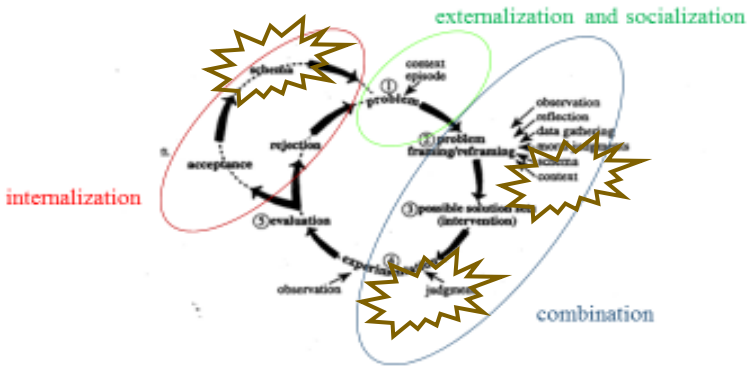

Figure 6. Revised model. Adapted from the reflective thinking model & The SECI model.

In the revised model (Figure 6), I have highlighted places within the Reflecting Thinking Model that are impacted by subjective and tacit knowledge. Schema and judgment encompass a largely tacit component. My participants explained that the scientific approach did not always solve a problem, and the tacit, intuitive, artistic approaches were important to make tacit knowledge explicit and internalized for the next scenario. This subjective and "artistic" dimension of decision-making also reflects the increased value of "tacit knowledge." The artistic component demanded intuition and "getting a feel" for the situation and thus drew upon tacit and implicit knowledge. The internalization of the tacit knowledge

(subjective art) for these practitioners occurs when a new solution to a problem is accepted and added to a practitioner's current schema.

Eraut (2010) referred to this as a "paradox" for professionals, where codified scientific knowledge is clear but is used in ways that are tacit. For this group of practitioners, it would be difficult to codify all of their tacit and explicit knowledge into procedural documents that could convey a summary of the problem-solving expertise of individuals in the context of the laboratory. My research findings are particularly powerful in fields that are portrayed as being de-skilled due to the failure of recognizing the role of "gut intuition" (tacit). If this occurs in highly automated and technical fields such as clinical laboratory science, then the value of gut intuition should be considered, regardless of the perceptions that a field is highly prescriptive and technical.

The participants recognized the need for the "objectiveness" that the machines provide to reduce human error; however, they described incidents in which intuition, creative problem solving, and "subjectiveness" had roles in the decision-making process. The tools of the laboratory were seen as helpful extensions of the work when they function as expected and source of stress when they do not (Luczak, Roetting, & Schmidt, 2003). Luczak et al. (2010), in their study of anthropomorphism with technical devices, stated that reducing the perception of a machine as an "enemy, obstacle, tool, or servant" will reduce stress associated with the interaction with the machine (Luczak et al., 2003, p. 1372). Speaking to and/or describing the machine with human characteristics (anthropomorphism) allowed laboratory personnel to de-stress in uncertain situations. Similar to the conclusions of previous researchers, this study found that participants exhibited anthropomorphism in both the perceived "enemy" and "tool"

roles of the machines as they used positive and negative words surrounding interactions with the machines.

In addition, participants legitimized their roles as an MLS. Humanization of their environment allow MLSs to create an environment in which the machines are an extension of them. When faced with an anomalous situation, participants indicated that their contribution to the decision-making could not be totally programmed into a machine. The human component was still needed. This is a powerful conclusion for this group, who are taught to value the "objective" approach to decision-making to reduce errors. Eve said it best:

> Yes, there's [sic] been a lot of technological advancements that have replaced a lot of the human factor, but you can't remove it completely. There would be no way. I mean I wouldn't want to be that patient in the hospital where the entire clinical lab was analyzers. . . . but you have to trust your instincts yourself, you are the human. So, it when it comes down to it, I trust myself. Or my peers. Like if I'm not sure, then I ask another human being. Based on well the analyzer counted more cells than me. That's not the way that I operate. I mean to me that's one of the reasons that the career is the career. You can't just replace the human aspect of it because this is what is going to happen. You are always going to have an analyzer like, well I think I see this but I'm not really sure. I need a human being to tell me.

In this study, anthropomorphism played a critical role in humanizing a largely technical environment. The need to control and create a social connection with inanimate objects through anthropomorphism allowed legitimization of workers' self-worth and sense of agency (Epley & Waytz, 2008). The anthropomorphism created a stronger sense of agency in this highly structured environment of technical work in the laboratory. Considering agency as

the ability to have power to act as an individual, the participants confirmed that their sense of agency increased as they anthropomorphized within the routine and non-routine environments.

Through the participants' descriptions of environment and their strategies to be productive in that environment, their roles as "artist" and "scientist" are illuminated. As Schon (1985) posited, the balance of art and science and building of competency occurs at the juncture of theory and practice. Ted experienced the juncture of theory and practice when he stepped away from codified procedure in the case of the baby high glucose. He related that he felt power in his ability to intervene in the baby's treatment. When he had successfully solved a problem and internalized new tacit knowledge, his self-esteem and perception of his abilities increased. His story was steeped in emotion when he said, "I saved a baby's life." The process of gathering tacit and explicit knowledge was driven by a higher purpose for the work to be done, competency in the ability to make a good decision, and a sense of belonging. Other participants were animated during their interviews when they recalled stories that showed their sense of their own knowledge and skills leading to a higher order purpose—that they make a difference in patients' lives. They spoke of doing the right thing, making a difference, having a level of pride in their work, and leaving a legacy of respect amongst their coworkers.

Making a difference returns us to motivation theories. This study strengthens how we think about motivation. Humanizing the environment is a motivator in the following ways: it enhances self-efficacy, it validates the importance of their work in terms of human life, it enhances the sense of personal expectancy and process instrumentality, and it increases the sense of belonging. Daniel Pink, in his book *Drive* (2009), labels this "purpose" or "the yearning to do what we do in the service of something larger than ourselves" (p. 204). The

MLS participants value their role in patient care and their ability to master the laboratory skills needed. The "power" to do that leads to enhancing purpose and creates for the professional a sense of "expectancy" or self-efficacy (Mclleland, 1961; Vroom, 1964). Belief in their abilities to solve problems creates the energy that drives the loops of the revised conceptual model (p. 62). Vroom (1964) used the terms *valence*, *instrumentality*, and *expectancy* (VIE), where valence related to the anticipated positive outcome of a decision. In this study, the MLS shared that they are working to provide accurate, reliable laboratory results for the betterment of patients. The need in the workplace to balance control between human and machine led to the use of anthropomorphism to satisfy and make meaning of personal needs. They value their intuitive, creative solutions and are motivated to complete their work with the processes and instrumentality they have available. The participants related stories showing that they value the larger goal of helping patients. The motivation theories of Maslow (1943) and Herzberg (1959), creating a sense of belonging, self-esteem, and self-efficacy, are evident in this group dynamic.

In summary, anthropomorphism led to humanizing the environment for these technical workers. It allowed for support of tacit knowledge creation. The anthropomorphism strengthened workers' self-efficacy and value as professionals because they were in a more pre-eminent position in the decision-making process. Art, creativity, and subjectivity are apparent in this technical field. This is particularly powerful in fields that are portrayed as being de-skilled. MLSs who do not have direct interaction with patients still recognize that every patient result, whether it is a test interpretation, numerical result, or positive or negative result, will impact patient treatment, diagnosis, and further monitoring of a patient status.

Implications for Practice

This research has important implications for practice. While objectiveness, accuracy, and prescribed procedures are important in preparing students for work in technical fields, limits to rationality exist within situations where routinization and science break down. It is possible that rationality is too highly valued in technical fields. Practitioners' previous schema may not be sufficient in these situations. Educators need to prepare new students and trainees to embrace intuition. However, embracing intuition as a decision-making piece does not compromise ethical behavior. This does not suggest that practitioners should invalidate codified procedure or the professional code of ethics when using intuition. Rather, intuition can play a part in ethical decision-making as a way to provide extra communication between practitioners. Intuitive solutions to problems can be made explicit and remain within the boundaries of a professional code of ethics and codified procedure.

Program directors, faculty, and training preceptors should be asking themselves if an adequate amount of time is provided in training programs to build on reflective practice. Trainers and faculty should support making gut intuition a legitimate choice for trainees and students and recognize that it is difficult to articulate in these training programs. Providing more time in practice for pause or reflection and asking students to listen to their inner voices during problem-solving and express that explicitly in the moment would build on reflective practice. This voice is grounded in past-experience, which should be valued and supported in externalization.

The challenges of this solution are the pressures of financial, space, and workforce issues to support a plan for extra time needed in the classroom/internship for reflective practice to be supported. Administrators can collaborate with faculty and preceptors/trainers

to support the building of reflective practice skills in key courses. For example, in the overview course for clinical laboratory science, it is crucial to build more time in the laboratory and extra faculty support as students are introduced to basic practice skills. The use of simulation laboratories does not have to require more space, but rather it will enhance the apprenticeship model for students that allows for trial and error and the development of gut intuition. In the workforce clinical training, administrators and laboratory managers must investigate the training models in use. With the increasing levels of automation and requirements of technical savvy practitioners, managers should pay attention to factors that support stronger levels of agency among practitioners. As an educational leader in a technical field, I can work more closely with clinical managers to ensure the proper design of curriculum and work culture to support a sense of agency, validate their role in technical work, create a sense of belonging, and remind practitioners of a transcendent purpose. All of these strategies support greater motivation to perform in technical fields.

Practitioners who serve as preceptors in CLS and other healthcare clinical/internship fields need to be made aware of how they value tacit knowledge in their field. An analysis of the language used in each profession may indicate the places where tacit knowledge is paramount in training. Implementing teaching modules for preceptors will illuminate the creative aspect of that semi-professional field. Practitioners should be encouraged to analyze the language of their profession. Each technical field has its specific technical language that new professionals quickly learn in order to perform in the field. However, a deeper look at the tacit component is warranted to support training in these fields.

Implications for Theory and Methods

According to Eraut (2004),

> "The problem for professionals, however, is not to exclude… experiential learning—they would be lost without it—but to bring it under more critical control. This requires considerable self-awareness and a strong disposition to monitor one's action... Hence, we have the paradox of professionals being able to refer to codified, scientific knowledge in clear explicit terms, yet using that knowledge in ways that are still largely tacit" (p. 255).

Humanizing an environment through anthropomorphism shows that this "critical control" of the balance between scientific knowledge and experiential learning is an emotional process. Previous frameworks addressing anthropomorphism emphasize the motivational aspects but fail to acknowledge how anthropomorphism legitimizes work in the participants' minds.

This study also has implications for qualitative research methods. It illustrates the power of identifying the language, and especially metaphors, used by professionals to identify key beliefs, values, and norms. These metaphors reveal hidden tacit knowledge that may be hard to articulate. Thus, the careful categorization of practitioner metaphors is a powerful technique to capture tacit knowledge.

The anthropomorphism found in this study was consistent with earlier research, in that it had the effect of increasing motivation and reducing stress, and thus enhanced productivity (Epley et al., 2008; Luczak et al., 2003). Epley et al. (2008) found that "those who are particularly fond of feeling in control of one's environment, for instance, should be especially likely to anthropomorphize in times of uncertainty" (p. 146). This study identified a further

effect: the anthropomorphization created an environment where subjectivity and art had primacy over objectivity and science in the most difficult situations where maintaining "control" of their environment for accurate and timely patient results is paramount. This role of anthropomorphism has not been included in existing theoretical frameworks. The effect of that raises the workers' perceived level of professional value in an era where their jobs are seen as being de-skilled. The study of MLS decision-making reveals that the participants used anthropomorphism to cope with malfunctioning machines with the intent to relieve stress.

Implications for Future Research

Future research should examine the behaviors exhibited when practitioners engage in both routines and critical incidents. When previous schemas are not sufficient to solve the problem in an uncertain situation, a deeper analysis is needed. Both explicit technical and tacit knowledge are revealed to the researcher in these situations, and further research is needed to understand the relationships between explicit and tacit knowledge. A comparison of novice and expert practitioner sharing of routine and significant events would give a better idea of what types of skills become tacit. Furthermore, data from experts and novices could illuminate how the tacit skills become explicit for practitioners. For example, we know that many routine tasks become tacit and it seems to free the mind for more anomalous events. How do experts model these skills to novices? There must be commonly accepted routines that become internalized and socialized to new practitioners.

Many practitioners work in different contexts, so further research in CLS could explore these contexts. For example, in the laboratory context, practitioners work in different areas involving manual and automated procedures. A more in-depth research study for these practitioners should be conducted.

Future researchers should also be cognizant that there are limitations in asking participants to tell their stories of problematic, uncertain decision-making. An assumption that researchers may make is that asking participants to talk about a problematic situation will reveal the required tacit and explicit knowledge. However, the ability of the participants to state or behave according to both their theories in use and espoused theories may be difficult. It is not sufficient to create a list of competencies incorporated into teaching and assume that the process of internalization will take place. Observation of reflective practice in context may allow researchers to observe a conflict between theories in action and theories in use. Argyris and Schon (1978) termed the conflict an "incompatibility" (p. 7). They warned of a sort of paradox for researchers studying artifacts, knowledge, and the collective group that the only way to assign meaning is to observe behaviors. In addition, the examination of interview data for the use of metaphors in a particular workgroup can be highly revealing of the underlying assumptions, values, and beliefs that may or may not support and create tacit knowledge. Anthropomorphism is linked to tacit engagement and motivation and thus becomes a useful lens for examining practice.

This study of MLSs' decision-making processes uncovers the role of tacit knowledge through the use of anthropomorphization and provides a new lens to look at the tension between decision-making as art (as opposed to "science") for many different "semi-professional" fields. A deeper look at the tacit component is warranted to support training in these fields.

References

Ambrosini, V., & Bowman, C. (2001). Tacit knowledge: Some suggestions for operationalization. *Journal of Management Studies, 38*(6), 811–829.

Argyris, C., & Schon, D. (1978). *Organizational learning: A theory of action perspective.* Reading, MA: Addison-Wesley.

ASCP report: Building a laboratory workforce to meet the future: ASCP task force on the laboratory professionals workforce. *American Journal of Clinical Pathology*, *141*(2), 154-167. Retrieved from: http://ezproxy.emich.edu/login?url=http://search.proquest.com/docview/1499834588?accountid=10650

Bandura, A. (1986). *Social foundations of thought and action*: *A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1988). Self-regulation of motivation and action through goal systems. In V. Hamilton, G. H. Bower & N. H. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (pp. 37–61). Dordrecht, the Netherlands: Kluwer Academic Publishers.

Beck, S., & Laudicina, R. (1999). Clinical laboratory scientists' view of the competencies needed for current practice. *Clinical Laboratory Science, 12*(2), 98–103.

Benner, P. (1984). From novice to expert: Excellence and power in clinical nursing practice. Menlo Park, CA: Addison-Wesley.

Bragg, A. K. (1976). The socialization process in higher education (ERIC/Higher Education Research Report No. 7). Washington, DC: American Association for Higher Education. (ERIC Document Reproduction Service No. 132909).

Bruhn, J. (1992). Problem-based learning: An approach toward reforming allied health

education. *Journal of Allied Health, Summer,* 161–173.

Burton, A. J. (2000). Reflection: Nursing's practice and education panacea? *Journal of Advanced Nursing, 31*(5), 1009–1017.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis.* Thousand Oaks, CA: Sage Publications.

Choo, C. (1998). *The knowing organization: How organizations use information to construct meaning, create knowledge, and make decisions*. New York, NY: Oxford University Press.

Clarke, A. (1995). Professional development in practicum settings: Reflective practice under scrutiny. *Teaching and Teacher Education, 11*(3). 243–261.

Creswell, J. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage Publications.

Dachelet, C., Wemett, M., Garling, J., Craig-Kuhn, K., Kent, N., & Kitzman, H. (1981). The critical incident technique applied to the evaluation of the clinical practicum setting. *Journal of Nursing Education, 20*(8), 15–31.

Delwiche, F. (2003). Mapping the literature of clinical laboratory science. *Journal of the Medical Library Association, 91*(3), 303–310.

Demanding. (n.d). Webster dictionary online. Retrieved from https://www.merriam-webster.com/dictionary/demanding

Dewey, J. (1933). *How we think.* Buffalo, NY: Prometheus Books. (Original work published 1910).

Dunn, L., & Musolina, G. (2011). Assessing reflective thinking and approaches to learning. *Journal of Allied Health, 40*(3), 128–136.

Eisner, E. W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice.* New York, NY: Toronto.

Epley, N., Waytz, A., Akalis, S., & Cacioppo, J. (2008). When we need a human: Motivational determinants of anthropomorphism. *Social Cognition, 26*(2), 143–155.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*(4), 1–33.

Foundation for Critical Thinking. Critical thinking community. (n.d.). Retrieved from http://www.criticalthinking.org/pages/our-concept-and-definition-of-critical-thinking/411

Garcia, E., Asma, A., & Choudry, S. (2013). The American society for clinical pathology's 2012 vacancy survey of clinical laboratories in the United States. *Lab Medicine, 44* (1), 1–18.

Geertz, C. (1973). *The interpretation of culture*. New York, NY: Basic Books, Inc.

Greenwood, J. (1993). Reflective practice: A critique of the work of Argyris and Schon. *Journal of Advanced Nursing, 18,* 1183–1187.

Gustafsson, C. (2004). Reflection, the way to professional development? *Journal of Clinical Nursing, 13,* 271–280.

Hearn, J. (1982). Notes on patriarchy, professionalization, and semi-professions. *Sociology, 16*(2), 184–202.

Herzberg F., Mausnek, B., & Snyderman, B. (1959). *The Motivation to Work.* New York: John Wiley and Sons.

Jolly, B. (1999). Clinical logbooks: Recording clinical experiences may not be enough. *Medical Education, 33*(2), 86–88.

Jordi, R. (2011). Reframing the concept of reflection: Consciousness, experiential learning, and reflective learning practices. *Adult Education Quarterly, 6*(2), 181–197.

Kenimer, E. (1999). The identification and description of critical thinking behaviors important in clinical laboratory science (Doctoral dissertation). Retrieved from UMI (9929027).

Kenimer-Leibach, E. (2011). Grounded theory in medical laboratory science: Expert practice development. *Fall 2011 Supplement to Clinical Laboratory Science, 24*(4), 37–44.

Kinsella, E. (2009). Professional knowledge and the epistemology of reflective practice. *Nursing Philosophy, 11*(1), 3–14. doi:10.1111/j.1466-769X.2009.00428.x PMID:20017878

Klemola, U., & Norris, L. (1997). Analysis of the clinical behavior of anaesthetists: recognition of uncertainty as a basis for practice. *Medical Education, 31,* 449–456.

Lincoln, Y., & Guba, E. (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications.

Littler, C. (1982). *The development of the labour process in capitalist societies: A comparative study of work organizations*. Heinman Educational Books.

Luczak, H., Roetting, M., & Schmidt, L. (2003). Let's talk: Anthropomorphization as a means to cope with stress of interacting with technical devices, *Ergonomics, 46*(13–14), 1361–1374.

Mamede, S., & Schmidt, H. (2004). The structure of reflective practice in medicine. *Medical Education, 38,* 1302–1308.

Maslow, A. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396.

Maxwell, J. (1992). Understanding and validity in qualitative research. *Harvard Educational Review 62*(3), 279–300.

McClelland, D. (1961). *The achieving society*. New York: The Free Press.

McClure, K. (2009). Student perceptions of the clinical laboratory science profession. *Clinical Laboratory Science, 22*(1), 16–21. Retrieved from http://ezproxy.emich.edu/login?url=http://search.proquest.com/docview/204805633?accountid=10650

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco: Jossey-Bass.

Mortier, T., & Anderson, D. (2017). Understanding tacit knowledge in decision making. In D. J. Bouagina & G. L. Jamil (Eds.), *Handbook of research on tacit knowledge management for organizational success,* (418–435). Hershey, PA: IGI-Global.

Munhall, P. (1991). A phenomenological method. In *Nursing research: A qualitative perspective*, (145–210). Sudbury, MA: Jones and Bartlett.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company.* New York: Oxford University Press.

Peshkin, A. (1988). In search of subjectivity: One's own. *Educational Researcher, 17*(7), 17–22.

Piaget, J. (1977). *The Essential Piaget,* H. E. Gruber, J. J. Voneche (Eds.) New York, NY: Basic Books.

Pink, D. (2009). *Drive: The surprising truth about what motivates us.* New York, NY: Penguin Books.

Plebani, M., & Lippi, G. (2010). Is laboratory medicine a dying profession? Blessed are those who have not seen and yet have believed. *Clinical Biochemistry.* doi:10.1016/j.clinbiochem.2010.05.015.

Polyani, M. (1967). *The tacit dimension*. London: Routledge.

Pugach, M. C., & Johnson, L. J. (1990). Developing reflective practice through structured dialogue. In R. T. Clift, W. R. Houston, & M. Pugach. (Eds.), *Encouraging reflective practice in education: An analysis of issues and programs,* (186–207). New York: Teachers College Press.

Ribeiro, R. (2012). Tacit knowledge management. *Phenomenology and the cognitive sciences, 12*, (2), 337–366.

Rutgers Center for State Health Policy. (2011). Proceedings from John J. Heldrich Center for Workforce Development: Preparing the workforce for a reformed healthcare system: Toward a research agenda. New Brunswick, NJ: Rutgers.

Schill, J. M. (2012). *Professional behaviors, sense of belonging, and professional socialization of early career clinical laboratory scientists.* Retrieved from ProQuest Dissertations and Theses (129).

Schluter, J., Seaton, P., & Chaboyer, W. (2008). Critical incident technique: a user's guide for nurse researchers. *Journal of Advanced Nursing, 61*(1), 107–114.

Schon, D. (1983). *The reflective practitioner*. San Francisco: Jossey-Bass.

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences.* New York, NY: Teachers College Press.

Shepard, K., & Jensen, G. (1990). Physical therapist curricula for the 1990s: Educating the reflective practitioner. *Physical Therapy, 70*(9), 566–573.

Sobral, D. (2000). An appraisal of medical students' reflection-in-learning. *Medical Education, 34*, 182–187.

Sternberg, R. J., Forsythe, G. B., Hedlund, J., Horvath, J. A., Wagner, R. K., & Williams, W. M. (2000). *Practical intelligence in everyday life*. Cambridge: Cambridge University Press.

Strauss, A., & Corbin, J. (1994). Grounded theory methodology. In N. K. Denzin & Y. S. Lincoln (Eds.) *Handbook of Qualitative Research* (pp. 217–285). Thousand Oaks, Sage Publications.

Stress. (n.d.). *Oxford dictionary* Retrieved from https://en.oxforddictionaries.com/definition/stresshttps://en.oxforddictionaries.com/definition/stress

Taggart, G. (1995*). Reflective thinking: A guide for training preservice and in-service practitioners.* Retrieved from UMI: 9637212.

Taggart, G., & Wilson, A. (2005). *Promoting reflective thinking in teachers: 50 active strategies*. Thousand Oaks, CA: Sage Publications.

Teekman, B. (2000). Exploring reflective thinking in nursing practice. *Journal of Advanced Nursing 31*(5), 1125–1135.

The Lewin Group. (2008). The value of laboratory medicine to healthcare. *Laboratory Medicine – A National Status Report,* 2-10. Retrieved from: https://wwwn.cdc.gov/futurelabmedicine/pdfs/2007%20status%20report%20laboratory_medicine_-_a_national_status_report_from_the_lewin_group_updated_2008-9.pdf

TJC The Joint Commision (formerly JCAHO). About us. Retrieved from https://www.jointcommission.org/about_us/about_the_joint_commission_main.aspx

US News and World Report (2012). The best jobs of 2012. Retrieved from http://money.usnews.com/careers/best-jobs/rankings/the-100-best-jobs?page=3

Vroom, V. H. (1964). *Work and motivation*. New York: John Wiley & Sons Inc.

Vygotsky, L. (1978) *Mind in society*. M. Cole (Ed) Cambridge, MA: Harvard University Press.

Weidman, J., Twale, D., & Stein, E. (2001). *Socialization of graduate and professional students in higher education: A perilous passage.* New York, NY: John Wiley & Sons.

Wians, F. (2009) Clinical Laboratory tests: Which, why and what do the results mean? *Laboratory Medicine*, Feb 2009, *40*(2) 105–113.

Woeste, L., & Barham, B. (2006). The signature pedagogy of clinical laboratory science education: The professional practice experience. *Lab Medicine, 37*(10), 591–592.

RESEARCH @EMU

UHSRC Determination: EXEMPT

DATE: November 9, 2015

TO: Teresa Mortier, MS, BS
School of Health Sciences
Eastern Michigan University

Re: UHSRC: # 801022-1
Category: Exempt category 2
Approval Date: November 9, 2015

Title: Decision-making in Clinical Laboratory Science: The nature of decision-making and judgment in clinical laboratory science

Your research project, entitled **Decision-making in Clinical Laboratory Science: The nature of decision-making and judgment in clinical laboratory science,** has been determined **Exempt** in accordance with federal regulation 45 CFR 46.102. UHSRC policy states that you, as the Principal Investigator, are responsible for protecting the rights and welfare of your research subjects and conducting your research as described in your protocol.

Renewals: Exempt protocols do not need to be renewed. When the project is completed, please submit the **Human Subjects Study Completion Form** (access through IRBNet on the UHSRC website).

Modifications: You may make minor changes (e.g., study staff changes, sample size changes, contact information changes , etc.) without submitting for review. However, if you plan to make changes that alter study design or any study instruments, you must submit a **Human Subjects Approval Request Form** and obtain approval prior to implementation. The form is available through IRBNet on the UHSRC website.

Problems: All major deviations from the reviewed protocol, unanticipated problems, adverse events, subject complaints, or other problems that may increase the risk to human subjects **or** change the category of review must be reported to the UHSRC via an **Event Report** form, available through IRBNet on the UHSRC website

Follow-up: If your Exempt project is not completed and closed after **three years ,** the UHSRC office will contact you regarding the status of the project.

Please use the UHSRC number listed above on any forms submitted that relate to this project, or on any correspondence with the UHSRC office.

Good luck in your research. If we can be of further assistance, please contact us at 734-487-3090 or via e-mail at human.subiect emich.edu. Thank you for your cooperation.

Sincerely,

Sonia Chawla, PhD
Research Compliance Officer

SAINT JOSEPH MERCY HEALTH SYSTEM
A Member of Trinity Health

ST. JOSEPH MERCY ANN ARBOR
5301 East Huron River Drive
P.O. Box 995
Ann Arbor, Ml 48106-0995
Phone : 734-712-3456
stjoeshealth. org

January 20, 2016

Teresa Mortier, MD
347 Marshall Building
Yps il ant i, Ml

Dear Dr. Mortier:

On behalf of the SJMHS Institutional Review Board #1, expedited review was conducted and approved on **January 12, 2016** and **January 18, 2016** confirming that the following meets the requirements for expedited review and approval per 45 CFR 46.11 O(b) and 21 CFR 56.11 O(b):

HSR-15-1629: Decision-making in Clinical Laboratory Science: The nature of decision making and judgment in clinical laboratory science

Consent Issued -- All items noted from the full board meeting on December 1st, 2015 have been addressed.

Thank you for informing the IRB of this update. If you have any quest ions , or if I can be of ass is tance, feel free to contact me at 734-712-7912.

Sincere ly,

13 e-n.dcvK CU1.0'Y\.CI/
V

Digitally signed by Brenda Kanona
DN: cn=Brenda Kanona, o=S:.
..bseph Mercy Health S,,stem ,
ou=Institutional Raview Board
(Iffi),
email=brenda.kanona@;tjoeshealt
h.ofg. c;;=U S
Reason: amt)1eauthor of this
doa.iment
Date: 2016.01.2009:53:29-05'00'

Brenda Kanona, MA
IRB #1 Administrator
Saint Joseph Mercy Health System

EMU

Teresa Mortier <tmortier@emich.edu>

St. John Participation in Proposed Study

1 message

Taylor, Dawn <Dawn.Taylor@stjohn.org> Wed, Sep 30, 2015 at 4:18 PM
To: Terry Mortier <tmortier@emich.edu>

Terry,

This email serves as documentation of agreement by St. John Providence (SJP) Laboratories to participate in the proposed study as outlined in the attached informed consent. The file has been reviewed by SJP legal representation and their changes are highlighted in red. SJP will require that participants review and sign the attached notice and acknowledgment prior to beginning the study. I look forward to working with you.

Thank you,

Dawn M. Tayl01; MA, MLS(A SC P)cwi
Manager of Labora tor y Education
Program, Director/School of Medical Technolo gy
St. John Prov id ence Health System Laboratories
19251 Nlack Ave, Suite 101
Grosse Pointe Woods, NII 48236
Phone: 313-343-3433; Fax: 313-881-4727; Pager: 313-609-1048
Email: dmcn.tay lor@s ;ohn .org; Web address: www.stjohn.org/labcareers

"The place God calls you to is the place where your deep gladness and the world's deep hunger meet." - Frederick Buechner

2 attachments

HRKHL-#1824241-v1-SJPHS_-_Informed_Consent_Form_re_participation_in_Labo .docx
91K

HRKHL-#1824204-v2-SJPHS_-_Notice_and_Acknowledgment_re_Research_Study_Participation.DOC
24K