ARE HIGHER EDUCATION INSTITUTIONS ADDRESSING THE EMPLOYMENT NEEDS OF CLINICAL LABORATORIES IN RURAL AREAS?

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APPROVAL OF DISSERTATION

We, the faculty supervising the work of **Pamela Meadows**, affirm that the dissertation, *Are Higher Education Institutions Addressing the Employment Needs of Clinical Laboratories in Rural Areas?*, meets the high academic standards for original scholarship and creative work established by the EdD Program in **Leadership Studies** and the College of Education and Professional Development. This work also conforms to the editorial standards of our discipline and the Graduate College of Marshall University. With our signatures, we approve the manuscript for publication.

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DEDICATION

This dissertation is dedicated to my angel watching upon me from up above and the one person whose shoes no one could ever fill, my mother. Thank you for making me the independent and determined woman that I am today. I love and miss you!!

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ABSTRACT

Clinical laboratories across the nation are faced with a shortage of qualified Medical Laboratory Technicians (MLTs) and Medical Laboratory Scientists (MLSs). As the clinical laboratory workforce continues to shrink, it is essential that higher education institutions acknowledge the employment needs of rural laboratories to ensure quality health care in underserved areas. An aging workforce, program closures, and a general increase in demand for laboratory testing have compounded the workforce shortage for rural clinical laboratories, which often face unique challenges. The purpose of this research study was to examine the perceptions of rural clinical laboratory managers toward higher education's response to the shortage of MLTs and MLSs, and to determine the extent to which MLT and MLS programs are meeting the staffing and professional development needs of rural clinical laboratories. This descriptive mixed-method study was conducted utilizing a survey of 429 MLT and MLS program directors, in addition to interviews with 10 clinical laboratory managers in rural West Virginia. The results of this study revealed higher education institutions are not adequately meeting the employment needs of rural clinical laboratories, with notable key areas for improvement, including communication, partnership, and promotion of the profession. Interviews with laboratory managers indicated a moderate to severe rural workforce shortage, with a glaring deficiency of MLS candidates. Research findings demonstrated community and technical colleges, specifically MLT programs, were more likely than universities and four-year colleges to establish formal relationships with rural laboratories and served as a primary source of job candidates for rural laboratories. The findings further suggested rural clinical rotations, targeted recruitment efforts, and the creation of online and hybrid programs, would aid rural laboratories in securing a qualified workforce, while the delivery of online continuing education modules would benefit incumbent workers. This research adds to the limited literature in the clinical laboratory science field by addressing workforce issues specific to rural laboratories. The study also provides useful information to higher education institutions by identifying problems with recruitment of students, as well as concerns for the future of rural clinical laboratories that may influence MLT and MLS program creation and sustainability.

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CHAPTER ONE: INTRODUCTION

Each year, millions of people across the nation find themselves in need of medical care. Whether it is a childhood occurrence of strep throat, an adolescent case of mononucleosis, or a more serious condition such as a heart attack, most individuals will find it necessary to seek medical attention at some point in their life. Once a patient's vital signs have been reviewed and a thorough exploration of the patient's history and symptoms has taken place, it is often inevitable that laboratory testing will be required to confirm the physician's diagnosis. Most people give little thought to what happens behind the scenes once their blood is drawn and sent to the laboratory. What they don't realize is that their diagnosis, treatment, and safety greatly depend on a rarely recognized health care field, known as clinical laboratory science.

The field of clinical laboratory science faces several struggles, including a general lack of public knowledge regarding the importance of the profession and a nationwide shortage of qualified clinical laboratorians. Perdue (2016) stated "the most critical reason for the shortage of skilled laboratory scientists is the lack of awareness of the profession" (Future of the profession section, para. 1). Unlike other health care professions, such as nursing, clinical laboratory professionals are not "visible" to the public, resulting in a "lack of public understanding and recognition" for the profession (California Hospital Association, n.d.). The general lack of knowledge regarding clinical laboratory science also decreases student awareness of career opportunities in the field (California Hospital Association, n.d.). McPherson, Pincus, and Henry (2007, p. 5)

noted that a “lack of public and professional recognition” has exacerbated the inability of clinical laboratories to effectively recruit staff. The shortage of laboratory professionals has been compounded by higher education program closures, especially in rural areas (Bennett et al., 2014). Those programs that remain open are coming under increased scrutiny due to lack of enrollment and the high cost of equipment and supplies required for laboratory programs (Beckering & Brunner, 2003).

Literature in the field of clinical laboratory science is primarily limited to journals and periodicals produced in cooperation with professional societies within the field. Although considerable data is available regarding the nationwide shortage of clinical laboratory professionals, there is insubstantial literature that specifically addresses the clinical laboratory manager’s perception of higher education’s response to the personnel shortage. This research study examined the perceptions of rural clinical laboratory managers toward higher education’s response to the shortage of Medical Laboratory Technicians (MLT) and Medical Laboratory Scientists (MLS), as well as the extent to which Medical Laboratory Technician and Medical Laboratory Science programs are currently meeting the employment and professional development needs of rural clinical laboratories.

Related Literature

Rural health care facilities are faced with the monumental challenge of attracting qualified health care professionals to what are often considered to be less than desirable locations. An overall shortage of rural health professionals has been noted in the literature, with an emphasis on physician and nursing shortages. The shortage of

clinical laboratory personnel, specifically MLTs and MLSs, emphasizes a system of fragmented education, certification, and licensure requirements in a profession that is essential to the delivery of quality health care.

The Clinical Laboratory's Role in Health Care

Clinical laboratory science is "one of the most under-recognized health professions" (Rohde, 2014). As a critical part of the health care team, Medical Laboratory Technicians and Medical Laboratory Scientists work behind the scenes to supply physicians and caregivers with objective information used to treat and diagnose patients. Laboratory professionals play a vital role in patient care, yet the general public knows little about the importance of the profession and the nationwide staffing shortages that potentially threaten patient outcomes and safety (Rothenberg, 2016).

In a 2005 position paper from the American Society for Clinical Laboratory Sciences (ASCLS), the society stated that the clinical laboratory staff has a direct influence on several aspects of patient care, including patient safety, length of stay, and customer satisfaction (American Society for Clinical Laboratory Sciences (ASCLS), 2005). The value of the clinical laboratory profession is expansive and involves the performance of testing that enables physicians to diagnose a variety of conditions, including diabetes, coronary artery disease, impaired liver function, renal failure, acute myocardial infarction, hormonal imbalance, leukemia, anemia, and autoimmune disorders. In addition, clinical laboratory practitioners perform analyses to monitor therapeutic drug levels, identify bacterial and viral pathogens causing infection, determine antibiotic susceptibility for bacterial pathogens, ensure the safe transfusion of

blood products, and provide surveillance of infectious disease that can pose a potential risk to public health (ASCLS, 2013).

Clinical laboratory professionals are commonly employed in a variety of healthcare settings, including hospitals, clinics, physicians' offices, research laboratories, and reference laboratories, which perform both routine and specialized testing. There are two categories of practitioners employed in the general laboratory: Medical Laboratory Technicians (MLT), who hold an associate degree, and Medical Laboratory Scientists (MLS), who hold a bachelor's or graduate degree. While both categories of laboratorians perform low to moderate complexity testing, it is commonly observed that positions involving high-complexity testing or management duties are filled with practitioners at the MLS baccalaureate level to meet clinical laboratory accreditation standards.

Clinical Laboratory Scope of Practice and Professional Licensure

The Clinical Laboratory Improvement Amendment of 1988, commonly referred to as "CLIA," was created to ensure the integrity and quality of clinical laboratory testing (Centers for Medicare and Medicaid Services (CMS), 2017). The Centers for Medicare and Medicaid Services (CMS) and the Department of Health and Human Services Office of Laboratory Services are responsible for implementing and enforcing the objectives of CLIA. In order to receive Medicare or Medicaid payment, laboratories must hold a CLIA certificate. As of December 2016, CLIA regulated and certified approximately 254,000 laboratories (CMS, 2017).

CLIA established educational requirements for individuals performing testing, as well as general and technical supervisors, in the clinical laboratory (CMS, 2003). Although CLIA was enacted to ensure quality, critics question the minimal and somewhat non-specific education requirements that open the door for individuals who lack formal training through accredited MLT or MLS programs to perform testing. CLIA regulations require only a high-school diploma or GED to perform some levels of laboratory testing (CMS, 2003). According to Rohde, Falleur, and Ellis (2015), CLIA regulations are not only inadequate but they raise concerns for patient safety and the quality of laboratory test results. The growing shortage of clinical laboratory personnel can lead to less restrictive employment requirements in some geographical areas, especially in those states that lack stringent requirements for formal training as a MLT or MLS through professional licensure of clinical laboratory personnel (Rohde, Falleur, & Ellis, 2015).

The ASCLS developed a scope of practice document for the laboratory profession based on CLIA regulations and the educational objectives set forth by the National Accrediting Agency for Clinical Laboratory Sciences (ASCLS, 2012). The scope of practice position paper outlined the expected job duties at various levels of education and professional certification (ASCLS, 2012). The position paper also noted support for “equivalent routes” for MLT and MLS certification only in combination with an associate degree or baccalaureate degree, respectively, as recognized by the Board of Certification (ASCLS, 2012). Depending on the type of college coursework completed, some individuals with baccalaureate degrees in areas such as biology and chemistry, may be eligible for national certification as an MLT or MLS if they have documented

proof of a minimum amount of clinical laboratory work experience (American Society for Clinical Pathology, 2017).

The licensure of clinical laboratory personnel has been a topic of much discussion in recent years. A 2006 position paper from the ASCLS identified the need for personnel licensure in defining and implementing the scope of practice for clinical laboratory science and suggested that licensure should require both specific educational and certification requirements (ASCLS, 2006). In 2013, only thirteen states required licensure of clinical laboratory personnel. Those states that did require personnel licensure had educational requirements exceeding those of the Clinical Laboratory Improvement Act and required national certification (Bennett, et al., 2014). As of December 2017, only eleven states, including West Virginia, required licensure of laboratory practitioners (ASCLS, n.d.a). It is unclear what effect, if any, that licensure and changes to the scope of practice for the profession have had on the employment practices of clinical laboratories, specifically those in rural settings. In a profession that is already faced with workforce shortages, scope of practice revisions and more rigorous licensure requirements may make it more difficult for rural clinical laboratories to find qualified employees. Therefore, it is imperative that higher education institutions work closely with rural clinical laboratories to ensure an adequate rural laboratory workforce that meets educational and licensure requirements.

The Clinical Laboratory Personnel Shortage

Clinical laboratories across the country are faced with a shortage of qualified Medical Laboratory Technicians and Scientists. In a 2008 study by the American

Society for Clinical Pathology, it was determined that the highest percentage of vacancies in the core laboratory were at the MLS, or bachelor's degree, level (Thompson et al., 2009). This represents a significant issue for the field because CMS guidelines require a baccalaureate degree in a biological science to fulfill regulatory requirements for supervisory positions under CLIA. Lack of recognition and inferior compensation in comparison to other health care professions has contributed to the shortage of qualified personnel in the clinical laboratory field (Garcia, Ali, & Choudhry, 2013).

A 2013 report from the American Society for Clinical Pathology stated that since 1990, nearly 25% of clinical laboratory training programs had closed (Bennett et al., 2014). The National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) 2015 Annual Report revealed limited numbers of accredited clinical laboratory training programs in some states. According to the 2015 report, seventeen states had two or fewer MLT programs, while twenty states had two or fewer MLS programs (National Accrediting Agency for Clinical Laboratory Sciences (NAACLS), 2015). In 2015, seven states including Arkansas, Delaware, Hawaii, Maine, New Hampshire, Nevada, and Oregon, had only one Medical Laboratory Technician Program and one Medical Laboratory Science Program (NAACLS, 2015). Three states, Idaho, Montana, and Vermont, had only one MLS program and no MLT programs, while Wyoming had only one MLT program and no MLS program (NAACLS, 2015). Without standardized national licensure of laboratory personnel, there are no specific requirements as to the number of educational programs offered per state. Program offerings are highly

dependent on the employment needs as expressed by local hospitals and laboratory administrators, as well as available funding for higher education. Overall, in 2015 there was a total of 250 MLT and 224 MLS accredited programs in the United States (NAACLS, 2015). NAACLS (2015) data showed that the state of WV had 4 MLT and 3 MLS programs clustered in the northern and south-western portions of the state, leaving the eastern, south-eastern, and central portions of the state with limited, if any, access to higher education programs in clinical laboratory science.

The shortage of clinical laboratory personnel is a doubled-edged sword because of the direct effect the personnel shortage has on the clinical practicum portion of clinical laboratory science education. MLT and MLS programs are considered low enrollment programs, partially due to limited availability of clinical sites (Malone, 2011). The clinical practicum experience is an important part of the education of Medical Laboratory Technicians and Medical Laboratory Scientists and is a core requirement for educational programs accredited by the NAACLS (NAACLS, 2017). According to Linder (2012), “the clinical site provides practical learning and an introduction to the culture of patient care” (Practical training section, para. 2). As clinical laboratories have been faced with the growing personnel shortage, it has become increasingly more difficult for educational programs to place students for clinical rotations. Clinical laboratories acknowledge the role student training plays in solving the personnel shortage, however, the facilities simply lack the staff to dedicate to the education of students in the clinical setting (Linder, 2012). Clinical Laboratory Network interviews of program directors

revealed that some educational programs could take more students but are unable to do so due to problems securing clinical site placement (Scott, 2015).

As many laboratories face staffing shortages, it is crucial to note the importance of education at both the MLT and MLS level. It is common practice for an MLT to pursue a MLS degree immediately after graduation or later in their career, as they seek professional advancement or management positions. In a dissertation study of the barriers that Medical Laboratory Technicians face when returning to school to pursue a baccalaureate degree, it was noted that problems with the transfer of associate level coursework toward a MLS degree was a significant hurdle (Anderson, 2016). In addition, a general lack of options when searching for bridge, or 2+2, programs that accept a MLT degree as partial fulfillment of bachelor's degree curriculum requirements created barriers to professional development (Anderson, 2016). Challenges in obtaining and completing clinical rotations were also noted as a minor barrier for MLT's planning to pursue their MLS degree (Anderson, 2016).

The Shortage of Rural Health Professionals

Ensuring that individuals in rural areas have adequate access to health care is one of the primary challenges in the United States health care system (Whitcomb, 2005). Rural hospitals across the country find themselves faced with significant staffing issues, including recruitment barriers for physicians, nurses, and allied health professionals. Health professionals working in rural health care facilities may find themselves playing dual roles. For instance, in some rural areas where an inadequate number of physicians are available, nurse practitioners and other mid-level health care

professionals often oversee the primary care issues of patients (American Hospital Association (AHA), 2011).

A review of the literature revealed very limited information regarding the response of higher education programs to the rural shortage of Medical Laboratory Technicians and Scientists. The similar issue of rural physician shortages has been addressed in the literature, however, it is also limited as to extent. A study by Chen, Fordyce, Andes, and Hart (2010) revealed that medical students who completed residency training in rural areas were three times as likely to practice in a rural setting, in comparison to those students who did not complete rural training requirements. Chen et al. (2010) also noted that "a small number of medical schools produced high proportions of rural physicians" (Discussion section, para. 1). Rosenblatt (2010) suggested that the use of selective admission processes that target students from rural areas, along with the creation of curriculum tracks that integrate rural medicine, can significantly increase the number of students who choose to practice in rural areas after graduation. Rosenblatt (2010) further stated that publicly funded institutions, including medical schools, have a responsibility to ensure that the healthcare needs of rural areas are met. Regarding the creation of curriculum tracks that focus on rural medicine, Rosenblatt (2010) noted "given the fact that the absolute number of physicians needed to adequately staff rural areas is relatively small, a targeted commitment on the part of half of the medical schools" (p. 2) would help diminish the shortage of physicians in rural areas.

Changes to the clinical laboratory scope of practice and delegation of job duties between Medical Laboratory Technicians and Medical Laboratory Scientists is an issue

for rural laboratories. As the ASCLS worked to define the scope of practice in hopes of strengthening the profession, rural laboratories were faced with an additional concern. A survey of laboratory managers, educators and practitioners revealed concern for rural laboratories with regard to the redefined scope of practice (Beck, Briden, & Epner, 2008). Respondents indicated that a lack of educational programs may create additional problems for rural laboratories, which may be unable to meet the requirements set forth by the professional scope of practice (Beck et al., 2008). These concerns also resonated with educators who acknowledged the need for developing new programs and addressing accessibility issues that may create a barrier for Medical Laboratory Technicians that wish to pursue a bachelor's degree (Beck et al., 2008).

A nationwide shortage of qualified Medical Laboratory Technicians and Medical Laboratory Scientists represents a prominent issue for rural laboratories. A 2014 ASCP task force report on the status of the laboratory workforce indicated the need for a general focus on recruitment, retention, and retirement challenges in the profession (Bennett et al., 2014). The report suggested that rural laboratories are more likely to struggle with staffing issues, largely due to issues with access to training programs and clinical laboratory science program closures in higher education (Bennett et al., 2014). The National Rural Health Association has also indicated that the shortage of allied health professionals, which includes laboratory technicians and laboratory scientists, in addition to a projected increased demand for allied health professionals due to an aging population, will have a piercing effect on rural health facilities (Burrows, Suh, & Hamann, 2012).

A 2013 survey of laboratory directors in Tennessee found that rural laboratories were more likely to depend on recruitment of local residents in comparison to urban hospitals, and rural laboratories are faced with "limited access to resources." The study noted that 84.3% of respondents indicated that their employees are typically from a rural area (nearly double the response from urban hospitals), 72.3% specified that they target community colleges for new hires, and only 66.7% expressed that they had "effective co-op programs with universities" (Slagle, 2013). The responses suggested that access to community colleges is critical for rural laboratories. In addition to traditional training, some community colleges also strive to offer continuing education for those already in the field, however, only 39.1 % of rural respondents noted that they have "adequate opportunities for professional development" (Slagle, 2013).

In 2016, the shortage of clinical laboratory personnel in rural areas led to a dramatic and controversial ruling by CMS which proposed that a degree in nursing was equivalent to a degree in biological science as required to perform and supervise CLIA-defined moderate and high complexity laboratory testing (ASCLS, 2018). CMS representatives indicated that an internal policy was adopted to accommodate areas that struggle to find qualified laboratory practitioners (ASCLS, 2018). Citing the differences between nursing and Bachelor of Chemistry, Biology, or Physical Science curriculum requirements, as well as imminent health care quality and patient safety concerns (ASCLS, 2018), professional leaders in clinical laboratory science rallied against the CMS memorandum. The outcome of the dispute was still pending at the time of this research.

The Relationship Between Clinical Practicum and Professional Practice

The clinical practicum experience is a critical portion of the education of clinical laboratory science students. During the clinical experience, students work one-on-one with clinical instructors and perform the day to day duties of a MLT or MLS. Although the length of clinical practicum experiences varies between programs, clinical laboratory science students generally spend a minimum of one semester at a health care facility. The clinical practicum is designed to give students a “real world” experience that cannot be easily replicated in a classroom environment.

Studies that examined the influence of rural clinical practicum placement on practice location post-graduation revealed similar findings for medical, nursing, and allied health students. Wilson et al. (2009) suggested that rural assignment for clinical practicum moderately influenced the decision of medical students to practice in a rural setting after graduation. A multi-disciplinary study of allied health students revealed that students who voluntarily completed clinical rotations at a rural facility were more likely to work in a rural setting (Playford, Lawson, & Wheatland, 2006). The study conducted by Playford, Lawson, and Wheatland (2006) further suggested that students who spend any time at all in a rural facility during clinical rotations are more likely to seek rural employment.

Dissertation studies involving medical student and nursing disciplines signify the benefits of rural clinical rotations and residencies. According to Nguyen (2013), there is a connection between the location of medical residency and practice location after graduation. A study of physicians who completed a residency in rural Kansas revealed

that those physicians were five times more likely to practice medicine there (Nguyen, 2013). The research also demonstrated that location of residency has more influence on where physician's practice than the location of the medical school they attended (Nguyen, 2013). A qualitative dissertation research study conducted by Sharp (2010) included interviews with nurse practitioner students and indicated that rural clinical rotations allowed students to work more independently and perform procedures commonly reserved for physicians, as compared to urban settings. Rural rotations can allow students to gain additional skills, while staying within their scope of practice. Nurse practitioner students also noted an increased feeling of gratification due to an all-around involvement in patient care, as the result of the strong connections between community and health care providers in rural locations (Sharp, 2010). The researcher's suggestions for future studies included a recommendation for the examination of the effects that rural didactic courses and clinical rotations have on the future practice of nurse practitioners (Sharp, 2010).

Limited literature is available regarding the link between rural clinical practicum and clinical laboratory science graduate employment. In 1993, the West Virginia University (WVU) Medical Technology Program joined other allied health disciplines to provide collaborative training under the Rural Interdisciplinary Training Grant. The three-year grant provided funding, including housing, for students to complete a one-month clinical rotation at a rural facility (Kirby, 2007). A retrospective study of WVU Medical Technology student perceptions of rural clinical rotations demonstrated that 50% of the respondents worked at a rural facility after graduation and 73.4% believed

that the rural clinical rotation was beneficial because it helped them to better understand the unique needs of rural laboratories (Kirby, 2007).

Research Purpose

As the nationwide shortage of Medical Laboratory Technicians and Medical Laboratory Scientists continues, it is vital to the health care system that higher education institutions strive to meet the employment needs of clinical laboratories, particularly in rural areas. Higher education programs in clinical laboratory science find themselves fighting the threat of program closure amid low enrollment numbers, while also struggling to find clinical site placements for students. The creation of strong working relationships between clinical laboratories and higher education institutions is critical to ensuring adequate health care to the nation's rural population.

Higher education institutions have a responsibility to serve rural health care facilities and clinical laboratories from both a mission and service standpoint. The Higher Learning Commission (HLC) Assumed Practices Policy (2017) for accredited higher education institutions requires that higher education institutions implement mission, vision, and value statements. According to the HLC (2016), Congress is placing more focus on accountability of higher education institutions, with a concentration on assessment measures that include persistence, completion rates, and job placement.

NAACLS accredited MLT and MLS programs must also meet standards for program assessment and quality improvement which require that accredited clinical laboratory science programs meet benchmarks for certification rates, graduation rates,

and graduate placement. The NAACLS (2016) established a benchmark of "at least 75% pass rate on the ASCP Board of Certification examinations, for those who take the exam within the first year of graduation," as well as a benchmark of 70% for both MLT/MLS program completion and job placement within one year of graduation. For states that require national certification to obtain professional licensure as an MLT or MLS, rural clinical laboratories are likely to rely on partnerships with higher education institutions to ensure an adequate pool of qualified job candidates. MLT and MLS programs are also required to maintain documentation as to the role of their program advisory committee in sustaining program effectiveness (NAACLS, 2016). Rural clinical laboratory inclusion on advisory committees ensures that MLT and MLS programs are sufficiently serving the health care community, a primary economic driver for most rural areas.

In rural areas, where the laboratory shortages are significant, the quality of health care provided to patients may be at risk. Otto (2011) suggested that issues including employee fatigue, time constraints and workflow interruptions can lead to laboratory errors and endanger patient safety. As staffing levels become problematic, patient safety concerns relating to these types of issues become more prominent.

Rural clinical laboratories that struggle with employee recruitment may find it necessary to hire individuals without a MLT or MLS degree. The ASCLS (2012) scope of practice supports alternate routes to professional practice if individuals meet specific education and training requirements for professional certification. The Board of Certification also offers a certification route for individuals having earned a set number

of college credits in biology and chemistry, in addition to clinical laboratory experience gained through on-the-job training (ASCP, 2017). Therefore, the shortage of Medical Laboratory Technicians and Medical Laboratory Scientists may result in a shift of job duties to individuals who lack significant coursework in clinical laboratory science theory and application. The extent to which rural laboratories hire individuals falling into the alternative certification category, and the effect, if any, on the quality of laboratory testing has not been addressed in the literature. The qualitative portion of this research examined the extent to which rural laboratories employ individuals in the alternative certification category, due to the inability to recruit MLT and MLS program graduates.

To ensure access to quality laboratory testing, accurate diagnosis, and effective medical treatment, it is essential that higher education institutions strive to meet the needs of clinical laboratories in all settings. The purpose of this research study was to examine the perceptions of rural laboratory managers toward higher education's response to the shortage of Medical Laboratory Technicians and Medical Laboratory Scientists. This research also investigated the extent to which MLT and MLS programs are meeting the staffing and professional development needs of rural clinical laboratories. Focus was placed on clinical affiliation agreements between MLT/MLS programs and rural laboratories, as well as the common dialogue and collaboration between the two entities regarding recruitment and professional development of Medical Laboratory Technicians and Medical Laboratory Scientists in rural areas.

Research Questions

1. What formal relationships, if any, exist between rural clinical laboratories and MLT/ MLS programs?
2. To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?
3. To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

Methods

A mixed method study utilizing non-experimental descriptive methods with correlational analyses was employed for this dissertation research. Mixed method studies assume that a combination of quantitative and qualitative research techniques provides a more extensive comprehension of the research problem (Creswell, 2014, p. 4). The utilization of mixed methods allowed for an in-depth examination of both educational program director and clinical laboratory manager perspectives regarding higher education's response to the laboratory personnel shortage in rural communities.

Initially, a nationwide survey of clinical laboratory science program directors at higher education institutions was conducted to determine the extent to which clinical laboratory science programs are reaching out to rural hospitals regarding clinical rotation assignment, job placement, and professional development. The survey instrument was delivered online and remained open for a six-week period. The use of non-experimental quantitative research, such as surveys, allows for causal-comparative analysis of groups based on independent variables (Creswell, 2014, p. 12). By utilizing

these quantitative methods, comparisons were made between MLT and MLS programs, as well as geographical location and type of higher education institutions.

The second phase of research utilized a phenomenological approach to qualitative research. Bogdan and Biklen (2007) defined phenomenological studies as "research that is concerned with understanding the point of view of the subjects" (p. 274). A multicase study design was utilized for the qualitative portion of the research. When qualitative research involves a case study format using two or more subjects with the purpose of generalizing the research findings for a given setting or characteristic, a multicase study design is beneficial (Bogdan & Biklen, 2007, pp. 69-70). Semi-structured interviews were conducted with 10 managers of rural clinical laboratories to determine if higher education institutions and clinical laboratory science programs are meeting the needs of rural laboratories regarding employee recruitment, as well as professional development of current employees who wish to pursue an advanced degree or obtain continuing education credits. The use of interviews also helped to reveal the rural laboratory manager's perception of higher education's overall response to the laboratory personnel shortage.

Population and Sample

The survey of higher education institutions was conducted by using a specific audience of clinical laboratory science program directors. Only directors of programs accredited by the National Accrediting Agency for Clinical Laboratory Science (NAACLS) were surveyed. The primary route for MLT and MLS certification through the ASCP Board of Certification requires that applicants complete a NAACLS approved

program (ASCP, 2017). A survey of only NAACLS accredited programs, therefore, represented the educational programs that supply most of the clinical laboratory workforce. A complete list of all program directors and contact information was available for retrieval from the NAACLS website. Although clinical coordinators in educational programs may have been equipped to answer some of the survey questions, it is typically the program director who approves affiliation agreements, determines advisory committee membership, monitors job placement for graduates, oversees program assessment, and develops the strategic plan for educational program sustainability and growth; therefore, program directors were best suited to answer the survey questions in this study.

The qualitative portion of this research study involved interviews with 10 clinical laboratory managers from rural areas in West Virginia (WV). A study performed by Guest, Bunce, and Johnson (2006) revealed that data saturation can be achieved with as few as six interviews when using small sample populations. The use of interviews in qualitative research allows the interviewee to share historical perspectives of the research problem (Creswell, 2014, p.191). Laboratory managers were the most ideal interview subjects for this study because they are responsible for oversight of clinical laboratory strategic planning initiatives, as well as human resource management, including staff recruitment and compliance with laboratory accreditation standards regarding educational requirements for laboratory employees (McPherson, Pincus, & Henry, 2007, pp.4-5). Lab managers are also responsible for establishing and approving affiliation contracts with higher education institutions. The director for the West Virginia Office of Laboratory Services assisted in the identification of rural

laboratories that demonstrated difficulty recruiting and retaining qualified Medical Laboratory Technicians and Medical Laboratory Scientists as evidenced during CLIA inspections.

The term “rural” has numerous definitions depending on the context in which it is used. According to the United States (U.S.) Census Bureau’s classification system, areas with 50,000 or more people are considered “urban,” while the term “urban cluster” is used to define areas having between 2,500 and 49,999 people (Ratcliffe, Burd, Holder, & Fields, 2016). The term “rural’ is defined as all populations and territory not included in urban areas and is depicted graphically as sparsely populated areas that lack density, are “not built up” and which demonstrate “a distance” between blocks or tracts of land (Ratcliffe et al., 2016). The 2010 census indicated that Charleston, West Virginia was the only city in the state with a population greater than 50,000, thereby classifying it as a metropolitan area (United States (U.S.) Census Bureau, 2010). To account for West Virginia’s range of population and geography, only health care facilities located more than forty miles from cities having a population of greater than 25,000 were included for the qualitative portion of the research. Utilizing U.S. Census Bureau data (2010), this research stipulation excluded clinical laboratories within a forty-mile radius of five West Virginia cities, including Charleston, Huntington, Parkersburg, Morgantown, and Wheeling.

A qualitative research focus on rural clinical laboratories in West Virginia was supported by a review of the literature. As described by Burrows, Suh, and Hamann (2012), the shortage of allied health professionals, including MLT’s and MLS’s, is projected to greatly impact rural hospitals. Laboratory staffing shortages in rural

hospitals is of great concern, especially for those areas which lack access to clinical laboratory science programs (Bennett et al., 2014). A 2005 project conducted by the WV Office of Laboratory Services (WVOLS) and the Department of Health and Human Resources Bureau for Public Health indicated "a disturbing trend in reduced numbers of qualified laboratory personnel in WV clinical laboratories" (Cibrik, 2005, p. 1). The WVOLS report denoted the consequences of the laboratory personnel shortage in the following statement:

> Shortages of qualified clinical laboratory professionals will negatively impact both public health and private sector (hospitals, research, reference) laboratories. Competency, quality, and the availability of laboratory testing services to the public will be compromised if staffing continues in a downward spiral. (Cibrik, 2005, p. 2)

According to Chappell, Cibrik, Scott, and Taylor (2007), a survey of clinical laboratories in WV revealed that, despite competitive salary and benefit offerings, some laboratories in the state experienced job vacancies lasting greater than two years. The authors also stated "most disturbing was the finding that in some of the most rural areas, 75% of the workforce is over 55 years old" (Chappell, Cibrik, Scott, & Taylor, 2007).

A workforce report from the WV Long Term Care Partnership (2010) further supported a qualitative research focus on WV, stating that as the number of WV residents in need of long-term care will continue to increase, the health care workforce is expected to be insufficient to meet the medical needs of state residents. The report further indicated that educational programs for health professions in WV appeared disproportionate, with an abundant offering of programs in majors such as nursing and

psychology (West Virginia (WV) Long Term Care Partnership, 2010). While there is a multitude of programs to serve certain health professions within the state, other professions suffer from inadequate program offerings, which adds to the lack of qualified health care workers (WV Long Term Care Partnership, 2010). As a result, the group recommended further studies within the state to examine workforce needs and "better understand educational program creation" (WV Long Term Care Partnership, 2010, p. 15).

Significance

This research will provide valuable information to professional societies, such as the American Society for Clinical Laboratory Sciences, which could influence professional licensure regulations for clinical laboratory practitioners. The study will also aid higher education institutions across the nation by identifying the problems and needs of rural clinical laboratories regarding recruitment and retention. The data collected in this research study may also be beneficial to states working toward clinical laboratory personnel licensure legislation or higher education organizations that are evaluating the benefits and barriers to implementing a new MLT or MLS program. In addition, this information could prove useful to current MLT and MLS programs that are faced with possible program closure, as the research indicated the level of importance placed on the relationship between rural health care, specifically rural clinical laboratories, and higher education institutions.

CHAPTER TWO: LITERATURE REVIEW

Higher education institutions play a pivotal role in ensuring a strong rural health care workforce. The relationship between higher education and rural health should not be underestimated. Rural health institutions often rely on the help of educational programs to recruit new health care professionals. Targeted recruitment strategies and rural curriculum tracks can be useful in attracting graduates to rural practice after graduation (Daniels, VanLeit, Skipper, Sanders, & Rhyne, 2007). The ability of higher education institutions to offer flexible curriculum may be particularly attractive to rural residents, however, access to higher education institutions may be an issue.

A review of literature related to the field of clinical laboratory science and rural health care indicated the need for further research to examine if higher education institutions are meeting the needs of rural clinical laboratories. The literature revealed a limited quantity of research that specifically addressed the relationship between higher education and rural health care. Research in the field of clinical laboratory science is also sparse regarding rural health, however, a few publications specifically addressed the effect that the shortage of clinical laboratory professionals may have on laboratories located in rural areas.

Rural Health Overview

The ongoing debate over health care reform in the United States has a direct influence on the health care professional workforce, especially in rural and underserved areas. The Affordable Care Act (ACA) enacted in 2010, resulted in the expansion of health care coverage, primarily through Medicaid, to citizens living below 138% of the federal poverty level (CMS, n.d.). Rural populations, which typically fall within the low-

income bracket, were a target for health care coverage reform through the ACA (Newkirk and Damico, 2014). Health care reform has also directly affected the clinical laboratory. As a result of federal health care reform, the number of individuals with health insurance has increased, which in turn has increased the utilization of clinical laboratory testing as the number of people seeking medical attention has increased (Bureau of Labor Statistics (BLS), 2015).

Health care institutions are often viewed as the nucleus of rural communities, but they face an abundance of struggles. Rural hospitals face a unique set of financial challenges due to remote location, reimbursement issues, and a growing shortage of qualified health professionals and practitioners (American Hospital Association (AHA), 2017). Hospitals are often the most prominent and largest employer in a rural community, yet the financial constraints experienced by many rural hospitals have a direct effect on their ability to recruit and retain qualified health care professionals (AHA, 2011). The effect of a workforce shortage can be troublesome for any health care institution, but a shortage of qualified health care professionals, including clinical laboratory professionals, can be detrimental for small rural hospitals and clinics. The Institute of Medicine (2005) recognized the need for focus on rural health care access, as well as the need to address human resource issues that hinder remote health care facilities from being able to adequately recruit and retain health care workers.

Geographic, demographic, and economic variables have a distinct influence on health care in rural communities. According to the American Hospital Association (2017), approximately 51 million Americans reside in rural communities and depend upon rural hospitals for preventive health care and management of chronic disease.

Burrows, Suh, and Hamann (2012) suggested that the shortage of allied health professionals will acutely affect rural health care facilities and will be compounded by an aging population. Rural residents tend to be older in age and suffer from chronic illnesses at a higher rate than individuals residing in suburban areas (AHA, 2011). Individuals living in rural areas are also faced with several barriers that impede their ability to obtain health care. According to the Stanford School of Medicine (2010), barriers to rural health care include financial limitations, isolation from society, lack of transportation, limited access to health care due to geographical variables, a limited supply of health care providers and facilities, as well as issues concerning quality of care.

Healthcare in Rural West Virginia

The health care system of West Virginia (WV) is burdened by an aging and unhealthy population, which highly depends on rural health care. WV is a primarily rural state with notable issues regarding access to health care (West Virginia Department of Health and Human Resources (WVDHHR), 2012). According to 2010 United States census data, WV had a population of 77.1 people per square mile (United States Census Bureau, 2010). The general population of WV is described as one of the oldest in the country and is plagued with a high rate of disability, heart disease, cancer, diabetes, respiratory disease, and one of the highest obesity rates in the nation (WVDHHR, 2012).

The WV Rural Health Association (WVRHA) collects and analyzes numerous data sets to determine the primary health concerns and needs of rural West Virginians,

while identifying areas of concern regarding the rural health care workforce. The WVRHA collects data for numerous health professions, including primary and specialty practice physicians, nurse practitioners, nurses, and various allied health professions, including physical therapy, social work, dietetics, and speech pathology (West Virginia Rural Health Association (WVRHA), 2015). It is, however, noticeable that the shortage of clinical laboratory professionals has not been addressed in the WVRHA's reports. The WVRHA utilizes data from professional licensing boards to prepare workforce analyses; therefore, one explanation for the void of data regarding clinical laboratory professionals is an inability to access accurate and current data. In 2014, the WV state legislature passed House Bill 4245 "to facilitate planning for future workforce needs for health care professionals" (WVRHA, 2015, p. 5). As a result of the legislation, six WV licensing boards, including the Board of Medicine, Board of Osteopathy, Board of Dentistry, Board of Pharmacy and the Board of Examiners for Registered Professional Nurses and Licensed Practical Nurses, are now required to report various information, including expected retirement date, age, and practice location of licensed health professionals (WVRHA, 2015).

Tools such as the newly implemented WV Health Data Portal can provide valuable information regarding current workforce trends and areas of concern for the health care arena. The portal allows users to look at the distribution equality of health care professionals between rural and urban settings, with the expectation that data will eventually be available for all health care professions in the state (WVRHA, 2016). Data available through the portal will make it possible to more accurately determine the

impact of an aging health care workforce, and identify areas having higher populations of patients with chronic disease (WVRHA, 2016).

Information gathered from the WV Health Data Portal can give lawmakers, higher education institutions, and licensing board insight into the health care needs of state residents, as well as the workforce needs of health care institutions. In 2015, WV had the highest percentage of Medicaid enrollees suffering from a disability (WVRHA, 2015). Data from 2015 also indicated that the highest percentage of elderly residents resided in the northern tip and south-eastern portions of the state, while the average age for primary care professionals, including physicians, nurse practitioners, and physician assistants, in WV, was 48 years. The examination of an unhealthy population in combination with an aging health care workforce can reveal the need for strategically placed educational programs that address the recruitment, training, and retention of health care professionals (WVRHA, 2015).

The Rural Health Workforce Shortage

The shortage of health care professionals is one of the most disturbing issues facing rural health. Access to and quality of medical care revolve around the ability to recruit and retain qualified health care providers and allied health professionals. A shortage of physicians and surgeons exists, in addition to a scarcity of various other health care disciplines, including nursing, physician assistants, radiology, and clinical laboratory science (Szabo, 2011). Recruitment and retention issues have resulted in some hospitals opting to recruit health care professionals from other countries (Szabo, 2011). According to Szabo (2011), the Rural Assistance Center indicated that remote

health care facilities are most likely to struggle with staffing issues due to “aging workforce, lack of educational and training opportunities for younger people, smaller staffs and heavier workloads, and higher pay and more benefits offered in metropolitan areas.” Szabo (2011) further noted that a major issue with recruiting and retaining health care professionals at rural hospitals is the inability to find people who are satisfied with working and living in a rural community; therefore, targeted recruitment of rural residents and high school students, along with scholarship and grant programs, can increase the likelihood of attracting future employees into the rural health care environment.

The rural health care workforce shortage encompasses several medical professions. A survey of Chief Executive Officers of rural hospitals indicated that 75.4% of rural hospitals had shortages of physicians, while 73.5% experienced nurse shortages and 61.2% were faced with a shortage of physical therapists (MacDowell, Glasser, Fitts, Nielsen, & Hunsaker, 2010). Results from the survey of rural hospitals also demonstrated a significant shortage of pharmacists and occupational therapists, as well as several other allied health professions (MacDowell et al., 2010). One option to improve recruitment and retention efforts is the use of targeted educational programs and an emphasis placed on rural environmental factors such as a family-oriented environment, a welcoming community, respect for health professionals, and community acknowledgement that health care plays a major role in the local economy (MacDowell et al., 2010).

The use of targeted recruitment strategies and rural clinical rotations can attract health care professionals to rural practice, however, there is a need for further research

on the effectiveness of these strategies. A report for the Department of Veterans Affairs examined the status of the rural health care workforce and indicated that there are limited studies that investigate recruitment of health professionals to rural areas (Shekelle, 2015). The report further indicated that there was a distinct need for additional studies on the use of "interventions," such as rural tracks in higher education curriculum, to increase recruitment of health care providers to rural areas (Shekelle, 2015). A rural upbringing and rural tracks within medical education curriculum have been noted to play a role in future practice in rural locations, however, the previously mentioned Department of Veterans Affairs report indicated the need for further research to examine the ideal amount of time spent in rural clinical rotations in relation to the choice of rural practice after graduation (Shekelle, 2015).

Issues including impending retirements and professional limitations due to scope of practice regulations further influence rural health care staffing shortages. The National Advisory Committee on Rural Health and Human Services (2010) noted that rural health care professionals are closer to retirement than their urban counterparts. Issues with professional scope of practice also affect the workforce. In rural communities, health care professionals sometimes take on additional duties beyond those expected of their suburban counterparts. Since the workforce is smaller, health care institutions may find it beneficial to cross-train employees in other areas. Most health care professions are governed by a scope of practice which outlines the standards of practice for the profession. For certain health care professions, such as nurse practitioners, restrictions in the professional scope of practice can not only limit the ability to efficiently staff rural facilities but can intensify staffing shortages because it

restricts them from performing job duties that may not fall within the standard of care for which they were formally trained (AHA, 2011).

Multiple factors play a role in a health care professional's choice to practice in a rural setting. A study of Nurse Practitioners, Physician's Assistants and Nurse Anesthetists revealed that "community ties" play a role in the choice of practice location (Lindsay, 2007). The same study noted that women were less likely to practice in a rural area out of fear of being "professionally isolated;" however, males liked the autonomy of working in a rural setting. A focus on recruitment of individuals who were raised in a rural area may aid in the identification of employees who are likely to commit to and remain in a rural setting (Lindsay, 2007).

The Shortage of Rural Physicians and Nurses

A review of the literature indicated a notable shortage of physicians in rural health care facilities. Lee and Nichols (2014) noted that although there is a fair amount of research regarding facilities' ability to recruit and retain physicians, research on the topic is still sparse. An inability to recruit physicians can ultimately affect a health care facility's ability to offer quality care (Lee & Nichols, 2014). According to Hing and Hsiao (2014), the ratio of physicians to patients is 39.8 per 100,000 in a rural setting versus 53.3 per 100,000 in urban settings.

The literature clearly notes a connection between medical school rural residency and a student's decision to practice in a rural location after graduation. A systematic review of medical schools offering programs with a focus on rural medicine indicated that 53-64% of graduates practice in rural areas (Rabinowitz, Diamond, Markham, & Wortman, 2008). A research study that examined graduates of a rural track curriculum

at the University of Missouri School of Medicine indicated that more than 57% of students that pursued the rural track chose to practice in a rural location after graduation (Quinn et al., 2011).

Primary care is one of the paramount health care needs in rural or underserved areas. To address the needs of underserved areas, some medical schools choose to include rural residency requirements in their curriculum (West Virginia Higher Education Policy Commission (WVHEPC), 2015). A 2015 report of West Virginia medical school graduates revealed that physicians were more likely to practice in West Virginia if they completed residency within the state (WVHEPC, 2015). Between 2005-2010, approximately 10% of medical school graduates in West Virginia ended up practicing in a rural West Virginia community (WVHEPC, 2015).

The inclusion of rural residency requirements for medical students and relocation support can aid in the recruitment of physicians to rural areas. Lee and Nichols (2014), however, noted that some physicians miss opportunities to work in rural facilities because they complete residency at an urban location and are presented with opportunities or job offers without being aware of unique opportunities to work in rural communities. The implementation of visa waiver programs and spousal employment programs can also be helpful in recruiting graduates to rural areas, especially for physicians and other primary caregivers (Slack, Cummings, Borrego, Fuller, & Cook, 2002).

The nationwide nursing shortage parallels that of physicians and other primary care providers. According to MacLean et al. (2014), the documented shortage of physicians has influenced the demand for nurses in primary care. The shortage of nurses in rural areas has been further intensified by problems with workforce

maldistribution (MacLean et. al, 2014). Although many nursing graduates of rural education programs seek employment in rural settings, most programs are in urban areas, which further adds to the nursing shortage in rural and underserved communities (MacLean et al., 2014).

Rural communities face unique barriers to higher education and depend upon local colleges to supply the nursing workforce. A doctoral study by Reid (2005) determined that a significant nursing shortage exists in "economically stressed" rural counties. Reid (2005) further discovered that rural health care institutions heavily rely on community and tribal colleges. General barriers, such as transportation and economic issues, make it difficult for rural residents to seek a nursing degree, while a documented shortage of nursing program faculty further exaggerates the workforce shortage (Reid, 2005).

Nursing programs in higher education face serious concerns. According to the American Association of Colleges of Nursing (2017), a shortage of nursing program faculty, difficulty securing clinical site placements, inadequate classroom space, budget constraints, and subpar salary for nurse educators has added to the shortage of nursing graduates. In a qualitative doctoral study that examined the perceptions of program administrators, faculty, and students of a rural nursing program, Hurst (2010) revealed community colleges may not be strategically prepared for future nursing faculty shortages. Hurst (2010) also noted that rural nursing programs had difficulty recruiting nursing faculty due to some of the same issues, such as location and salary, which interfere with many health care institutions' ability to recruit nursing staff. It is also

important for educational programs in nursing to recognize the changing needs of the workforce. The educational needs of nurses at various stages of their career must be addressed, as some nurses may seek advanced degrees for career advancement (Mbemba, Gagnon, Pare, & Cote, 2013). Nursing program recruitment and retention strategies, as well as curriculum and delivery formats, should reflect the needs of both students entering college for the first time, as well as incumbent workers.

Recruitment of individuals from rural communities and rural clinical rotation placements play a role in resolving the rural nursing shortage. Mbemba, Gagnon, Pare, and Cote (2013) found that the use of targeted recruitment and rural exposure during clinical rotations are moderately important in rural retention of nurses. A study by Webster et al. (2010) that examined student perceptions before and after rural clinical rotations found that students developed a more thorough understanding of the unique health care challenges that rural communities face. Webster et al. (2010) noted that, after completing rural clinical rotations, the students had a more positive attitude toward rural health care and became more keenly aware of the unique differences between urban and rural health care. Coyle and Narsavage (2012) reviewed the influence of an interdisciplinary rural rotation on future practice of nursing students. The Coyle and Narsavage (2012) study revealed that 53.6% of nursing students were more interested in rural health after completing a rural rotation. Students who attended a rural high school and had a favorable view of the rural rotation were more likely to practice in a rural community after graduation (Coyle & Narsavage, 2012). The study performed by

Coyle and Narsavage (2012) suggested that nursing programs should focus on curriculum strategies that have the potential to influence rural practice of graduates.

The Shortage of Rural Clinical Laboratory Professionals

The shortage of clinical laboratory professionals, primarily Medical Laboratory Technicians and Medical Laboratory Scientists, is not a new phenomenon. While there is a moderate amount of literature and position papers that address the shortage of clinical laboratory professionals in general, there is an inadequate quantity of literature that specifically addresses those shortages as they affect rural communities. Nolan (2015) stated that data from the 2014 American Society for Clinical Pathology vacancy survey indicated the challenge to meet clinical laboratory workforce needs was "more striking" in rural areas. The clinical laboratory science profession does not have standardized nationwide requirements for personnel licensure and certification. As the shortage of clinical laboratory professionals grows, some rural health care institutions may be forced to hire non-certified, or less qualified, individuals to fill clinical laboratory job vacancies because of a decrease in qualified applicants (Nolan, 2015).

In comparison to health care professions such as nursing, the clinical laboratory employees a minimal number of MLTs and MLSs. According to Bennett et al. (2014), "unlike nursing and other professions that use patient ratios, the development of a sound staffing formula for medical laboratories remains elusive because of the varied and complex nature of the tasks laboratory professionals perform" (p. 4). In some rural areas, the loss of just one MLT or MLS could result in the inability to staff the clinical

laboratory at all times, or possibly even closure of the laboratory all together (Fonkert, 2005).

The overall employment outlook for the clinical laboratory science field is favorable. The Bureau of Labor Statistics (2015) noted that there is an expected 16% increase in MLT and MLS employment positions between 2014 and 2024. This rate of job growth is described as much faster than the average for all occupations (BLS, 2015). An aging population, a general increase in demand for laboratory testing, and utilization of more advanced clinical laboratory testing procedures have increased the demand for Medical Laboratory Technicians and Medical Laboratory Scientists (BLS, 2015).

The job market for Medical Laboratory Technicians and Medical Laboratory Scientists looks promising; however, the looming shortage of qualified clinical laboratory professionals has become a focus for political action groups within the profession. In a 2017 position paper to Congress, the American Society for Clinical Laboratory Sciences, Clinical Laboratory Management Association, American Society for Clinical Pathology, American Medical Technologists and Association of Genetic Technologies joined together to urge Congress to enhance efforts to recruit and retain clinical laboratory personnel, authorize funding for clinical laboratory training programs, and "authorize the Government Accountability Organization to study the shortage of clinical laboratory personnel and make recommendations to Congress" (ASCLS, 2017, p. 1). The position paper further stated that in 2016, the Veterans Administration Office of Inspector General reported that Medical Laboratory Technicians and Scientists were

among the top five occupations in critical need in the Veterans Administration health care system (ASCLS, 2017).

Professional societies in clinical laboratory science recognize the influence that the clinical laboratory workforce shortage has on the quality and expediency of medical care and have been proactive in the fight to strengthen the workforce. Hilborne (2008), president of the American Society for Clinical Pathology at the time, stated:

> ASCP is working with the Coordinating Council on the Clinical Laboratory Workforce (CCCLW), a coalition of clinical laboratory organizations, government agencies and industry partners, to examine the situation and determine what the profession as a whole can do. However, we will need the involvement of stakeholders outside the laboratory, including other clinicians, healthcare administrators, legislators and the public, if we are to avert a crisis in our hospitals and waiting rooms. (para 8)

The CCCLW has acknowledged the need to enhance community awareness of the profession, define opportunities for career advancement, improve recruitment and retention strategies, and expand "collaborative and consultative roles for practitioners" (Garrott, 2008, p. 2).

Recruitment, retention, and retirements.

The nationwide shortage of clinical laboratory professionals has been compounded by an inadequate provision of new graduates as compared to demand. The supply of clinical laboratory professionals is dwindling due to a combination of challenges involving recruitment, retention, and pending retirements (Bennett et al., 2014). Data published by the Bureau of Labor Statistics in 2016 indicated that

approximately 12,000 clinical laboratory professionals would be needed per year to meet the increasing demand of the health care sector; however, educational programs are only producing roughly 5,000 graduates per year (ASCLS, n.d.b).

There are numerous elements that lead students to enroll in clinical laboratory science programs. A study conducted by Barfield, Folio, Lam, and Zhang (2011) found that factors such as social influence and career opportunity heavily impacted a student's decision to enroll in an allied health educational program. A research study utilizing focus groups with clinical laboratory science majors and non-majors revealed that students indicated the need for increasing visibility of the profession at both the high school and college levels (McClure, 2009). Focus group participants also indicated that they saw the profession as a "stepping stone to another career field in healthcare or a related field" and that they were not planning to remain in the profession long term (McClure, 2009, p. 1).

The growth of the clinical laboratory workforce is highly dependent upon educational programs, but clinical laboratory managers and staff must also promote the profession to recruit students into the field. Ghazarossian's (2010) study that examined the attitudes of laboratory managers in Southern California toward the clinical laboratory workforce shortage, noted that laboratory managers' attitudes are important when evaluating strategies to recruit students. The clinical laboratory workforce shortage would be amplified if managers fail to view the shortage as a problem, according to Ghazarossian (2010). Surveys were administered to laboratory managers before and after attending a "Shortage Awareness Course" with results that indicated that the course succeeded in raising awareness of the shortage among managers; however,

respondents noted that teaching expectations, in addition to regular job duties, added significant burden to clinical laboratory professionals (Ghazarossian, 2010). This same study revealed that laboratory managers perceived that it was laboratory management's responsibility to educate staff as to the importance of active involvement in clinical education, professional organizations, and activities to promote the profession and recruit students at the local level.

A perceived lack of career opportunity and work environment conditions may be to blame for retention issues in the clinical laboratory. McPherson, Pincus, and Henry (2007, p.5), noted that low salaries, job-related stress, and a high-risk work environment are major issues with recruiting and retaining staff in the clinical laboratory. Ghazarossian (2010) suggested that lower salaries and the high-stress nature of the clinical laboratory science field are two reasons why students often choose other health care professions and current clinical laboratorians choose to leave the field. Linder (2012) stated that many clinical laboratorians indicated a lack of professional development opportunities and low morale as a reason for leaving the clinical laboratory field for other health care careers, such as nursing. Linder (2012) further suggested that a focus on career ladder programs and online curriculum, along with recognition of work experience within the field, may aid in workforce retention. Creating educational pathways for Medical Laboratory Technicians to pursue a Medical Laboratory Science degree, for instance, can create opportunity for career advancement.

Issues with retention of current clinical laboratory professionals have escalated the workforce shortage. A study of 972 Medical Laboratory Scientists indicated that most planned to remain in the profession for a minimum of ten years, but only 26% of

respondents planned to stay in the field for at least 25 years (Beck & Doig, 2007). Retention rates in the clinical laboratory are affected by the perception of a lack of opportunities (McClure, 2009). According to Ghazarossian (2010), a review of the literature indicated that improved work environments, salary increases, additional training programs, and public promotion of the profession are all realistic methods to deal with clinical laboratory staffing shortages, but most importantly "support, participation and active involvement of laboratory managers" (p. 3) will be necessary.

Baby boomer retirements are also a concern, as that population represents a large portion of the current workforce (Garrott, 2008). Passiment (2006) stated that a clinical laboratory workforce survey indicated a median age of 48 years, with most laboratorians noting that the youngest employee in their laboratory was 40 years of age. The 2006 workforce survey further showed that an estimated 25% of the clinical laboratory workforce planned to retire within the next ten years (Passiment, 2006). The ASCP 2015 wage survey of clinical laboratories in the U.S., indicated that the average age of staff MLTs was 40.12 years, MLS was 41.96 years, clinical laboratory supervisors was 48.34 years, and clinical laboratory managers was 55.04 years (Garcia & Fisher, 2017). Bennett, et al. (2014) noted that the projected rates for retirement were higher for clinical laboratory professionals in supervisory positions. The ASCP 2014 vacancy survey revealed that the highest percentage, 23.6%, of employee retirements was expected for clinical chemistry departments, while blood bank departments were expected to suffer from the highest rate of supervisor retirements at 38.46% (Garcia, Ali, Soles, & Lewis, 2015).

Patient safety and public health.

The clinical laboratory workforce shortage has the potential to dramatically effect issues such as patient safety and quality of care. Hilborne (2008), President of the American Society for Clinical Pathology, stated that the clinical laboratory workforce shortage "seriously compromises patient care and safety" (para. 7). The closure of educational programs directly influences the shortage of qualified laboratory professionals and can directly lead to delay in diagnosis and treatment, as well as increased costs to the hospital and patient due to increased length of stay (Enrado, 2009).

Clinical laboratory professionals sometimes inadvertently become a threat to patient safety. According to Astion (2013), burnout due to poor staffing can lead to tiredness and health problems that can lead to the inability to concentrate and thus lead to errors and patient safety concerns. Rothenberg (2016) remarked that staffing shortages and retention issues can lead to increased workload and employee burnout, both of which can result in increased rates of laboratory error. Rogowski, Staiger, and Patrick (2013) made similar suggestions regarding the understaffing of neonatal intensive care units, which they claimed led to higher rates of neonatal nosocomial infection due to an increased workload for nursing.

Clinical laboratory professionals also play a fundamental role in public health. McClure (2008) stated that the lack of qualified laboratory professionals will "impact the quality and efficiency of patient care and impede appropriate actions in response to public health threats, such as emerging infectious disease" (p.2). Many Medical Laboratory Technicians and Medical Laboratory Scientists are employed by public

health laboratories at the state or federal level to perform diagnostic testing and oversee activities for disease surveillance (Perlino, 2006). The shortage of qualified laboratory technicians and scientists, among other health care professions, can lead to public health concerns including natural disasters, new and re-emerging infectious disease, and bioterrorism (Perlino, 2006).

Public health is an area of concern for urban areas, but rural communities face unique public health threats as well. The diversity of the clinical laboratory workforce is an issue in rural areas, where it is often more difficult to attract public health practitioners (Perlino, 2006). Rural and underserved areas are of serious concern for public health because the medical well-being of an individual also greatly impacts the community. To ensure that public health concerns are adequately addressed, especially in rural areas, the recruitment and retention of qualified workers is of paramount importance (Perlino, 2006).

As the technological aspect of clinical laboratory science evolves and changes in the healthcare delivery system place greater emphasis on patient safety, the traditional role of laboratorians will also likely transform. The role of clinical laboratory professionals, specifically those with a bachelor's or MLS degree, is expected to encompass more consultant tasks and multi-discipline teamwork in the future (Ranne, 2009). The MLS will likely be more involved in the evaluation of new diagnostic technologies and performance improvement initiatives regarding proper laboratory test utilization, both of which can help improve patient care and safety by aiding in the reduction of medical errors (Ranne, 2009).

Clinical laboratory science programs.

The shortage of clinical laboratory professionals is well documented. Educational programs, however, find themselves struggling to convince higher education administrators of the grave importance of keeping current programs open, despite low student enrollments. The factors influencing the clinical laboratory workforce shortage include educational program closures, higher education faculty recruitment issues, and competition from other health care fields, such as nursing, that often offer higher salaries (Garrott, 2008). Bennett et al. (2014) stated that "besides our ability to train new medical laboratory professionals, fewer training programs can have profound impact on rural areas, where prospective laboratory practitioners often seek training close to home" (pp. 12-13). According to the American Society for Clinical Laboratory Sciences (ASCLS, n.d.b), the number of accredited programs fell from approximately 1000 in 1970 to 479 in 2015. A 2013 report from the ASCP stated that since 1990, nearly 25% of clinical laboratory training programs had closed (Bennett et al., 2014). Declining student enrollment and high costs associated with laboratory supplies and equipment have influenced higher education institutions to close some programs (Bennett et al., 2014). A lack of available clinical sites has also decreased student enrollments in clinical laboratory science programs. Due to the workforce shortage, many laboratories simply do not have the staff to devote to teaching students during clinical rotations. From the perspective of clinical affiliates, participation as a clinical site is often a burden because there is no funding or reimbursement for labor costs, while the redirection of staff time to teaching responsibilities results in decreased work efficiency and productivity in the clinical setting (Bennett et al., 2014).

The current workforce shortage and concern for a possible deluge of upcoming retirements indicates the need to increase CLS program offerings. When comparing 2014 findings to data from the 2012 ASCP vacancy survey, the demand for laboratory professionals is increasing (Garcia et al., 2015). A stronger economy in conjunction with high retirement rates has increased the need to recruit clinical laboratory students (Garcia et al., 2015). Linder (2012) stated that although there is a need to create new educational programs, clinical laboratory science educators are often faced with resistance from higher education administrators who lack knowledge about the field. CLS programs are high-cost in comparison to many other majors, however, it is important that advocates for new program development or current program continuation stress the positive aspects of the field including comparable pay rates to professions such as nursing, supply and demand issues, employment rates, as well as job stability and outlook (Linder, 2012). Limited availability of clinical rotation placement is also a factor that restricts student enrollment for programs offered by higher education institutions (Bennett et al., 2014).

The field of clinical laboratory science is an ever-changing environment. Significant growth in new testing techniques, especially advanced techniques in molecular and genetic testing, may require increased skill levels, more intense program curriculum, and revisions to the professional scope of practice (Rothenberg, 2016). Education will play a key role in the future of clinical laboratory science as the need for training in molecular techniques increases and more Medical Laboratory Scientists find themselves in consultative roles that aid physicians in evaluation of laboratory testing for diagnosis and therapeutic regimens (Stombler, 2005).

State and federal support for clinical laboratory science training programs is crucial to meeting the workforce demands for clinical laboratory professionals in the current and future health care environment. Allied health training grants approved by congress to fund academic training in the field of clinical laboratory science, as well as public service announcements to promote the profession are vital to the growth of the field (Stombler, 2005). The decrease in allied health training grants signals the need for discussions with representatives in local, state, and federal government (Bennett et al., 2014). The Medical Laboratory Personnel Shortage Act was introduced to Congress in 2001, 2003, and 2005 with the premise of securing scholarship funding and loan repayment programs for clinical laboratory science students in designated areas affected by significant workforce shortages (Stombler, 2005). Professional societies have acknowledged the lack of recognition for the clinical laboratory workforce shortage and looming health care crisis that may result. As stated by Bailey et al. (2013), the ASCP Task Force on the Laboratory Professionals Workforce voiced concern as follows:

> There is little understanding and thereby a lack of resources allocated to the field of laboratory medicine by Congress and federal agencies. Familiar with the plight of physician and nursing shortages, Washington has put funding into training for these healthcare careers but appears to be unaware of what a critical part of the healthcare team the laboratory professional plays and therefore has been unwilling to commit resources to revitalizing and maintaining a highly qualified, adequately staffed laboratory workforce. Throughout the years,

> millions of dollars have been allocated for the training of various health professions. However, training and/or funding for laboratory personnel is virtually nonexistent. (p. 13)

The Higher Education and Rural Health Partnership

To ensure quality health care and address workforce needs, higher education must build strong working relationships with the health care sector. Input from health care partners, often gathered through program advisory committees, can help shape program offerings and ensure that higher education institutions are meeting industry needs. It is crucial that education institutions develop "strategic partnerships" to ensure that the needs of employers are met (Linder, 2012). Advisory committees play a valuable role in program assessment. Hammerling and Van Der Heyden (2011) noted the importance of advisory committees that include a wide range of affiliates "to discuss program and curricular issues." Inclusion of practitioners and health care facility administrators on educational program advisory committees can aid in determining the needs of rural health care institutions. Hilborne (2008) encouraged dialogue between training programs and clinical laboratory practitioners in the field as a means of gauging the needs of the local area.

Higher education institutions must make an effort to build relationships not only with rural health care institutions, but with rural communities as well. Some health care facilities have found that working with higher education institutions can assist in employee recruitment and foster opportunities for career advancement that can benefit both the employee and the health care facility for which they work (Szabo, 2011). It is

also important for educational programs to build strong working relationships with rural communities to ensure that the unique needs of rural health care facilities are met (Gazewood, Rollins, & Galazka, 2006). Higher education institutions and academic health centers can help recruit health professionals to rural areas through the use of targeted admissions, intertwining rural research into program requirements, and creation of curriculum that support and encourage rural practice (Gazewood et al., 2006).

Various factors influence higher education's ability to meet workforce demands in health care. To address current and future needs of the health care system, it is imperative that academic programs offer flexible curriculum formats, accelerated curriculum tracks, and rolling admission (Linder, 2012). Online education is one method of boosting enrollment, while giving students the flexibility that they need with scheduling. The use of online course also makes it easier for those already working in the field to return to college to pursue an advanced degree. Bennett et al. (2014) suggested that using effective recruitment strategies, various curriculum delivery models, and innovative opportunities for clinical rotations can increase the number of clinical laboratory science graduates.

Promotion of the Clinical Laboratory Science Profession

The recruitment of students into clinical laboratory science programs revolves around promotion of the profession. Bennett et al. (2014) suggested that an emphasis should be placed on introducing students to clinical laboratory science careers during or before high school, when students often select their future career. A survey of clinical laboratory professionals, clinical laboratory directors, and program directors of clinical

laboratory science programs revealed that most respondents indicated that their career choice was influenced by a teacher or school counselor (McClure, 2008). According to McClure (2008), 44% of respondents indicated that a high school counselor had influenced their career choice, while 25% indicated that college advisors had influenced their choice to pursue a career in clinical laboratory science. McClure (2008) further noted that respondents indicated a "lack of respect" for clinical laboratory professionals from other members of the health care team and suggested that opportunities, such as high school career days and job fairs, be utilized to increase awareness of the clinical laboratory's role in patient care.

The task of creating a more positive perception of the clinical laboratory science field is multifaceted. A study by Salazar (2017) that examined student perceptions regarding inter-professional education revealed that clinical laboratory science students perceived a lack of respect because other health care disciplines failed to recognize the important role that clinical lab professionals play in patient care. The students in Salazar's (2017) study considered inter-professional education to be a positive step in bridging the gap of understanding between the clinical laboratory and other health professions. Salazar (2017) stated "all participants indicated that other health professions students' attitudes changed for the better when they understood the role of CLS within the healthcare team" (p. 4). Kurec and Wyche (2006) suggested that strengthening communication between nursing and the clinical laboratory can shed a more positive light on the profession, while simultaneously improving patient care. The fight for mandatory professional licensure of all clinical laboratory professionals is one additional step to garnering respect from other health care disciplines (Kurec & Wyche,

2006). Nursing and clinical laboratory professionals should show a mutual respect for the unique skills and expertise that each health care professional brings to the table (Kurec & Wyche, 2006).

The ASCLS has recognized the importance of promotion of the profession and recruitment of students as a major task in strengthening the clinical laboratory workforce. Kaplan and Burgess (2010) suggested that increased visibility of the profession to both K-12 educators and students is needed and can be accomplished through active recruitment at the middle and high school levels. Social media and involvement with healthcare-oriented student organizations, such as the Health Occupations Students of America and the National Youth Leadership Foundation for medicine, can elevate public awareness of the profession while enticing students to pursue a career in the clinical laboratory (Kaplan and Burgess, 2010).

"Pipeline" Programs

Recent emphasis on Science, Technology, Engineering and Mathematics (STEM) education may be helpful in recruiting students into health care professions. According to the U.S. Department of Labor (2007), significant growth in the health care industry represents a need for STEM curriculum in K-12 schools. The mastery of skills required by health professionals is highly dependent on primary education in STEM fields (United States Department of Labor, 2007).

STEM education can be used as a pipeline to many health professions, including clinical laboratory science. Rothenberg (2016) noted that the use of STEM curriculum as a pipeline for recruitment into clinical laboratory science programs can be

advantageous. Rothenberg (2016) also noted the importance of educating high school counselors and teachers about the important role that clinical laboratory science plays in health care as a means of raising awareness and promoting the profession. The targeting of students with an interest in science, especially those in STEM curriculum, can be an advantageous recruitment tool for clinical laboratory science programs, which require a highly technical curriculum with an emphasis on biology, anatomy, physiology, chemistry, and mathematics (Bennett et al., 2014).

The state of West Virginia has developed programs to address the issue of an aging rural health care workforce. The WV Rural Health Initiative was implemented with the primary goal of increasing recruitment and retention of health care providers in rural areas of the state (WVHEPC, 2015). The development of “pipeline programs” that spark student interest in rural health care and actively involve rural health facilities and communities in the education of future health care professionals is one recruitment method that can be utilized (WVHEPC, 2015). The West Virginia Rural Health Association (2015) noted the role of higher education institutions in ensuring stability in the rural health care workforce, expressing the importance of investment in pipeline programs and health career programs, such as summer camps and job-shadowing, to draw students to health care professions.

WV utilizes a variety of outreach activities to recruit students into health care professions, including health career days at middle and high school events, aid including scholarships and housing vouchers, inter-professional learning communities, and continuing education courses and conferences (WVHEPC, 2015). Special efforts, including rural student mentor programs and presentations on the importance of rural

health and workforce supply and demand, have been made to attract students to pursue health care careers in rural practice (WVHEPC, 2015).

Student organizations and science-based academies can also be used to raise student awareness of health care career options. Science academies, such as the Health Sciences and Technology Academy (HSTA), introduce students to various career paths within health care (WVHEPC, 2015). Student organizations, including the Health Occupations Students of America (HOSA), give students the opportunity to learn leadership and practical skills applicable to the health care field. A research study involving middle school students at a Kentucky "summer health camp" revealed that students identified the "perception of need of physicians" as an influence on their aspirations to become a health care professional (Anderson et al., 2009). The Kentucky study suggested that more effort should be made to "increase the aspirations" of rural students (Anderson et al., 2009).

Targeted Recruitment of Students

Higher education institutions should make rural recruitment of students a priority. A research study that examined graduates from twelve health professions programs, including clinical laboratory science, at a higher education institution in New Mexico suggested a link between recruitment of students from rural areas and their choice to practice in rural settings after graduation (Daniels et al., 2007). Students who grow up in rural areas have a unique understanding of the "way of life" and the health care needs of rural communities (Daniels et al., 2007). Factors linked to rural practice included the completion of a rural clinical rotation or residency, financial aid or loan forgiveness linked to health professional service in a rural area, the "desire to work in a

smaller community," and the adequate availability of opportunities for professional advancement (Daniels et al., 2007). It is critical that rural communities and educational institutions work together to create outreach programs that "attract rural students" (Daniels et al., 2007).

Targeted recruitment of rural students can help strengthen the rural health workforce. Slack, Cummings, Borrego, Fuller, and Cook (2002) noted that identifying students with a specific interest in rural practice and targeting rural students in recruitment initiatives can increase the likelihood of future rural practice. Slack et al. (2002) further stated "rural rotation programs seem necessary, but not sufficient, to promote practice in rural communities" (p. 9). Previous residence in a rural area and rural clinical rotation requirements may both influence the choice to practice in a rural location, but procedures should be utilized to combat the feeling of isolation that some rural health care students and professionals experience (Slack et al., 2002). It is also important to encourage student involvement in rural health organizations and professional conferences (Slack et al., 2002).

"Rural Tracks" and Clinical Rotations

To encourage rural practice after graduation, many medical schools and health professions programs include rural "tracks" or clinical rotations in their curriculum. The Rural Health Research and Policy Centers (2009) suggested that nursing programs should use rural clinical rotations and "rural relevant" curriculum to address the rural shortage of registered nurses. Rural training tracks have also been utilized in health professions such as dentistry (Rural Health Research and Policy Centers, 2009).

The West Virginia Rural Health Initiative is one strategy for the identification of students interested in rural practice. Under the WV Rural Health Initiative, some higher education institutions offer specialized training to better prepare students for rural practice (WVHEPC, 2015). Some WV medical schools use tools, including requirements for rural health research projects and rural clinical assignments, to better prepare students to work in rural communities (WVHEPC, 2015). Szabo (2011) noted that it can be helpful for colleges to offer students from metropolitan areas the opportunity to do clinical rotations at a rural location as a means of exposing them to a new environment that they may find desirable for future employment.

Interdisciplinary training programs can also be useful in the recruitment and retention of medical professions in rural communities. Slack et al. (2002) examined the use of rural interdisciplinary training involving multiple health professions, including clinical laboratory sciences. Interdisciplinary training programs in rural areas, including North Carolina and New Mexico, highlighted the unique opportunities involved with both rural clinical rotations and interdisciplinary work. Tasks including rural community-based research, as well as involvement in community activities that address rural health issues, not only gave students a better understanding of the unique struggles that rural communities face regarding chronic disease and health disparities, but it increased the student's knowledge far beyond that needed to provide direct care to patients (Slack et al., 2002).

Online Education in Clinical Laboratory Science

Online education has been incorporated into many health professions programs, including MLT and MLS curriculum. Educational programs are pressured to increase

program enrollment while faced with the issue of decreased funding (Russell et al., 2007). Several clinical laboratory science programs have adopted online or blended curriculum due to institutional pressure to increase both class sizes and cost-effectiveness (Freeman, 2010). Leaders in the clinical laboratory science field have noted that the availability of training programs, specifically those that offer options for distance education, is pivotal to ensuring the growth, stability, and quality of the clinical laboratory workforce (Bennett et al., 2014).

Blended and online courses have many benefits but may be limited in their application in clinical laboratory science programs. Courses having an online component are more convenient for students with long commutes and can also be useful for communication and instruction of students completing clinical rotations at distant locations (McCown, 2010). Blended, or partially online, courses are more frequently used in clinical laboratory science programs, primarily due to laboratory sessions that are “best done face-to-face” due to the nature of clinical laboratory procedures and the need for hands-on training (McCown, 2010).

Online courses can dramatically increase the number of students enrolled in a program, however, there are some disadvantages. One downside to online and blended courses is technical problems as they relate to internet issues and platforms that are not user friendly (McCown, 2010). Instructors should recognize the possibility that technical problems may prohibit a student’s performance, especially those students who reside in rural areas. Access to broadband internet used for online course access can be an issue for rural students. More than half of the residents in rural areas of the United States lack access to broadband internet that meets current benchmark

standards (Federal Communications Commission, 2015). Academic integrity, including cheating and plagiarism, is also an issue with online courses (Conway-Klaassen & Keil, 2010).

Limited research studies have examined the use of online courses in MLT or MLS programs. A comparative research study of MLT students that examined certification first-time pass rates of traditional and online students found that online students were just as prepared as those who attended live courses on campus (Hansen-Suchy, 2011). The study looked at 2007-2009 certification pass rates for 75 on-campus MLT students and 32 online students, as well as a cohort group of 82 students who attended on-campus classes and 28 online students (Hansen-Suchy, 2011). The study further revealed that MLT students completing an online program are just as prepared to enter the workforce as are MLT students completing on-campus courses. Another study that compared the academic performance, GPA, and certification exam scores, of 155 students, 113 on-campus and 42 online, showed that online students were “as academically prepared as their on-campus counterparts” (Russell et al., 2007).

CHAPTER THREE: METHODS

Faced with a nationwide shortage of Medical Laboratory Technicians and Medical Laboratory Scientists, clinical laboratories are highly dependent upon higher education institutions to ensure the stability and sustainability of the clinical laboratory workforce. An increased emphasis has been placed on the mission and service statements of higher education institutions (HLC, 2017). Congress is also holding higher education institutions more accountable for assessment measures, including job placement (HLC, 2016). The partnership between higher education and rural clinical laboratories is paramount in assuring the availability of clinical laboratory services and quality medical care in rural communities. As MLT and MLS programs accredited by the National Accrediting Agency for Clinical Laboratory Science (2016) are faced with increasingly stringent benchmarks for certification pass rates and job placement, higher education institutions must work closely with health care affiliates to ensure that employer needs are met. This is particularly important in states that require professional licensure of clinical laboratory practitioners, where rural areas may face an up-hill battle to find qualified job candidates.

The purpose of this research study was to examine the perceptions of rural clinical laboratory managers toward higher education's response to the shortage of Medical Laboratory Technicians and Medical Laboratory Scientists. This study investigated to what extent Medical Laboratory Technician (MLT) and Medical Laboratory Science (MLS) programs meet the staffing and professional development needs of clinical laboratories in rural communities. The research added to the limited

literature in the clinical laboratory science field by addressing workforce issues specific to rural clinical laboratories. Data collected in this study will be useful for states seeking clinical laboratory personnel licensure, as well as higher education institutions considering the addition, expansion, or closure of clinical laboratory science programs.

Research Questions

This study addressed the following research questions:

1. What formal relationships, if any, exist between rural clinical laboratories and MLT/ MLS programs?
2. To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?
3. To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

Research Design

This research study incorporated a mixed methods approach to data collection. As stated by Saldana (2011) “mixed methods research utilizes a strategic and purposeful combination of both qualitative and quantitative data collection and analysis” (p. 10). Saldana (2011) further indicated that mixed methods “can work in concert to corroborate or more robustly support the findings, or to reveal complimentary or even contradictory outcomes” (p. 10). A survey tool and face-to-face interviews were used to examine the research problem. The use of mixed methods allowed for a deeper assessment of MLT and MLS program partnerships with rural communities and health

care institutions, as well as clinical laboratory manager perspectives regarding MLT and MLS program response to rural workforce shortages.

A nationwide survey of MLT and MLS program directors was utilized to determine the extent to which educational programs partner with rural healthcare institutions regarding clinical rotation assignment, employee recruitment, and professional development opportunities for current employees. The use of survey methods gives a researcher the ability to perform a causal-comparative analysis of groups (Creswell, 2014, p. 12). Survey data allowed for the comparison of findings between educational programs located in rural and urban areas, as well MLT and MLS programs. The online survey was created using Qualtrics software and delivered via email. The survey remained open for a period of six weeks, with reminders sent to all invited participants during weeks two and four.

The qualitative portion of the study incorporated a phenomenological approach to research. Bogdan and Biklen (2007, p. 274) recognized phenomenological studies as those in which the researcher focuses on a research subject's point of view. According to Tong, Sainsbury, and Craig (2007), a theoretical framework of phenomenology is used "to describe the meaning and significance of experiences" (p.3). The use of semi-structured interviews allowed for the determination of clinical laboratory manager perceptions of higher education's response to the rural shortage of Medical Laboratory Technicians and Medical Laboratory Scientists. The inclusion of open-ended questions gave the researcher a general understanding of the topic, while probing questions were used to encourage more detailed responses (Bogdan & Biklen, 2007, pp. 104-105).

Population and Sample

This study examined two populations: MLT and MLS program directors and rural clinical laboratory managers. Both groups were asked similar questions as a means of comparing the perspectives of higher education institutions and rural clinical laboratories. Insight from MLT and MLS program directors was derived using survey methods, while rural laboratory manager perceptions were extracted with face-to-face interviews.

Quantitative Research Sample

A survey of directors from National Accrediting Agency for Clinical Laboratory Science (NAACLS) accredited MLT and MLS programs was conducted. The American Society for Clinical Pathology Board of Certification (2017) recognizes graduation from a NAACLS approved program as the primary route for MLT or MLS certification eligibility. The selection of only directors of NAACLS accredited programs, therefore, coincides with the education requirements set forth for MLT and MLS staff positions in clinical laboratories that prefer or require employee certification as a term of employment. Contact information for directors of all NAACLS approved programs was manually retrieved from the NAACLS website. Directors of MLT and MLS programs offered by higher education institutions and hospital-based programs were included in this study; however, military based programs were excluded.

Program directors are typically responsible for securing and approving clinical affiliation agreements, determination of advisory committee membership, and reporting of graduate certification and employment statistics to the NAACLS. It is also the responsibility of program directors to assess and create strategies for student

recruitment and retention. Therefore, program directors were best suited to answer the survey questions for the quantitative portion of this study.

Qualitative Research Sample

The qualitative portion of this study focused on the findings from interviews of 10 clinical laboratory managers from rural health care institutions in West Virginia (WV). Guest et al. (2006) stated that as few as six interviews can result in data saturation when a small sample population is available. Creswell (2014, p. 189) denoted that the acceptable sample size for phenomenological studies ranges from three to ten. A qualitative focus on the state of West Virginia was supported by the findings of Cibrik (2005), Chappell et al. (2007), and the WV Long Term Care Partnership (2010), as described in *Chapter One*.

The director for the West Virginia Office of Laboratory Services was consulted for input regarding the identification of rural laboratories faced with MLT and MLS recruitment and retention issues. Creswell (2014, p. 189) noted that the use of "purposefully selected" research participants is the best method to aid a researcher in understanding a problem. For the purposes of this study, the term "rural" was defined as communities more than forty miles from cities having a population of greater than 25,000. This working definition excluded clinical laboratories within a forty-mile radius of Charleston, Huntington, Parkersburg, Morgantown, and Wheeling, West Virginia.

Data Collection

An online survey was administered to NAACLS accredited MLT and MLS program directors using Qualtrics survey software. For this research, the following

terms were used: “urban” was defined as an area having a population of greater than 50,000; “somewhat urban” was defined as an area having a population between 25,000 and 50,000; “rural” was defined as areas > 40 miles from cities having a population of >25,000.

The qualitative portion of this research study involved semi-structured interviews of clinical laboratory managers. Tong et al. (2007) stated “in-depth and semi-structured interviews explore the experiences of participants and the meanings they attribute to them” (p. 3). Interviews were conducted in a face-to-face format and lasted an average of 45 minutes to one hour.

Open-ended questions were supplemented with probing questions as the researcher deemed necessary to fully understand the interviewees’ perception and viewpoint. All interviews were audiotaped and manually transcribed by the researcher. Field notes were recorded as a supplemental data record. Health care institution characteristics, including general geographic location and facility descriptions, were also recorded for data comparison purposes. The Tong et al. (2007) checklist for interviews and focus groups was utilized as a general procedural guide (p. 4).

Data Analysis

Survey results were analyzed using IBM SPSS Statistics Version 22.0. Descriptive and correlational statistics were used to summarize data collected by survey methods. Correlation studies were utilized to examine the difference in response between geographical location of higher education institutions, as well as the type of

program offered. Analysis also evaluated the variation of responses between MLT and MLS programs at community colleges, four-year colleges, and universities.

Recordings from interview sessions were transcribed and reviewed for accuracy. Transcribed data was then coded to identify common elements among interview question responses. Data categories and qualitative themes were derived through manual review of coding. Triangulation methods were used to compare and combine qualitative findings with those of the quantitative portion of the study. Bogdan and Biklen (2007, pp. 115-116) described triangulation as the gathering of data from multiple sources to increase understanding of a research phenomenon.

Validity and Reliability

Both the survey and interview questions were examined for validity and reliability. Quantitative studies have three aspects of validity; including content, criterion, and construct, each of which play an important role in research (Muijs, 2004, pp. 66-70). A research instrument must demonstrate all three aspects of validity to be considered valid (Muijs, 2004, pp. 66-70). To ensure the validity and reliability of the survey questions for MLT and MLS program directors, three educators within the clinical laboratory science field were asked to review the questions and suggest revisions. Two survey questions were restated for clarity. Interview questions were validated by review of three clinical laboratory managers, with one minor recommendation involving collection of demographic data.

Limitations

Access to the health care facilities represented a significant limitation of this research study. Thirteen rural laboratories were invited to participate in the qualitative portion of this study, while only 10 facilities granted access for face-to-face interviews of clinical laboratory managers. The ability to obtain current and accurate contact information for program directors also represented a research limitation, as NAACLS records are not continuously updated. Twenty-six survey invitations were returned to the researcher as undeliverable emails, either as the result of inaccurate information available from the NAACLS website or institutional email filters that blocked delivery to potential survey participants.

CHAPTER FOUR: ANALYSIS OF FINDINGS

This research study examined the extent to which higher education institutions address the employment needs of rural clinical laboratories using non-experimental descriptive methods with correlational analyses where appropriate. To gain a better understanding of the relationship between Medical Laboratory Technician (MLT) and Medical Laboratory Science (MLS) programs and rural clinical laboratories, a mixed-method framework was utilized. Both an online survey of MLT and MLS program directors and face-to-face interviews with 10 clinical laboratory managers of rural hospitals were conducted. The decision to conduct research with both groups allowed for valuable input on the research topic from both higher education institutions and employers. The survey instrument and interview questions were devised to address the following research questions which focused on determining the extent to which higher education institutions are meeting the employment needs of rural clinical laboratories:

1. What formal relationships, if any, exist between rural clinical laboratories and MLT/MLS programs?
2. To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?
3. To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

Quantitative data were collected using an online survey instrument created with Qualtrics software, as shown in Appendix C. The survey link was distributed to the research population, MLT and MLS program directors of National Accrediting Agency for Clinical Laboratory Science (NAACLS) accredited programs, via email and remained open for a period of six weeks. Reminders were sent to all invited participants at weeks two and four of the survey availability window. Descriptive and correlational statistics for the survey data were derived using IBM SPSS Statistics Version 22.0. Although the survey consisted primarily of objective questions, two open-ended questions were included to derive common methods of rural student recruitment, as well as general concerns regarding higher education's response to the shortage of MLTs and MLSs in rural areas and general observations regarding the employment needs of rural clinical laboratories. According to Bogdan and Biklen (2007, p. 3), the use of open-ended questions allows research participants to share detailed perspective "using their own frame of reference."

The qualitative portion of the study involved face-to-face interviews with laboratory managers of 10 rural clinical laboratories. The interview questions addressed the same topics as the survey of program directors, allowing for comparison of perceptions between the two groups. The choice to conduct face-to-face interviews was purposeful in that it allowed the researcher to connect on a personal level with each laboratory manager with the hope of putting participants more at ease with the research process, and thus increasing the richness of participant feedback. An outline of the structured interview question set is available in Appendix F.

Creswell (2014, pp. 197-201) outlined a six-step approach to qualitative data analysis: preparation and organization of data, review of data, categorization and coding of data, generation of setting descriptions and identification of themes, determination of appropriate method of presentation for research findings, and interpretation. All research interviews were manually transcribed and then analyzed using Creswell's qualitative approach. Qualitative findings from program director surveys were also analyzed using this same technique. Manual coding methods were utilized for the data analysis of all qualitative findings in this study. Once the data were coded, it was further organized into categories to allow for identification of common themes.

Quantitative and qualitative findings from both program director surveys and clinical laboratory manager interviews are addressed conjointly in this chapter in relation to each of the stated research questions. For each of the three research questions, a discussion of quantitative findings from the survey is followed with relevant qualitative findings arranged categorically. Emerging themes, both similar and contrasting, are then identified to aid in the overall conclusion of the findings.

Population and Sample

The research population for this mixed-method study included two groups: Directors of NAACLS accredited MLT and MLS programs and clinical laboratory managers of rural hospitals. A nationwide sample of MLT and MLS program directors participated in the survey. The qualitative portion of this study focused on a sample of

clinical laboratory managers in West Virginia, a primarily rural state which also requires state licensure of clinical laboratory practitioners.

Program Directors

The survey portion of this research study focused on MLT and MLS program directors of NAACLS accredited programs. A list of NAACLS approved programs and program director contact information was readily available on the NAACLS website. Program director email addresses were manually retrieved from the NAACLS website. Since this research focused on higher education institutions, MLT and MLS programs at military institutions were excluded from participation. A total of 455 program directors were invited to participate in the research survey via email. Twenty-six of those emails were returned as undeliverable, resulting in a total of 429 successfully delivered invitations to participate. A total of 167 MLT and MLS program directors from across the United States participated in the survey, yielding a final survey response rate of 39%. A breakdown of participation by state is available in Appendix G.

As depicted in Table 1, more than three-fourths of respondents represented community and technical colleges and universities. The number of respondents representing community and technical colleges was slightly higher than universities. No presumptions as to institution type were made when compiling the list of NAACLS accredited programs, therefore, hospital-based programs were also included in the study.

Table 1

Demographics: Type of Higher Education Institutions Represented

Type of Higher Education Institution	*n*	Percentage of Respondents
Community and Technical College	73	43.71%
Predominately Four-Year College	10	5.99%
University	60	35.93%
Hospital-Based Program	24	14.37%
Total	167	

In addition to the type of institution represented and type of program offered, respondents were asked to identify the geographical location of their institution. For this research study, the terms “urban,” “somewhat urban,” and “rural” were defined by the researcher as indicated by the general note on Table 2. More than half of the respondents indicated that their institution was in an urban area, while less than one-third were in a somewhat urban area. The fewest number of respondents represented institutions located in rural areas.

Table 2

Demographics: Geographical Location of Higher Education Institutions Represented

Location	*n*	Percentage of Respondents
Urban	96	57.49%
Somewhat Urban	47	28.14%
Rural	24	14.37%

Note. Urban refers to areas with a population of greater than 50,000. Somewhat Urban refers to areas with a population between 25,000-50,000. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Survey respondents were asked to indicate whether they offered MLT and/or MLS programs at their institution. As shown in Table 3, the number of respondents offering MLT and MLS programs were nearly equally distributed. Slightly more representation of MLS programs was noted.

Table 3

Demographics: Clinical Laboratory Science Programs Offered at Higher Education Institutions Represented

Program Type	*n*	Percentage of Respondents
MLT	72	43.11%
MLS	83	49.70%
MLT and MLS	12	7.19%

Rural Clinical Laboratories

The qualitative portion of this study examined the perspective of clinical laboratory managers regarding the response of higher education institutions to the clinical laboratory workforce shortage. Laboratory managers were chosen as the population for this research study due to their in-depth knowledge of hiring practices and staffing needs in rural clinical laboratories. A sample of 10 clinical laboratory managers from rural West Virginia were interviewed. Input from the Director of the West Virginia Office of Laboratory Services was sought when identifying perspective facilities to participate in the study. Using the same definition of the term "rural" that was used for the program director surveys, only clinical laboratories in hospitals located greater than 40 miles from cities having a population of 25,000 or greater were included in the study.

Once potential sites were identified, each hospital laboratory was contacted by phone to compile contact information for each laboratory manager. A total of 13 laboratory managers were initially invited to participate in the study, while only 10 completed the necessary paperwork granting facility access as required for Institutional Review Board (IRB) approval. Once final IRB approval was granted, the laboratory managers were once again contacted to arrange a date and time for the interview. Rimando et al. (2015) recognized researcher fatigue as a primary challenge in qualitative data collection and suggested that the number of interviews conducted daily should be limited. For this study, a maximum of two interviews were conducted per day to ensure that the researcher remained focused and maintained the ability to effectively engage interview participants.

The type of institutions included in the interview portion of this study are depicted in Table 4. Five out of 10 of the hospitals included in the study held critical access designation and were licensed for 25 or fewer beds. Four of the hospitals were licensed for between 70-105 beds, while one hospital was licensed for 200 beds. All hospitals in the study primarily served patients from three to five surrounding counties and all laboratory managers indicated a primarily elderly patient population with a payer mix that included between 65-80% Medicare and Medicaid recipients. Seven out of 10 laboratory managers indicated that the local economy was highly dependent on coal mining. They also noted that the elimination of many coal mining jobs in recent years had resulted in both a significant population decline and a prominent decrease in the number of beds for which their facility was licensed. When asked about the impact of coal mine closures on the local economy, one laboratory manager stated “the coal mines shut down and once that happened we did see a lot of people leave here. They’ve shutdown two of the closest ones. It’s sad to watch that.” When asked the same question, a second laboratory manager noted, “the economy has been very, very rough since all the mines closed down. We’ve seen a lot of people move out of the area. We’ve seen a big increase in drug use.”

Table 4

Demographics: Primary Hospital Designation as Indicated by Laboratory Manager

Hospital Designation	*n*	Percentage of Interview Participants
Critical Access	5	50%
Non-profit Community	3	30%
Corporate Owned	1	10%
Trauma Center	1	10%

Findings

Each research question was analyzed individually through examination of both survey and interview findings. Interview questions used in the qualitative portion of this study closely mirrored those in the program director survey, allowing for comparison of data from both groups. For each research question, statistical analysis of survey data is followed with a discussion of relevant qualitative findings.

Creswell (2014, pp. 197-201) suggested a six-step approach to analyzing qualitative data. As previously outlined, interview data and responses to open-ended survey questions were categorized under each research question. Cross-themes between MLT/MLS program directors and rural clinical laboratory managers were also identified as they related to overall qualitative findings and are discussed at the end of this chapter.

RQ1: What formal relationships, if any, exist between rural clinical laboratories and MLT/ MLS programs?

The first research question was designed to determine what, if any, formal relationships existed between rural clinical laboratories and MLT and MLS programs. The program director survey identified the frequency of rural clinical site utilization by MLT and MLS programs and examined the correlation between use of rural clinical sites and various institutional characteristics, including the geographical location and type of higher education institution, as well as the level of programs offered. The survey also included a question used to identify the frequency with which MLT and MLS programs include rural hospital representatives on program advisory committees.

Interviews with laboratory managers examined the relationships between higher education institutions and rural clinical laboratories. Laboratory managers were asked questions regarding past and current clinical affiliation agreements, willingness to accept students for clinical rotations, barriers to participation in clinical rotations and training of MLT and MLS students, as well as inclusion on program advisory committees. Three categories of qualitative findings emerged from the data related to the first research question: barriers, environment, and partnership.

Clinical Affiliations.

Survey respondents were asked to identify the percentage of current clinical sites located in rural areas, as demonstrated in Table 5. Slightly over one-fifth of survey respondents indicated that 50% or more of their current clinical affiliates were in rural areas, as defined for this study. Nearly two-thirds of survey respondents indicated that fewer than 25% of their clinical sites were considered rural.

Table 5

Percentage of Current Clinical Sites Located in Rural Areas

Percentage of Clinical Sites Located in Rural Areas	*n*	Percentage of Respondents
>75% of clinical sites	16	9.58%
50-75% of clinical sites	22	13.17%
25-49% of clinical sites	25	14.97%
<25% of clinical sites	104	62.28%

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

When examining the use of rural clinical sites, survey data clearly identified that rural institutions were more likely to utilize rural clinical sites, as demonstrated in Table 6. Over 70% of higher education institutions located in urban and somewhat urban areas indicated that less than one-fourth of their current clinical affiliates were located in rural areas. Higher education institutions in somewhat urban locations identified a slightly higher use of rural clinical sites in comparison to their urban counterparts.

Table 6

Geographical Location of Higher Education Institution and Percentage of Current Clinical Sites Located in Rural Areas

Location of Higher Education Institution	*n*	Percentage of Clinical Sites Located in Rural Areas			
		<25%	25-49%	50-75%	>75%
Urban	96	70	16	9	1
Somewhat Urban	47	33	7	5	2
Rural	24	1	2	8	13
Total	167				

Note. Urban refers to areas with a population of greater than 50,000. Somewhat Urban refers to areas with a population between 25,000-50,000. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A strong negative correlation, as demonstrated in Table 7, was evidenced between geographical location of the higher education institution and the percentage of rural clinical sites utilized for student rotations. The correlation between geographical location and rural clinical site use suggested that rural higher education institutions are more likely than urban higher education institutions to utilize rural clinical affiliates for student rotations. The correlation further suggested that higher education institutions tend to utilize clinical affiliates within close proximity for student clinical rotations.

Table 7

Bivariate Correlation Between Geographical Location of Higher Education Institution and the Percentage of Current Clinical Sites Located in Rural Areas

	Geographical Location of Higher Education Institution	Percentage of Clinical Sites Located in Rural Areas
Geographical Location of Higher Education Institution	--	-.565**
Percentage of Clinical Sites that Located in Rural Areas	-.565**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Survey data was further delineated to examine the use of rural clinical sites in relation to the type of institution as shown in Table 8. Over half of the respondents representing community and technical colleges, as well as two-thirds of those representing universities, indicated that fewer than 25% of their clinical sites were considered rural. Approximately one-third of community and technical colleges and one-third of predominately four-year colleges, compared to slightly over one-tenth of universities, stated that over 50% of their clinical sites were considered rural. Hospital-based programs, as expected, were the least likely to utilize rural clinical sites with over three-fourths of hospital base programs indicating that fewer than 25% of their clinical affiliates were in rural areas. Considering that most hospital-based MLT and MLS programs are based in larger hospitals or health systems, they are often located in urban areas. Hospital based programs also typically incorporate clinical rotations at their own facility, and, therefore, may have limited clinical affiliates outside of their own institution.

Table 8

Type of Higher Education Institution and Percentage of Clinical Sites Located in Rural Areas

Type of Higher Education Institution	*n*	Percentage of Clinical Sites Located in Rural Areas			
		<25%	25-49%	50-75%	>75%
Community & Technical College	73	37	12	13	11
Predominately Four-Year College	10	5	2	2	1
University	60	42	10	6	2
Hospital-Based Program	24	20	1	1	2
Total	167				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A strong correlation was identified when examining the type of institution and the percentage of rural clinical sites with which programs had clinical affiliation agreements. The correlation, as detailed in Table 9, revealed that there was a significant relationship between the type of institution and use of rural clinical sites. Community and technical colleges and predominately four-year colleges were significantly more likely to establish clinical affiliations with rural hospitals, than were universities.

Table 9

Bivariate Correlation Between Type of Higher Education Institution and the Percentage of Current Clinical Sites Located in Rural Areas

	Type of Institution	Percentage of Current Clinical Sites Considered Rural
Type of Institution	--	.251**
Percentage of Current Clinical Sites Considered Rural	.251**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

The use of rural clinical sites was also examined with regard to program type. The survey data revealed that MLT programs are more likely than MLS programs to utilize rural clinical sites. Table 10 shows that over one-third of MLT programs, and only approximately one-tenth of MLS programs, indicated that at least 50% of their clinical affiliates were in rural areas.

Table 10

Program Type and Percentage of Clinical Sites Located in Rural Areas

		Percentage of Clinical Sites Located in Rural Areas			
Program Type	*n*	<25%	25-49%	50-75%	>75%
MLT	72	35	11	14	12
MLS	83	65	9	6	3
MLT and MLS	12	4	5	2	1
Total	167				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A strong correlation between program type and the utilization of rural clinical affiliates for clinical rotations is demonstrated in Table 11. Statistical analysis suggested that associate degree MLT programs were significantly more likely to use rural clinical sites, than were bachelor's degree MLS programs. This correlation may further be explained by considering the complexity of testing performed in rural clinical laboratories. Requirements for MLS clinical rotations often entail student exposure to high-complexity and advanced methods of clinical laboratory testing, often unavailable in rural laboratories.

Table 11

Bivariate Correlation Between Program Type (MLT or MLS) and the Percentage of Current Clinical Sites Located in Rural Areas

	Program Type (MLT, MLS)	Percentage of Clinical Sites Located in Rural Areas
Program Type (MLT, MLS)	--	.201**
Percentage of Clinical Sites Located in Rural Areas	.201**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Barriers: Clinical affiliation obstacles.

In response to the open-ended survey question, program directors signified that they experience difficulty securing clinical site placement, especially at rural health care facilities. Both Malone (2011) and Scott (2015) described difficulty securing clinical sites as a major concern for MLT and MLS programs. Several of the respondents noted that NAACLS accreditation standards indicate that a program must ensure clinical site

placement for each student accepted into the program. It was often noted that due to the nationwide shortage of laboratory professionals, especially in rural areas, it is very difficult to secure clinical site placement. When staffing levels are already low, training of students can create additional burden on rural laboratory affiliates that are already working with "skeleton crews." Some program directors stated that issues with available housing and accommodations also made it difficult to place students in rural facilities for clinical rotations.

Survey respondents indicated rural clinical laboratories do not always serve the needs of the educational program. Several program directors shared their experience that rural laboratories were not appropriate for MLS clinical rotations. One respondent pointed out that rural laboratories were, "not conducive to a MLS level of education due to the small test menu," while others noted the lack of exposure to advanced instrumentation and methods available to students in a rural laboratory. According to survey responses, microbiology and immunohematology rotations create specific hurdles regarding clinical rotations. As the occurrence of hospital mergers has increased and private laboratories have found a new niche in buyouts of clinical laboratory departments within large hospitals and health systems, outsourcing of certain laboratory testing, such as microbiology, has grown exponentially in the past few years. As a result, rural laboratories are more likely to offer only stat testing in-house and, thus, making it more difficult to justify rural clinical site placement of students. In addition, research findings also revealed that some clinical laboratory programs are now using simulated laboratory sessions to replace traditional clinical rotations for testing that is not often available at clinical sites.

Contradictory to survey responses from program directors, rural laboratory manager interviews revealed an eagerness to participate in the training of students. Interview participants were asked if they have current affiliation agreements for student clinical rotations with MLT and MLS programs. Only one out of 10 laboratory managers stated that they did not have any clinical affiliation agreements to accept MLT or MLS students. Several laboratory managers stated that they had clinical affiliation agreements but that student placement at their location was sporadic. Multiple laboratory managers also noted that it had been several years since they had participated in student clinical rotations, primarily because they had not been approached about taking students for rotations. It is important to note that although nine out of 10 laboratory managers stated that they had affiliation agreements with community and technical colleges, only two of the laboratories had agreements to participate in MLS student rotations. When probed as to why they did not have affiliation agreements with MLS programs, the majority of laboratory managers stated that they would be willing to accept MLS students for rotations, but they had simply not been contacted by MLS programs to create affiliation agreements. One laboratory manager pointed out that accepting students for clinical rotations can be beneficial by forcing those working with the students to stay current with new technology and procedures, stating “I think it would be really good. And it makes you really look at things again when you’ve had the same people for years…I’ve had the same staff for 20 years.”

Similar to quantitative findings from the program director survey, rural laboratory managers acknowledged that there are unique barriers that hinder rural clinical

laboratories from accepting students for clinical rotations. Four of the 10 laboratory managers interviewed indicated that they could only take one student at a time due to concerns with low staffing, deficient time to adequately teach students, as well as productivity standards set forth by hospital administration. The finding that four out of 10 laboratory managers indicated that there were no barriers that hindered them from accepting students for clinical rotations was somewhat unexpected. When asked if they would be likely to hire a student that had completed clinical rotations at their facility, all of the laboratory managers interviewed said that they were very likely to hire students if they had a position available at the time.

Comments from the laboratory managers echoed those from the program director survey regarding suitability of rural laboratories for clinical rotations. While all the hospitals involved in the interview process performed immunohematology (blood bank) testing, the procedures that they performed were limited. Only a few of the hospitals performed antibody identification in-house, which supported comments from the program director survey stating that rural labs were too limited in the testing that they perform to adequately prepare students for the workforce. One laboratory manager stated:

> They [MLT program] contacted me and I said I don't mind at all doing a rotation here, but not the entire rotation. I don't feel that we should do blood bank. That allows the person to come through, see a rural lab...So, I think it's a good thing for them to see, and I realize some students would love the setting and some students would not.

Opposite of current trends with microbiology testing, as noted in the comments of the program director survey, most of the rural laboratories included in the interview portion of this study were performing general microbiology testing in-house. While some only performed urine cultures, at least half indicated that they performed all bacterial cultures in-house.

Environment: Rural labs offer a "unique" perspective.

One category of responses that emerged in the laboratory manager interviews that did not appear in the survey comments of program directors involved the distinct atmosphere of rural laboratories. Several laboratory managers noted that rural clinical rotations can offer a unique perspective on the health care system and that it can open students' eyes to aspects of laboratory medicine that they are unlikely to experience in larger, urban hospitals. One of the laboratory managers had completed a four-week rural hospital rotation as part of her bachelor's degree requirements. After working for many years as a travel tech in several states and at a variety of facilities, including large health systems and Indian Health Service facilities, she returned to West Virginia and began her management career in the same rural hospital where she had performed clinical rotations as a student. Her insight was powerful:

> I will tell you that the reason that I'm sitting here right now, the reason that I got this job I truly believe was the perspective that I could bring from having all that experience, from being in large hospitals, medium sized hospitals, small hospitals, that's what I believe *(sic)*. And I believe that having both, doing

> [rotations in] a large hospital and a rural hospital, definitely *(sic)* brings perspective.

Several other laboratory managers acknowledged the distinct characteristics of rural laboratories in comparison to larger urban laboratories. One of the laboratory managers noted that working in a rural facility can play a role in job satisfaction because MLTs and MLSs have more opportunity to directly interact with the patients and thus, have a positive impact on the "quality of care and customer service they [patients] receive." For individuals that prefer working in all departments of the laboratory, versus specialization in only one or two areas of testing, rural hospitals often offer the ability to work as a generalist, performing testing in all areas of the laboratory. With reference to working as a generalist in a small rural laboratory and seeing the "whole picture" of patient care, one laboratory manager stated, "I think that being in a smaller [lab]…you are better able to piece together things that are happening with the patient."

Some of the laboratory managers also noted a distinct requirement for problem solving and teamwork in rural settings. One laboratory manager stated, "I think rural hospitals do need more skilled people who can think and problem solve because of the fact that *(sic)* you're on your own…I will have to say here that 99% of the providers here listen to us." A second laboratory manager further stressed the importance of teamwork both within the laboratory and with other hospital departments, noting the interaction that routinely takes place between the clinical laboratory, radiology, nursing, and physicians. She discussed teamwork in relation to the important role that rural hospitals play in the community, noting:

> I lived in [this] county when there wasn't a hospital…and people died getting to a larger institution because there was nobody to stabilize them. We save a lot of people by getting them stable and getting them on the road *(sic)*. You know, heart attacks, that sort of thing…that's a long way for a person having chest pain or a delivery.

The laboratory manager interviews also revealed a sense of family among rural hospital employees. One manager remarked "we all work together and we all help each other. It's just like a family." A second manager stated, "I think that there's a lot more a feeling (*sic*) of the [rural] hospital being more of a family unit as opposed to being in a large hospital." Another manager indicated that an emphasis on employee satisfaction keeps many employees from leaving rural facilities for larger hospitals, where they may make more money and have better benefits. She further emphasized the importance of workplace atmosphere by describing a recent student that chose to accept a position at that facility due to the welcoming and family-oriented environment that he experienced during clinical rotations.

Program advisory committees.

A second aspect of establishing the extent of formal relationships between rural clinical laboratories and MLT and MLS programs involved advisory committee participation. Table 12 depicts the percentage of respondents that include rural representatives on advisory committees using a scale of frequently, occasionally, rarely, or never. Over half of the survey respondents indicated that they frequently or occasionally include rural laboratory representatives on their advisory committees. Less

than one-fifth of respondents indicated that they never include rural representatives on their advisory committees.

Table 12

Frequency of Rural Clinical Lab Representation on Program Advisory Committees

Frequency	*n*	Percentage of Respondents
Frequently	71	42.51%
Occasionally	29	17.37%
Rarely	41	24.55%
Never	26	15.57%

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

When examining the inclusion of rural clinical laboratory representation on advisory committees in relation to geographic location of the higher education institution, survey data revealed that more than nine-tenths of rural institutions frequently utilized rural representation on their program advisory boards. Only approximately one-third of urban, and two-fifths of somewhat urban higher education institutions, indicated that they frequently include representatives from rural health care facilities on their advisory boards. Table 13 shows the frequency of rural representation on program advisory committees in relation to geographic location of the MLT or MLS program.

Table 13

Geographical Location of Higher Education Institution and Frequency of Rural Representation on Program Advisory Committee

Location of Higher Education Institution	*n*	Frequency of Rural Representation on Program Advisory Committee			
		Never	Rarely	Occasionally	Frequently
Urban	96	16	34	16	30
Somewhat Urban	47	10	7	11	19
Rural	24	0	0	2	22
Total	167				

Note. Urban refers to areas with a population of greater than 50,000. Somewhat Urban refers to areas with a population between 25,000-50,000. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A strong negative correlation, as evidenced in Table 14, was demonstrated between the geographical location of higher education institutions and the inclusion of rural laboratory representatives on MLT and MLS program advisory committees. Higher education institutions in rural areas were significantly more likely to include rural representation on their clinical advisory committees. This correlation further denotes a significant relationship between geographical location and inclusion of rural representatives on MLT and MLS advisory committees.

Table 14

Bivariate Correlation Between Geographical Location of Higher Education Institution and Frequency of Rural Clinical Lab Representation on Program Advisory Committees

	Geographical Location of Higher Education Institution	Frequency of Rural Clinical Lab Representation on Program Advisory Committees
Geographical Location of Higher Education Institution	--	-.352**
Frequency of Rural Clinical Lab Representation on Program Advisory Committees	-.342**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

More than half of the survey respondents from community and technical colleges and predominately four-year colleges indicated that they frequently include representation from rural hospitals or clinics on their program advisory committee. Representatives from universities indicated that slightly less than one-third of university-based programs frequently include rural representation on their advisory committee. While the data indicated that universities were less likely to include rural representation on a frequent basis, it is notable that approximately one-third of universities indicated that they occasionally include rural representation on MLT and MLS advisory committees, as indicated in Table 15.

Table 15

Type of Higher Education Institution and Frequency of Rural Clinical Lab Representation on Program Advisory Committees

Type of Higher Education Institution	*n*	Frequency of Rural Representation on Program Advisory Committee			
		Never	Rarely	Occasionally	Frequently
Community & Technical College	73	6	18	9	40
Predominately Four-Year College	10	1	3	0	6
University	60	12	12	18	18
Hospital-Based Program	24	7	8	2	7
Total	167				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A strong correlation, as represented in Table 16, was noted when examining the inclusion of rural hospital representatives on advisory committees in comparison to the type of higher education institution. Community colleges were significantly more likely to include rural facility members on MLT and MLS advisory committees on a frequent basis.

Table 16

Bivariate Correlation Between Type of Higher Education Institution and Frequency of Rural Clinical Lab Representation on Program Advisory Committees

	Type of Higher Education Institution	Frequency of Rural Clinical Lab Representation on Program Advisory Committees
Type of Higher Education Institution	--	.246**
Frequency of Rural Clinical Lab Representation on Program Advisory Committees	.246**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

The frequency for inclusion of rural clinical laboratory representatives on MLT and MLS program advisory committees was also determined to vary with the type of programs offered. As displayed in Table 17, over half of survey respondents representing MLT programs indicated that they frequently include representatives from rural facilities on their program advisory committee. Less than one-third of MLS programs indicated frequent inclusion of rural facility representatives on their advisory committee. Nearly half of higher education institutions that offered both an MLT and MLS program included rural representatives on their advisory committee. It was also notable that almost half of MLS programs, in comparison to less than one-third of MLT programs, stated that they rarely or never include rural representatives on their advisory committees.

Table 17

Program Type and Frequency of Rural Clinical Lab Representation on Program Advisory Committees

Program Type	*n*	Frequency of Rural Representation on Program Advisory Committee			
		Never	Rarely	Occasionally	Frequently
MLT	72	6	17	9	40
MLS	83	19	22	16	26
MLT and MLS	12	1	2	4	5
Total	167				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A moderate correlation, as shown in Table 18, was notable when the type of programs offered was examined in relation to the frequency of rural clinical laboratory representation on program advisory committees. The data further confirmed that MLT programs, and institutions offering both MLT and MLS programs, were significantly more likely to include rural representatives on their advisory committee than were MLS programs.

Table 18

Bivariate Correlation Between Program Type and Frequency of Rural Clinical Lab Representation on Program Advisory Committees

	Program Type (MLT or MLS)	Frequency of Rural Clinical Lab Representation on Program Advisory Committees
Program Type (MLT or MLS)	--	.155*
Frequency of Rural Clinical Lab Representation on Program Advisory Committees	.155*	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
*Correlation is significant at the 0.05 level (two-tailed)

Partnership: Advisory committee participation.

Qualitative data for the first research question revealed a third category of findings. Partnership between MLT and MLS programs and rural clinical laboratories largely depended on advisory committee participation. Six out of 10 laboratory managers indicated that they were members of at least one MLT program advisory committee, while one laboratory manager was a member of both MLT and MLS program advisory committees. Three out of 10 laboratory managers were not members of any MLT or MLS advisory committee. Linder (2012) and Hilborne (2008) noted the importance of forging partnerships between educational programs and clinical laboratories as a means of gauging employer needs. It is important to point out that while participation in MLT advisory committees was evident in this study, there was a glaring deficiency in MLS advisory committee participation.

Three of the laboratories involved in the interviews demonstrated optimism in filling future staff vacancies because a new MLT program was recently established within a reasonable distance from their facility. That program had not yet achieved NAACLS accreditation at the time of this research study, however, their first group of students had recently completed clinical rotations. Hammerling and Van Der Heyden (2011) noted the importance of advisory committee engagement regarding program issues. Four of the 10 laboratory managers participating in this study indicated that they had been asked to serve on the advisory committee for the new MLT program. When asked if they had a connection with any programs prior to that newly created MLT program, one manager stated "We had nothing. We had nothing at all." One other laboratory manager also commented on the program director of the new MLT program stating, "I feel like she reaches out a lot, but I've never officially met her. It would be nice, since I'm on the advisory committee, for her to make a point to visit and introduce herself."

RQ2: To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?

Program directors and rural laboratory managers were asked a series of questions to determine the extent to which MLT and MLS programs are meeting the staffing needs of rural clinical laboratories. Issues including graduate employment rates at rural facilities, targeted recruitment efforts, MLT and MLS program availability, and workforce supply and demand were examined. This research question yielded an extensive amount of qualitative data from both program directors and rural laboratory managers, for which several categories were identified.

The final question of the online survey of program directors asked what specific concerns, if any, they had regarding higher education's response to the shortage of MLTs and MLSs in rural areas. The question also asked that they note any observations regarding the employment needs of clinical laboratories in rural areas. Seventy-seven responses were received for the open-ended question. Bennett et al. (2014) noted that a lack of MLT and MLS programs may influence the ability of rural clinical laboratories to find qualified laboratory professionals, while a study by Slagle (2013) revealed that rural clinical laboratories in Tennessee heavily relied on community and technical colleges for employee recruitment. The program director responses to the open-ended question, and related to the second research question, were divided into two primary categories: workforce demand and quality of patient care, as well as student recruitment and program survival.

During the interview process, laboratory managers were asked a series of questions to gauge the extent to which rural clinical laboratories struggle to find qualified MLTs and MLSs, as well as barriers to employee recruitment. Simple employee demographics were collected to examine the need for MLTs and MLSs separately. The managers were also asked if they were aware of any higher education institutions that actively recruited students in their area and what they felt that higher education institutions could do to aid in the fight to secure qualified staffing and ensure an adequate clinical laboratory workforce. Four categories emerged upon review of laboratory manager interview data relating to the second research question: workforce management, employee recruitment barriers, communication and engagement, and concern for the future of rural laboratories. The categories reflected the literature,

particularly regarding barriers to recruitment of health care professionals to rural areas, as addressed by Szabo (2011) and Lindsay (2007), and future concern for clinical laboratories, as noted by Cibrik (2005), ASCLS (2017), Hilborne (2008), Garrott (2008), and McClure (2008).

Graduate employment at rural facilities.

After collecting demographic information from each survey respondent, program directors were asked to approximate the percentage of their program graduates that work at a rural facility. Less than one-fifth of respondents indicated that at least 50% of their graduates obtain employment at rural facilities. More than two-thirds of respondents indicated that fewer than 25% of program graduates work at a rural facility, as depicted in Table 19.

Table 19

Percentage of Program Graduates Working at a Rural Facility

Percentage of Graduates Working at Rural Facility	*n*	Percentage of Respondents
>75% of graduates	15	8.98%
50-75% of graduates	14	8.38%
25-49% of graduates	24	14.37%
<25% of graduates	114	68.26%

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

The percentage of program graduates was then examined in comparison to the geographical location of higher education institutions, as shown in Table 20. Half of the rural higher education institutions participating in the study indicated that 75% of their graduates work at rural facilities, while three-fourths of rural institutions indicated that at least half of their program graduates gained employment at a rural health care facility. This was starkly different from the data for urban institutions, which revealed that over three-fourths of both urban and somewhat urban higher education institutions have a rural graduate job placement rate of less than 25%.

Table 20

Geographical Location of Higher Education Institution and Percentage of Program Graduates Working at Rural Facility

		Percentage of Graduates Working at Rural Facility			
Location of Higher Education Institution	*n*	<25%	25-49%	50-75%	>75%
Urban	96	77	15	3	1
Somewhat Urban	47	36	5	4	2
Rural	24	1	4	7	12
Total	167				

Note. Urban refers to areas with a population of greater than 50,000. Somewhat Urban refers to areas with a population between 25,000-50,000. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Table 21 demonstrates a strong negative correlation between the geographical location of higher education institutions and job placement of MLT and MLS graduates at rural health care facilities. This strong correlation indicated that rural higher

education institutions were significantly more likely to serve the employment needs of rural clinical laboratories than were urban or somewhat urban institutions of higher education. This correlation also supported the finding in *Research Question One* that revealed that rural higher education institutions are more likely to have formal relationships with rural clinical laboratories.

Table 21

Bivariate Correlation Between Geographical Location of Higher Education Institution and Percentage of Program Graduates Working at Rural Facility

	Geographical Location of Higher Education Institution	Percentage of Program Graduates Working at Rural Facility
Geographical Location of Higher Education Institution	--	-.605**
Percentage of Program Graduates Working at Rural Facility	-.605**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

The reported percentage of graduates working in rural facilities was also compared between types of higher education institutions, as shown in Table 22. More than one-fourth of community and technical colleges indicated that at least 50% of their graduates work at rural healthcare facilities. In comparison, less than one-tenth of universities indicated that at least 50% of graduates obtain employment in rural areas. Only one-fifth of predominately four-year colleges indicated rural job placement of graduates at 50% or higher. Nearly all hospital-based programs, as expected, indicated that less than one-fourth of their graduates work in rural areas.

Table 22

Type of Higher Education Institution and Percentage of Program Graduates Working at Rural Facility

Type of Higher Education Institution	*n*	Percentage of Graduates Working at Rural Facility			
		<25%	25-49%	50-75%	>75%
Community & Technical College	73	42	10	10	11
Predominately Four-Year College	10	7	1	0	2
University	60	43	12	4	1
Hospital-Based Program	24	22	1	0	1
Total	167				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

As demonstrated in Table 23, a strong correlation existed between the type of institution and the approximate percentage of program graduates working at rural facilities. Community and technical colleges were significantly more likely to produce graduates that secured employment in rural health care facilities. This correlation suggested that, overall, community colleges are more effectively meeting the staffing needs of rural healthcare facilities than are university or predominately four-year colleges.

Table 23

Bivariate Correlation Between Type of Higher Education Institution and Percentage of Graduates Working at Rural Facility

	Type of Higher Education Institution	Percentage of Program Graduates Working at Rural Facility
Type of Higher Education Institution	--	.279**
Percentage of Program Graduates Working at Rural Facility	.279**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

The data in Table 24 represents the percentage of program graduates working at rural facilities in relation to the type of program, offering a unique vision of whether MLT or MLS programs best serve the employment needs of rural laboratories. Approximately one-third of MLT programs indicated that at least 50% of their graduates work at rural health care facilities. In comparison, less than one-twentieth of MLS programs indicated that at least 50% of their graduates work at rural facilities. One of the most striking findings in this study was that more than three-fourths of MLS programs indicated that fewer than 25% of graduates work in rural facilities.

Table 24

Program Type and Percentage of Program Graduates Working at Rural Facility

Program Type	*n*	Percentage of Graduates Working at Rural Facility			
		<25%	25-49%	50-75%	>75%
MLT	72	40	9	10	13
MLS	83	68	11	2	2
MLT and MLS	12	6	4	2	0
Total	167				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Comparison of the type of program, MLT or MLS, to the approximate percentage of program graduates working at rural healthcare facilities also revealed a strong correlation, as shown in Table 25. This finding, in conjunction with the previous finding that rural higher education institutions are significantly more likely to have MLT and MLS graduates working in rural communities, suggests that rural MLT programs are one of the primary sources of potential employees for rural clinical laboratories. The correlation further supports the finding that MLT are more likely than MLS graduates to secure employment at a rural facility.

Table 25

Bivariate Correlation Between Program Type and Percentage of Program Graduates Working at Rural Facility

	Program Type (MLT or MLS)	Percentage of Program Graduates Working at Rural Facility
Program Type (MLT or MLS)	--	.253**
Percentage of Program Graduates Working at Rural Facility	.253**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Graduate employment in relationship to rural clinical rotations.

After identifying the percentage of graduates working at rural facilities, program directors were asked to share the percentage of those graduates that completed clinical rotations at a rural facility. The purpose of this question was to examine the extent, if any, to which completion of rural clinical rotations influences the choice to practice in a rural facility after graduation. Daniels et al. (2007) noted that completion of rural clinical rotations influenced rural practice.

Table 26 shows the number of respondents for each frequency level regarding the percentage of graduates that work at rural facilities and who completed rural clinical rotations. Approximately one-third of respondents indicated that of the program graduates working in rural facilities, at least 50% completed a rural clinical rotation. This finding was like that of Chen et al. (2010), who suggested that medical students performing rural residencies were three times more likely to practice in a rural setting. In relation to the data indicating the percentage of program graduates employed at rural

facilities, it was somewhat surprising that over half of the respondents indicated that fewer than 25% of those graduates had completed a rural clinical rotation.

Table 26

Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

Percentage of Graduates Who Work at Rural Facility and Completed Rural Clinical Rotation	*n*	Percentage of Respondents
>75% of graduates	32	20.25%
50-75% of graduates	22	13.92%
25-49% of graduates	15	9.49%
<25% of graduates	89	56.33%

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Upon examination of the same data utilizing the geographical location of higher education institutions, it was discovered that rural higher education institutions were most likely to have MLT and MLS program graduates who both completed a rural clinical rotation and worked at a rural facility. More than two-thirds of rural higher education institutions indicated that of those graduates working in rural facilities, more than seventy-five percent had completed a rural clinical rotation. As depicted in Table 27 below, the data also demonstrated that over two-thirds of urban and more than half of somewhat urban institutions indicated that fewer than 25% of their graduates working in rural communities completed rural clinical rotations. Rural laboratory manager interviews did not include questions on this topic, as it was presumed that the managers

may not be aware of where each employee completed clinical rotations, particularly for clinical laboratorians who had been practicing in the field for several years.

Table 27

Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

Geographical Location of Higher Education Institution	*n*	Percentage of Graduates Who Work at Rural Facility and Completed Rural Clinical Rotations			
		<25%	25-49%	50-75%	>75%
Urban	92	63	9	11	9
Somewhat Urban	43	25	5	6	7
Rural	23	1	1	5	16
Total	158				

Note. Urban refers to areas with a population of greater than 50,000. Somewhat Urban refers to areas with a population between 25,000-50,000. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Correlation tests, as shown in Table 28, indicated a strong negative correlation between the geographical location of the higher education institution and the percentage of graduates employed in rural areas who had completed rural clinical rotations as part of their degree requirements. This correlation confirmed that rural higher education institutions are not only more likely to have MLT and MLS graduates that seek employment in rural areas, but that those graduates are significantly more likely to have completed rural clinical rotations.

Table 28

Bivariate Correlation Between Geographical Location of Higher Education Institution and the Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

	Geographical Location of Higher Education Institution	Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations
Geographical Location of Higher Education Institution	--	-.482**
Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations	-.482**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Program director survey data revealed nearly half of community and technical college respondents indicated that at least 50% of their graduates employed in rural laboratories had completed a rural clinical rotation. Approximately one-third of respondents from predominately four-year colleges, and less than one-fourth of universities, indicated at least 50% of graduates working in rural locations had completed a rural rotation as part of their clinical internship requirements. Table 29 suggests completion of a rural rotation may influence future employment in a rural community, especially for students graduating from a community and technical college.

Table 29

Type of Higher Education Institution and Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

		Percentage of Graduates Who Work at Rural Facility and Completed Rural Clinical Rotations			
Type of Higher Education Institution	*n*	<25%	25-49%	50-75%	>75%
Community and Technical College	69	31	4	15	19
Predominately Four-Year College	10	4	2	1	3
University	57	35	9	5	8
Hospital-Based Program	22	19	0	1	2
Total	158				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

A strong correlation was demonstrated between the type of institution and the percentage of graduates employed in rural areas that had completed clinical rotations in a rural facility. This correlation supported the suggestion that students who complete rural rotations are more likely to work in rural communities after graduation. This is particularly true for community and technical college students. The correlation between institution type and the connection between rural employment and rural clinical rotations is demonstrated in Table 30.

Table 30

Bivariate Correlation Between Type of Higher Education Institution and the Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

	Type of Higher Education Institution	Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations
Type of Higher Education Institution	--	.285**
Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations	.285**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Comparison of the percent of graduates completing rural rotations and subsequently gaining employment in a rural facility was also made based on the type of program offered. As shown in Table 31, over half of MLT programs indicated that at least 50% of their graduates working in rural areas had completed a rural clinical rotation as part of their curriculum requirements. Survey data also revealed that nearly three-quarters of MLS programs indicated that fewer than 25% of graduates working in rural areas had completed a rural clinical rotation.

Table 31

Program Type and Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

Program Type	*n*	Percentage of Graduates Who Work at Rural Facility and Completed Rural Clinical Rotations			
		<25%	25-49%	50-75%	>75%
MLT	69	29	4	15	21
MLS	78	55	10	5	8
MLT and MLS	11	5	1	2	3
Total	158				

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Correlation calculations, as shown in Table 32, revealed that a strong relationship existed between the type of program offered and the number of graduates completing rural clinical rotations prior to employment in a rural facility. The correlation suggested that MLT students who worked in rural clinical laboratories were more likely to have completed a rural clinical rotation, whereas, MLS graduate employment in rural laboratories was significantly less influenced by the performance of rural rotations.

Table 32

Bivariate Correlation Between Program Type and Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations

	Program Type (MLT or MLS)	Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations
Program Type (MLT or MLS)	--	.220**
Percentage of MLT/MLS Program Graduates Who Currently Work at a Rural Facility and Who Completed Rural Clinical Rotations	.220**	--

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Workforce issues for rural clinical laboratories.

Program directors and rural laboratory managers noted significant concern regarding the supply and demand of qualified clinical laboratory professionals. Survey responses from program directors focused on workforce demand and the quality of patient care. Clinical laboratory managers identified methods for surviving the workforce shortage and discussed the primary barriers that interfere with their ability to attract qualified applicants.

Workforce demand and quality of patient care.

Faced with a nationwide shortage of clinical laboratory professionals, some program directors noted that the workforce shortage was an issue in both rural and urban settings. Feedback from MLT and MLS program directors suggested that while

pay was sometimes an issue with rural laboratories, the primary problem with staffing of rural laboratories was undesirable location. A few survey respondents noted that although some rural facilities offer sign-on bonuses, employees typically do not remain at the facility long-term. Three respondents also acknowledged that some laboratories often recruit employees from the Philippines due to a lack of viable job candidates in their local area or state. One program director pointed out that although rural laboratories struggle to find employees, they are sometimes more reluctant to accept students, stating, "it definitely feels like there's a disconnect between the needs for employees in these rural sites, the willingness to take students (on both ends) and ultimately filling the open positions." Clinical laboratory science programs also typically yield a low number of graduates. Some respondents indicated that they often have as few as five graduates, all of which obtain employment before they even finish clinical rotations.

Several program directors noted that they had used or were planning to create alternative pathways for clinical laboratory science education. Respondents from Idaho, South Carolina, and North Carolina indicated that they had taken measures, such as "hybrid programs" to aid rural health care facilities in meeting workforce demands for MLTs and MLSs. One program director noted their institution had developed a career ladder pathway that allowed individuals to progress from phlebotomy, to MLT to MLS, the latter which could be completed online. In addition, the same program director noted that they were also working on an "adult and youth apprenticeship model" with the goal of placing graduates for future employment. A second program director highlighted an alternative for rural students that reduces the need for them to attend courses on

campus, stating “distant students complete labs [hands-on laboratory sessions] at a hospital in their geographical area. Our goal is to reach out to areas that do not have access to a lab program and assist them in training future laboratory professionals.”

Survey responses also demonstrated serious concern for the quality of care and patient safety amid growing workforce shortages. One respondent noted the fragmentation of professional requirements for clinical laboratory professionals, stating, “My concern is that the U.S. government is not mandating certification for MLT and MLS graduates to work in the health care field. People need certification to paint your nails.” A second program director declared “my biggest concern is that rural laboratories who do not have adequate MLS staffing may be forced to "bend" requirements allowing non-MLS certified staff to perform testing that is outside their scope.” Yet a third program director described a fear that outsourcing of laboratory testing from rural facilities could directly influence patient care by extending turn-around times and increasing pre-analytical errors for laboratory testing, noting, “I'm worried that with the shortage, instead of replenishing manpower, they [rural health care facilities] will seek to outsource laboratory testing to private laboratories…which could jeopardize the quality of patient care.”

Workforce management.

Using a scale of 1 to 10, with 10 being severe, each clinical laboratory manager was asked to rate the shortage of qualified job candidates in their local area. As demonstrated in Table 33, three of the managers ranked the shortage as moderate (4-6), while seven ranked the shortage as severe (7-10). This finding supported the conclusion of Nolan (2015), who noted that the workforce shortage was “more striking”

for rural clinical laboratories. When asked how long MLT and MLS staff vacancies typically remain open at their facility, responses varied from two months to over a year. While those responses were somewhat expected based on the nationwide shortage of clinical laboratory technicians and scientists, results of this study indicated that they had often experienced excessive lengths of time during which they were unable to attract qualified applicants. When asked to identify the longest amount of time that job openings had remained open, two managers stated a period of two months, three managers indicated a period of six months, three managers responded one to two years, and one manager astoundingly revealed that they had two job openings that had remained open for a period of four years. A second manager stated “We’ve been short, probably, for the last six to seven years. We’ve always had an opening.” It was also notable that one rural laboratory manager commented that if a MLT or MLS position was not filled within a period of 90 days, hospital administration eliminated the position, thereby further compounding the workforce shortage at that facility.

Table 33

Severity of the MLT/MLS Workforce Shortage as Indicated by Rural Laboratory Managers

Severity of Workforce Shortage	Frequency	Percentage of Interview Participants
10 (severe)	1	10.00%
9	2	20.00%
8	3	30.00%
7	1	10.00%
6 (moderate)	1	10.00%
5	1	10.00%
4	1	10.00%
3 or below (mild)	0	0.00%

It was notable that several of the managers that experienced less problems attracting job applicants disclosed that they had been somewhat lucky in that they had long-term employees, however, they were concerned about filling positions with upcoming retirements. The manager of one laboratory pointed out the issue of an aging workforce combined with a low number of graduates, stating "there's not a massive amount graduating each year. Unfortunately, there's a lot of hospitals out there that have an aging population in the lab. I'm fortunate not to have one of those. I don't have anyone past mid-forties." Another manager stated "It depends on the year, because it's cyclical for me. I'm very fortunate right now …there have been years prior that I had to

use a recruiter in order to get people in." One manager that was nearing retirement herself noted "so many people have retired. So many people are my age or older and have just recently retired in the last five to ten years, and there just wasn't anybody to replace them**."** These comments echoed the findings of both Garrott (2008) and Passiment (2006), who noted the high retirement rate for clinical laboratorians was a major concern for the field. It is also important to note the significance that staffing shortages can have on rural laboratories that employee a limited number of MLTs and MLSs. One manager pointed out the drastic impact that losing staff members can have on small rural labs, saying "I mainly have seven to nine techs, so if I lose two, I've lost a big percentage."

Due to the MLT and MLS workforce shortage and inability to recruit local job candidates, some rural laboratories look for alternative staffing solutions. Rohde et al. (2015) noted that the shortage of clinical laboratory personnel can lead to less restrictive requirements for employment in certain geographical areas. Due to the inability to find qualified MLT and MLS program graduates, some rural laboratories in this study noted that they had used or considered alternative routes for staffing. One interview participant noted that she had previously served as the laboratory manager at another rural hospital where they routinely recruited clinical laboratory technicians and scientists from the Philippines. The recruitment of laboratory professionals from the Philippines was also noted by some MLT/MLS program directors in the survey comments. When asked about the quality of their work, she made the following remarks:

> They were pretty good techs. They were educated. The language was good. They had to have a certain language skill, so that really wasn't a problem. For the most part, they were very eager to accommodate. They wanted to work, they were glad to be here...I picked a lot of them up at the airport, helped them get their driver's license and everything. It worked out pretty well, it just took a long time to get someone. Once you needed someone, it would be several months before you actually got them on the ground and of course you had to train them.

A second notable finding from the interviews was that rural laboratories often relied on "travel techs," MLTs or MLSs contracted through an outside company at a higher rate of pay for "traveling" between healthcare facilities as employment demands dictate. The use of travel techs was revealed to create significant budgeting issues for rural clinical laboratories, however, the topic has not adequately been addressed in the literature. Five out of 10 of the laboratory managers that were interviewed indicated that they had resorted to using travel techs due to the inability to secure qualified job applicants. When asked what type of experience they had with using travel techs, the managers shared mixed feelings. One manager stated, "I have had people leave here to be travelers because of the money." Three managers confirmed the rate they had paid for travel techs was often three to four times what their pay rates would be for a normal employee. One manager, who had themselves once worked as a travel tech, noted:

> When there's less availability for techs to be hired at a regular rate because they're all out there traveling…because they're not getting paid enough at a

regular rate…then you can't hire people because they're all leaving and going to travel, and then these facilities are having to hire travelers anyway because they can't find somebody full time to fill the position.

Employee recruitment barriers.

The laboratory managers were also asked to share what they considered to be the key barriers to MLT and MLS recruitment at their facility. Six out of 10 managers stated that location was the primary barrier to recruitment, while five out of 10 noted that pay was an issue. The most prominent remark involving problems with employee recruitment came from the first lab manager that was interviewed, who simply stated "people have to want to come here. People don't come here unless they want to be here or have family [here]." A second manager echoed those feelings saying "you can't force people to go wherever, I mean there has to be something there (*sic*) that peaks their interest to come and live here. Usually around here it is usually (*sic*) that you want to retire, or you have family." In response to the workforce shortage, some of the rural laboratories offer alternative scheduling to attract new employees. One of the laboratory managers described how she has used scheduling as an incentive, stating, "We have one of our techs that works weekends, he actually comes and does a forty [hours] straight. He comes in on Saturday mornings at 7am and he stays until 11pm Sunday night. And they have sleep rooms upstairs."

Most of the managers were willing to share their starting wage with me but asked that the information not be included in this study manuscript. Several noted that they recognized the need to pay a higher wage to attract job candidates and had actively

worked to remain competitive with peer institutions in larger cities. Some laboratories had offered sign-on bonuses as high as $3000. One manager revealed her feelings that hospital administrators did not take the clinical laboratory workforce shortage serious enough, stating “They recognize a nursing shortage a whole lot more than they recognize a lab shortage. Administration does. And I think that’s nation-wide. I don’t think that’s just at acute care hospitals.” It was also interesting that only three out of 10 noted that the lack of nearby MLT and MLS programs was a significant issue for them. One laboratory manager pointed out that attracting job candidates not only involved pay and benefits, but the availability for suitable employment for their spouse.

Several factors, including patient load, types of laboratory testing performed, and test complexity, influence the education mix of a clinical laboratory. Under CLIA guidelines, only MLSs meet the requirements for certain levels of supervisory positions. To fully understand the employment needs of rural clinical laboratories, it was important to reveal the total number of MLTs and MLSs employed by each facility participating in the research interviews, as available in Appendix H. Only four out of the ten laboratories participating in the study employed a staff that consisted of at least 50% MLSs. It should be noted that the location with the highest percentage of MLSs formerly housed a hospital-based NAACLS accredited MLS program. A second hospital, in close proximity to the former hospital-based MLS program, also found that it was easier to recruit MLSs, thus resulting in a higher percentage of MLS employees. That hospital-based program was ultimately closed due to the inability to recruit a program director, as well as program cost. The manager of that facility stated, “We

finally discontinued the program, because we couldn't find a program director…you have to have your master's degree and we couldn't find one [program director]." This statement was similar to that of Garrott (2008), who noted that faculty recruitment for MLT and MLS programs added to the program closure issue, as well as the workforce shortage. At the time of this research study, the hospital-based program had been closed for only eight years, so the influence of its closure had not been fully identified; however, the hospitals located in close proximity to the former program noted increased difficulty filling open positions since the program closure. Further discussion with the laboratory managers indicated that many rural laboratories particularly struggle to find job candidates with a MLS degree.

Several of the laboratory managers pointed to the issue of MLS recruitment as a major hurdle for rural clinical labs. One manager noted a severe problem with recruitment of MLS job candidates as a result of students choosing to pursue graduate school in disciplines such as medicine, physical therapy, physician assistant, and pharmacy, after completing an MLS program. She stated:

> We basically have one pool and that's [higher education institution] for MLSs. They may graduate 20 a year, 25 if you're lucky, but then how many of those 20-25 actually stay in the field? I interviewed a girl here three years ago. She was an MLS and I would have given my right arm to have her and she's in med [medical] school right now.

This statement supported the findings of Beck and Doig (2007), which revealed that only 26% of Medical Laboratory Scientists planned to stay in the field long-term. From a higher education or program director standpoint, acknowledging the fact that a degree

in clinical laboratory science is a good background for individuals who wish to pursue medical school, or another health care related graduate degree, seems like a valid program recruitment tool. However, some rural laboratory managers viewed that issue from a different perspective. When discussing the issue of MLS graduates using the field as a backbone to pursue medical school or other graduate programs, one manager stated:

> It's a great idea in theory because it will make for very good doctors with a very good clinical background in the laboratory to help them treat their patients. It doesn't do very good for the clinical labs, because that pool of people, those graduates, are not coming to the lab to work.

Although most of the rural lab managers demonstrated that they have trouble finding MLS candidates to fill positions, they also indicated that they prefer to hire the most qualified individual or the person who presumably will fit-in to the group the best, not the one with the most education. One manager remarked:

> I've interviewed and every time I get an application form an MLS, I'm like, oh I've hit the jackpot, because I need somebody to serve in that technical supervisor role, but…I refuse to hire out of desperation. I want to hire the right person for the job, and if that MLS is not the right person for the job, I will hire the MLT over the MLS and that's just the way it is.

Each manager was asked specific questions about the educational background of their employees. There are alternative routes that allow individuals with degrees in biological, chemical, or physical science to become nationally certified or obtain a state

license to work as a Medical Laboratory Technician or Medical Laboratory Scientist, therefore, it was important for the researcher to determine if rural laboratories were hiring individuals with alternative backgrounds or those who had completed a traditional MLT or MLS program. Several of the laboratory managers noted they did employee individuals who were "grandfathered" under West Virginia state licensure. Two managers reflected that they had each hired an individual with a Bachelor of Science degree in the past, with mixed opinion as to their ability to competently perform clinical laboratory testing. One of the managers also noted they had employed a person with military training in the past. Although the American Society for Clinical Laboratory Science and the American Society for Clinical Pathology both support alternative routes to certification, there is a lack of literature that specifically addresses competency of individuals falling into those categories.

While that information was expected, one clinical laboratory involved in the research study employed a medical assistant to perform clinical laboratory testing. This finding was perhaps one of the most unexpected in the overall research study. The medical assistant reportedly met the requirements for West Virginia state licensure as a Medical Laboratory Technician via an alternative route for individuals having an associate degree in a biological, chemical, or physical science in addition to one year of full-time experience, or training, as outlined in legislation for Clinical Laboratory Technician and Scientist Licensure and Certification (2017). Their job duties included testing in all areas of the laboratory, including immunohematology, review of Levey-Jennings charts and other quality control records, establishment of acceptable quality control ranges, and quality assurance activities. When asked if they felt comfortable

performing laboratory testing, especially immunohematology, the medical assistant replied:

> I don't mind it at all, I'm actually one of the faster ones. I got my training from the guy [vendor] who brought in our gel system and I kind of just had a knack for it for some reason…Once we find an antibody we just transfer the patient.

Under the licensure guidelines, the medical assistant was permitted to do ABO/Rh, antibody screens, and immediate spin cross-matches for patients requiring transfusion. If, however, a patient was determined to have an atypical antibody, the patient was transferred to another health care facility for antibody identification, compatibility workup, and transfusion of blood products. The laboratory where the medical assistant was employed reportedly did not perform urine microscopic analysis or manual peripheral blood smear review with white blood cell differential, which limited their scope to moderate complexity testing.

Recruitment of future clinical laboratory professionals.

As discussed in the literature review, targeted recruitment efforts have been utilized for other types of medical professionals, including nurses and physicians. Survey respondents were asked about their use of targeted recruitment methods as a means of determining the extent to which higher education institutions actively recruit students from rural areas. Rosenblatt (2010) suggested that targeted recruitment efforts can significantly increase the number of graduates that choose to practice in rural health care facilities. As depicted in Table 34, slightly more than one-fourth of MLT and MLS program directors indicated that their institution used targeted efforts to attract

rural students. There was no significant correlation between program type, institution type, or geographic location of the institution and the use of targeted recruitment efforts.

Table 34

Higher Education Institution Use of Targeted Recruitment for MLT and MLS Programs

Targeted Recruitment Use	*n*	Percentage of Respondents
Yes	47	28.14%
No	120	71.86%

An open-ended question asking for examples of recruitment activities was directed to all respondents who stated that they utilized targeted recruitment efforts. Thirty-eight responses to the open-ended question were received. Several respondents indicated that they conduct recruitment activities at rural high schools with a focus on targeting students involved in pipeline programs, STEM activities, and health care related groups. A few of the program directors indicated that they promote their program through more specialized activities such as health fairs, hospital career fairs, outreach to high school counselors, college visits, job "shadowing," as well as targeted use of social media. Some program directors also noted that they seek out individuals who are already working as a phlebotomist in rural facilities and advise them about available education pathways that would allow them to achieve a MLT degree.

Student recruitment and program survival.

Program directors highlighted a need for better promotion of the profession, as well as issues with student recruitment at the institutional level. Several program directors noted a general lack of public knowledge about the field of clinical laboratory science and low student interest, both of which make it more difficult to recruit students into their programs. One program director stated, "Students need to be informed about the opportunities and needs of the medical laboratory field. The laboratory seems to be a forgotten area of health care when counselors advise young people who have an interest in science." A second program director recognized wages as a common barrier to enticing students into the field of clinical laboratory sciences, explaining "the heavy science curricula and body of knowledge for both MLT and MLS is not rewarded with commensurate wages. Other programs, not as difficult, yield higher wages. Recruiting is difficult because students look at wages and compare before deciding upon a career path." This comment echoed McPherson et al. (2007, p.5), who stated that low salaries and job-related stress can make it difficult to recruit individuals into the field of clinical laboratory science. Some survey respondents also indicated the use of targeted recruitment efforts, such as seeking out students enrolled in STEM curriculum, in the high schools and declared that the best candidates for rural employment are those students who wish to return home to be with family or those who have an "appreciation for rural living."

Several of the program directors completing the survey indicated a looming fear of program closure amid continuing budget cuts. One respondent replied, "our institution is under reorganization and [we have experienced] over 25% [in] budget cuts

for the last two years, so our concerns (*sic*) of keeping our MLS program alive is very real." Another respondent stated, "Higher Ed [education] in Oklahoma has been cut drastically due to the budget crisis in the state of Oklahoma. There are only 4 MLT programs left in the state and more cuts are coming. I just hope the programs survive since these programs have a high cost per graduate ratio." A third program director noted that the current higher education system also creates sizable competition between institutions, explaining:

> Due to university administration, programs must meet size requirements and cannot generally do this in rural areas...Many MLT programs are at community colleges which are located in rural areas, so they push 2-year MLTs rather than BS MLS programs. This creates competition between programs rather than more cooperation…Rural facilities may not qualify as clinical training sites in [state] due to license laws, and because their scope of work is not equivalent to larger facilities, especially in Immunohematology and Microbiology.

In addition to issues with promotion of the profession, a large number of MLT and MLS program directors described frustration with institutional recruitment efforts. One program director stated:

> We have been extremely disappointed that, in spite of our repeated requests for increased recruiting activities by our marketing and admissions departments, and the college in general, the focus is still primarily on the nursing shortage and advertising our college's nursing programs...Our program is typically 1/3 filled, and of our two large local hospital labs, one had 10 openings for a time this past summer. Higher education needs to listen.

A second survey respondent echoed those same feelings, stating "our ASCLS-[state] professional organization does more to promote recruitment and communication about the programs than my academic institution." Other program directors noted that not only did they experience difficulty recruiting students, but it was also a challenge to recruit qualified and experienced instructors to teach in MLT and MLS programs. One program director noted:

> We have a rural campus…We have encountered many challenges with the rural campus including finding qualified faculty and students. In addition, administrators are reluctant to support both as they do not fully understand the role and value of medical laboratory practitioners.

Communication and engagement.

All laboratory managers participating in the interview process were asked if they were aware of any higher education institutions that conducted recruitment activities in their area. Nine out of 10 lab managers stated that they were unaware of any recruitment activities. When asked how far the closest higher education institution was from their health care facility, all 10 managers stated that they had a higher education institution within one hour away, however, not all those institutions offered MLT or MLS programs. Only half of the managers indicated that they had MLT or MLS programs within 45 miles of their location. Two managers indicated that the closest higher education institution offering a MLT or MLS program was approximately one hour away, while two additional managers indicated that the closest programs were an hour and a half away. One out of the 10 managers interviewed stated that the closest program was over two hours away.

Another important aspect of this study involved investigating rural laboratory manager's feelings about higher education's response to the shortage of MLTs and MLSs in rural areas. When asked if they felt that higher education institutions had done enough to address the clinical laboratory workforce shortage, seven out of 10 strongly responded "no", while two managers indicated mixed feelings. Most of the managers acknowledged that the issues that rural clinical laboratories, and rural hospitals in general, face are largely out of higher education's hands, however, they wished higher education would do more. The managers also felt that higher education institutions primarily focus on the needs of their own local area, instead of approaching job placement from a wider angle. One laboratory manager noted that they had seen an increase in the number of program graduates in recent years, while another manager observed a "low number of graduates and only one MLS pool." The issue of MLT and MLS programs struggling to remain open was also pointed out by one manager who stated, "I think honestly the programs are trying to survive as bad as we are, and then you have your own issues with recruiting students into your program."

A lack of programs and changes in curriculum requirements were also areas of concern for some of the laboratory managers. Half of the lab managers interviewed noted that not having a program nearby exacerbated their staffing issues. Two of the managers stated that they felt that students and new graduates lacked the ability to think critically. One of the managers had the following comment regarding program availability and student preparedness:

> Most of our problem is that there's not a school in this area…I'm also concerned, to be honest, I have noticed that the students come…less prepared. I think it's general that students are less prepared for the workforce…I mean, I know that at [higher education institution] they have to take less math than we did, or even MLTs did before…I think the medical lab is going to have some problems because you know, and I know, it took a mindset and a type of brain to become an MT [MLS] in the past. I mean you had to be fairly intelligent. You had to think outside of the box, good judgement. Those people are now engineers and computer people and making a whole lot more money than a Med Tech [MLS] is. I see a problem with recruitment going down the road. I think we're dumbing it [curriculum] down, but I think we are doing that to recruit, because how are we going to recruit otherwise for a job that doesn't pay any more than this one does.

After determining if the lab managers felt higher education had done enough to address the shortage of MLTs and MLSs in rural areas, they were asked what steps higher education institutions could take to address the shortage. All of the managers indicated that they would like to see higher education institutions, as well as MLT and MLS programs, conduct more recruitment activities at the middle and high school levels. This recommendation supported the findings of McClure (2008), who noted that the choice to enter the field of clinical laboratory science was heavily influenced by teachers or high school counselors. One manager remarked "We need to get these young kids, like the middle school kids. Because you know by the time they get to high school they should already be on a career path with the math and sciences."

The managers had several suggestions for recruitment, including setting up displays at local events and area attractions where young kids frequent, as well as overall promotion of the profession. One of the managers stated that as a profession we need to help people "understand what we do and that it's not a dull job. It's not somebody that sits behind a desk all day. I love my job and I think that if more people understood the job, they'd be like, oh that would be neat to see." A second manager said

> I think just because labs are sort of in the middle of a box in a hospital, they're not seen like nursing. I mean, if you see a lab person out somewhere, most people assume I'm a nurse. I think that's always been a problem. Promotion of the profession is a problem…just awareness…there's not enough education in the schools about the profession.

Interview findings further supported the suggestion of Gazewood, Rollins, and Galazka (2006) that targeted admissions and rural curriculum routes can increase the rate of rural practice. In terms of targeted recruitment efforts, one of the managers pointed out their thoughts on higher education institutions and the hurdles that prevent some rural students from attending college:

> What I would like to see is the people from the schools work closer with those places that are having shortages and target, that should be definitely a partnership type thing…the goal should be to try to help us target those areas that are lacking…I think that the higher education places [institutions] should go to the high schools and target those people and try to recruit with them and work

with them on the obstacles that are preventing those high school students from going to college.

A lack of communication with higher education institutions and MLT and MLS programs was also widely recognized as a problem by the rural laboratory managers. Remarkably, one lab manager stated that they felt discouraged regarding higher education because they "get no attention from schools." A second manager indicated that they were unaware of what higher education institutions in the state offered MLT and MLS programs. Six of the 10 lab managers indicated that they were not even aware of an in-state online MLS program that started seven years prior. Three of the managers suggested that better communication between MLT and MLS programs and rural laboratories could also aid in employee recruitment because the laboratory managers could share job openings with program directors. One manager stated, "I don't know if they [students] have a hard time getting a job, but if they do, send out information on the rural areas that have positions, as well…We are pretty rural, and they don't know that we even exist."

Concern for the future of rural laboratories.

To conclude the interviews, the lab managers were asked to share their primary concerns regarding the ability to effectively staff their clinical laboratory in the future. Some of the managers had specific concerns regarding the inability to obtain qualified staff and the effect that staffing issues have on the quality of laboratory testing and patient safety. One manager discussed their concerns regarding the quality of patient care amid the workforce shortage, stating "What kind of techs are you going to get? I

think that when you lower your standards, I think that's an issue, and we've had to lower our standards because we've been so desperate." Another manager echoed the general sentiment that without a clinical laboratory, patient care would suffer, noting, "When you don't have enough people, then you don't have a lab. If you lose your lab, then pretty much there goes your hospital." Yet another manager shared concerns about quality, sharing, "I think that what can happen with the shortage is that instead of focusing on hiring the highest quality personnel then you're focused just on having a body that's qualified." Looking forward to expected reimbursement cuts from Medicare and Medicaid in 2018, one manager said "My main concern is survival. I mean with the cuts in reimbursement I don't know how many of these smaller labs or smaller hospitals are going to be able to survive."

The rural laboratory managers recognized that it was not only higher education's responsibility to recruit students into the field, but that it was also the responsibility of rural laboratories to raise awareness of the profession as well. Several of the managers noted that they had participated in career day presentations or health occupation expos at local high schools. More than half of the managers also indicated that they had given local high school students a tour of the clinical laboratory to spark an interest in the field. One interview participant indicated that they were actively involved with the local chapter of the Health Occupations Students of America and encouraged students to enter the field of clinical laboratory science by allowing them to job shadow and perform phlebotomy rotations at their facility. This data supported the findings of Ghazarossian

(2010), which revealed that laboratory managers recognized their role in student recruitment and the development of recruitment strategies.

Two laboratory managers discussed laboratory staffing issues that they had observed in other local rural health care facilities. At the time of the interviews, one manager was acting in a consultant role for one of the most rural hospitals in the state. Their observations included great difficulty with employee recruitment due to remote location, the utilization of on-the-job training due to inability to recruit traditionally trained MLTs and MLSs, and issues of work quality and competency, specifically in immunohematology. A second laboratory manager shared information about another rural hospital where one of their employees had gone to work, then quickly quit due to concerns over quality. The manager stated, “They definitely need a hospital there…I think that they take people that have their Point of Care Technician license [West Virginia] and they’ll train them on the job for a year. I think that they do that.” Both statements from rural laboratory managers supported Nolan (2015), who suggested that rural health care institutions may be forced to employee less qualified or non-certified individuals due to a void of qualified applicants.

The areas of microbiology and immunohematology were the two primary areas of concern. Five out of 10 lab managers said that they were concerned about filling positions in the microbiology department, while two of the 10 were concerned with immunohematology. Only two locations had no specific concerns, primarily because their MLTs and MLSs are generalists and are trained to work in all departments of the laboratory.

The managers also indicated that they were concerned about filling future supervisory or management positions. Three out of 10 managers shared concerns about finding MLS candidates to fill management positions. This finding was comparable to that of Bennett et al. (2014), which noted projected retirement rates were high for laboratory supervisor positions. One manager shared how the workforce shortage had already changed the organizational chart for management in their laboratory, sharing:

> I used to have what they called a senior tech…so each major discipline had its own senior tech. But that had to change when I got into a really bad staffing crunch. I didn't have enough people and they were tired of working the bench and not getting administrative time and then being held responsible for all of that work, so now what I have is that my assistant manager retained blood bank because that's his background. So, he has responsibilities as a technical supervisor in the blood bank, as well as being an assistant manager.

A second manager stated, "I'm a little concerned about replacing me to be honest… I mean there's not an awful lot of Med Techs (MLSs) coming out [of school]." A third laboratory manager discussed their concerns regarding the inability to find staff that meet supervisor and management qualifications under CLIA, noting "I've heard about labs doing this, putting MLTs in the lab management roles. How can they do that? It's because their pathologist is serving as the technical supervisor. It's a scary situation."

Three managers demonstrated great concern over the infringement of nursing and point of care testing, as clinical laboratories struggle to secure adequate staffing.

Their fear was that nursing would take on more laboratory testing in a point of care, or bedside, format, thereby leading to issues of quality and safety. The general feeling of the managers was that promotion of the profession is paramount to ensure that hospital administrators, and patients, know what an important role that MLTs and MLSs play in patient care. One manager stated, "I just think we need to promote it [clinical laboratory science] and we can't let nurses take us [clinical laboratory] over, and that's exactly what's going to happen." A second manager shared those same concerns, saying:

> We need to get out there and be vocal, because if not, pharmacy and nursing will run us out…with point of care testing**…** I love nurses, I have some friends that are nurses and they're smart in their field, but they don't need to do my job.

RQ3: To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

Higher education institutions not only play a role in producing a quality workforce for the future, they sometimes serve as a continuing education provider for people already working in the field. National certification and state licensure commonly require that MLTs and MLSs obtain an annual minimum number of contact hours of continuing education in the field of clinical laboratory science. This research question sought to determine if MLT and MLS programs are meeting the needs of rural clinical laboratories regarding degree advancement, particularly from MLT to MLS, and continuing education for incumbent workers. No distinct categories emerged from the qualitative findings for

this research question, however, the need for better communication and partnership was evident.

Education for career advancement.

Online education in clinical laboratory science is one pathway that rural laboratories can utilize for career advancement, especially for MLTs that wish to pursue an MLS degree. MLT and MLS program directors were asked if their curriculum contained an online component. As outlined in Table 35, one-third of respondents indicated that they do utilize online teaching methods in their MLT or MLS curriculum, while two-thirds indicated they do not incorporate online courses into their program. Correlation studies revealed no significance when examining the relationship between either program type or institution type and the use of online courses.

Table 35

Percentage of MLT/MLS Programs Using Online Instruction Methods

Method of Instruction	*n*	Percentage of Respondents
Program Curriculum Includes Online Courses	55	32.93%
Program Curriculum Does Not Include Online Courses	112	67.07%

Survey respondents who indicated the use of online components were then asked to identify what type of online courses they offered. Nearly three-fourths of respondents indicated their program(s) utilized blended course formats, while only one-fourth of respondents indicated their MLT or MLS program included fully online courses, as depicted in Table 36. This finding supported the conclusion of McCown (2010), who

suggested that blended courses are more commonly used in clinical laboratory science programs due to the hands-on nature of MLT and MLS programs.

Table 36

Type of Online Course Formats Utilized by MLT/MLS Programs

Course Format	*n*	Percentage of Respondents
Blended: Mixture of Live and Online Components	39	70.91%
Fully Online	16	29.09%

Responses for the use of online courses were further analyzed according to program type offered. As demonstrated in Table 37, more than four-fifths of MLT programs offered blended courses, while less than one-fifth of MLT programs offered fully online courses. The incorporation of fully online curriculum was more evident in MLS programs and institutions offering both MLT and MLS programs. Two-thirds of MLS programs offered blended courses, while one-third offered fully online courses. More than half of the higher education institutions offering both MLT and MLS programs offered fully online curriculum.

Table 37

Type of Online Course Format Utilized by MLT/MLS Programs

Program Type	*n*	Blended	Fully Online
MLT	23	19	4
MLS	25	17	8
MLT and MLS	7	3	4
Total	55		

A moderate correlation was demonstrated between the type of program offered by an institution and the type of online format used for program courses, as depicted in Table 38. This correlation indicated a significant difference between MLT and MLS programs regarding the use of blended and fully online course formats. No significant correlation was found between the type of higher education institution and the use of blended versus fully online courses.

Table 38

Bivariate Correlation Between Program Type and Online Course Formats Utilized by MLT/MLS Programs

	Program Type (MLT or MLS)	Online Course Formats (blended vs. fully online) Utilized by MLT/MLS Programs
Program Type (MLT or MLS)	--	.274*
Online Course Formats (blended vs. fully online) Utilized by MLT/MLS Programs	.274*	--

*Correlation is significant at the 0.05 level (two-tailed)

Program directors were also asked to identify the frequency with which they establish articulation agreements with other clinical laboratory science programs in rural areas, as depicted in Table 39. This question was intended to explore the extent, if any, to which MLT and MLS programs promote professional advancement of incumbent workers by establishing articulation agreements that allow a more seamless transition from one clinical laboratory science program to another. The data revealed no significant correlation between type or geographical location of institution or type of program and the establishment of articulation agreements with other clinical laboratory science programs in rural areas.

Table 39

Frequency with which MLT/MLS Programs Establish Articulation Agreements with Rural MLT/MLS Programs

Frequency	*n*	Percentage of Respondents
Frequently	22	13.33%
Occasionally	31	18.79%
Rarely	30	18.18%
Never	82	49.70%

Note. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

Rural laboratory manager interviews included questions to determine their concerns for employees who wish to further their education in the field of clinical laboratory science. Interviews revealed that most rural laboratories try to "grow their own" by supporting current employees in their endeavors to further their education. Supporting phlebotomists to pursue an MLT degree, as well as MLTs to pursue an MLS degree, were both commonly mentioned ways in which rural managers prepared for future workforce demands. Most of the hospitals participating in this study indicated very limited options for employees to advance their education in clinical laboratory science due to the long travel distance to higher education institutions offering MLT and MLS programs.

Hospital funding for employee education and program format were both indicated to be major factors that affect an employee's ability to further their education. Five out of 10 lab managers stated that their facility offered moderate funding in the form of

scholarship benefits for current employees. Two of the 10 lab managers indicated that, in addition to funding for tuition and books, their facility offered housing stipends. Every rural laboratory manager that was interviewed noted that an online program was the best option for MLTs wishing to pursue an MLS degree, while eight out of 10 stated that online programs would be the only option for an MLT to pursue an MLS degree due to the physical distance from MLS programs. Managers were also asked about local internet access and whether a lack of high speed internet would interfere with an employee's ability to pursue an online degree. Only two managers indicated that internet access may be an issue.

Laboratory managers were also asked if recent CLIA regulation changes had forced any of their supervisors or lead techs to return to school. Recent changes in CLIA regulations for technical and general supervisor requirements have required some supervisors with a bachelor's degree in an area other than a biological, chemical, or physical science to return to school to pursue a Bachelor of Science degree in MLS. Only two rural lab managers indicated that they had laboratory supervisors who had been forced to pursue an MLS degree.

Continuing education for incumbent workers.

MLT and MLS program directors were also asked how frequently they offer continuing education to incumbent workers in rural areas. For this research study, continuing education was defined as workshops, conferences, online training modules and other methods of offering educational contact hours in the field of clinical laboratory science. As shown in Table 40, less than one-fourth of respondents indicated that they frequently or occasionally offer continuing education opportunities to rural laboratory

employees. More than half of respondents indicated that they never offer continuing education opportunities to rural laboratories.

Table 40

Frequency of MLT/MLS Program Offerings for Continuing Education of Incumbent Workers in Rural Clinical Laboratories

Frequency	*n*	Percentage of Respondents
Frequently	15	9.04%
Occasionally	21	12.65%
Rarely	40	24.10%
Never	90	54.22%

Note. For the purposes of this study, continuing education refers to workshops, conferences, online training modules, etc. made available to incumbent workers for continuing education credits, as required for licensure and certification maintenance. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

The data revealed that approximately one-fourth of universities occasionally or frequently offer continuing education for rural laboratorians, as shown in Table 41. More than one-third of hospital-based programs indicated that they occasionally or frequently offer continuing education for incumbent workers, in comparison to just over one-tenth of community and technical colleges.

Table 41

Type of Higher Education Institution and Frequency of MLT/MLS Program Offerings for Continuing Education of Incumbent Workers in Rural Clinical Laboratories

Type of Higher Education Institution	*n*	Frequency of Continuing Education Offerings			
		Never	Rarely	Occasionally	Frequently
Community & Technical College	73	44	20	5	4
Predominately Four-Year College	10	6	2	2	0
University	59	29	15	10	5
Hospital-Based Program	24	11	3	4	6
Total	166				

Note. For the purposes of this study, continuing education refers to workshops, conferences, online training modules, etc. made available to incumbent workers for continuing education credits, as required for licensure and certification maintenance. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.

The research data indicated an interesting negative correlation between higher education institution type and the frequency of continuing education offerings, as shown in Table 42. This correlation suggested that institutions offering advanced degrees, universities, are more likely to offer continuing education than are community and technical colleges, which typically offer associate degree programs. This was an unexpected finding, as community and technical colleges often place focus on workforce development initiatives. It was also determined that there was no significant correlation between geographical location of the institution or program type and the frequency with which continuing education is offered to rural clinical laboratories.

Table 42

Bivariate Correlation Between Type of Higher Education Institution and Frequency of MLT/MLS Program Offerings for Continuing Education of Incumbent Workers in Rural Clinical Laboratories

	Type of Higher Education Institution	Frequency of MLT/MLS Program Offerings for Continuing Education of Incumbent Workers in Rural Clinical Laboratories
Type of Higher Education Institution	--	-.211**
Frequency of MLT/MLS Program Offerings for Continuing Education of Incumbent Workers in Rural Clinical Laboratories	-.211**	--

Note. For the purposes of this study, continuing education refers to workshops, conferences, online training modules, etc. made available to incumbent workers for continuing education credits, as required for licensure and certification maintenance. Rural refers to areas located at least 40 miles from cities having a population of 25,000 or greater.
**Correlation is significant at the 0.01 level (two-tailed)

Laboratory managers were asked if they felt that higher education institutions offer adequate opportunities for continuing education, including workshops, conferences, and online training modules. Half of the lab managers indicated that higher education institutions could do a better job of offering continuing education, while the other half stated that they didn't feel that it was necessary with the options available through vendors and the West Virginia Office of Laboratory Services. Several of the managers noted that staffing issues often made it impossible for employees to attend off-site continuing education, such as workshops and conferences. Four managers stated that online continuing education modules would be the most helpful for rural

laboratories, however, they recognized the benefits of attending conferences and the importance of networking with peers in the field.

Themes

A theoretical framework of phenomenology was utilized for the qualitative portion of this research study. According to Bogdan and Biklen (2007, p. 274), phenomenological studies focus on a research subjects' point of view. Tong et al. (2007), further suggested that phenomenology is used "to describe the meaning and significance of experiences" (p.3). Open-ended questions were utilized in both the survey and interview components of this study, while additional probing questions were used, as appropriate, during face-to-face interviews. Responses to open-ended questions on the survey of MLT and MLS program directors, as well as semi-structured interview transcripts of rural clinical laboratory managers were carefully examined for emerging themes. As stated previously, a six-step approach, as outlined by Creswell (2014, pp. 197-201), was used to analyze the qualitative portion of this study. Data were carefully organized into categories and manually coded for the identification of themes.

Both common and contrasting categories were identified between data from MLT and MLS program directors and rural clinical laboratory managers. Although viewpoints differed slightly, program directors and rural laboratory managers shared many of the same concerns. Four overarching cross-themes emerged from the qualitative results of this study: partnership, promotion of the profession, environment, and quality of care.

Partnership: We "Get No Attention from Schools"

Analysis of the qualitative findings in this study indicated that communication, or lack thereof, was an issue for both MLT and MLS program directors and rural laboratory managers. The laboratory managers participating in the study revealed a desire for more engagement by MLT and MLS programs. As stated previously in the research findings, one manager said that rural labs "get no attention from schools [higher education institutions]". Some of the managers stated that they were also unaware of what higher education institutions offered MLT and MLS programs and that it would be beneficial if they could communicate rural job openings with program directors to share with students.

Program advisory committees play a vital role in the strategic planning of MLT and MLS programs. Some of the program directors noted that program viability is an issue. The findings further suggested that rural laboratory managers would like to be more involved with program advisory committees, however, issues such as staffing often prevent them from attending meetings. Advisory committees also help shape program delivery and curriculum, both of which were noted to be concerns for rural laboratory managers.

The research findings indicated that the strongest example of partnership between MLT and MLS programs and rural clinical laboratories involved clinical affiliations. While program directors suggested that they had difficulty placing students for clinical rotations and that rural facilities were sometimes not adequate for MLS level clinical rotations, the rural laboratory managers indicated an eagerness to accept

students for clinical rotations. The laboratory managers did recognize the limitations of a rural laboratory regarding MLS rotations, specifically in the areas of microbiology and immunohematology. There was, however, a notable concern by the laboratory managers that the inability to recruit MLSs will significantly affect rural laboratories in the future, as the pool of individuals qualified for supervisory positions continues to diminish.

Promotion of the profession: "A Joint Effort"

Following along with the theme of partnership, promotion of the profession was a prominent recurring theme. Both program directors and rural laboratory managers acknowledged a general lack of public knowledge about the clinical laboratory science profession. Laboratory managers recognized that they, along with higher education institutions, should play a role in student recruitment. One program director described the situation best, saying:

> The ability to recruit students into a (*sic*) unknown profession has to be a joint effort between employers, college and high school counselors, one (*sic*) entity cannot do it alone. It is hard to get students in the door even with 100% job placement and 100% pass rates on the BOC [Board of Certification] exam.

The rural laboratory managers strongly suggested that higher education institutions utilize targeted recruitment efforts in those areas where the workforce shortage is the most critical.

While the laboratory directors were largely unaware of any higher education institution recruitment initiatives in their area, MLT and MLS program directors noted

significant issues with recruitment priorities of higher education institutions. Some program directors suggested that while the department may recruit students, the higher education institution itself shows minimal effort in the recruitment of students for MLT and MLS programs. The program directors also noted that at the institutional level, student recruitment for the health care professions is largely biased toward nursing programs. One program director stated:

> I have asked my admissions office to help me with recruiting students from the areas that my affiliates are in, especially those areas that have difficulty hiring. Their response is that they recruit for the university, not for the program. Therefore, I find that recruiting efforts have to (*sic*) come from my department. This is a financial and personnel strain.

Laboratory managers also pointed out their concern that students are often recruited into MLS programs as a springboard into medical school, which does not help combat a dwindling laboratory workforce. Both program directors and laboratory managers indicated that the lack of recognition for the field of clinical laboratory science from both higher education and health care facility administrators makes it harder to recruit students into the field.

Environment: "People Have to Want to Come Here"

Program directors were quick to point out that you cannot force students to work in a certain geographical area. Laboratory managers also acknowledged that location was one of the primary barriers that they face when it comes to recruitment of employees. The first laboratory manager interview yielded the most straight-forward

example of barriers to recruitment, stating, “People have to want to come here.” While both program directors and laboratory managers indicated that salary was an issue in rural laboratories, location emerged as the primary barrier to attracting new employees.

One aspect of environment that emerged in the laboratory manager interviews, but not the program director survey, was the unique perspective of health care that rural laboratories have to offer students. The laboratory managers passionately described the “family-like” atmosphere in rural health care facilities. They also argued that those MLTs and MLSs working in a rural setting, in comparison to those working in an urban facility, were more apt to use critical thinking skills on a routine basis because they are more directly involved with the care patients. Several of the lab managers described a close relationship between the clinical laboratory, nursing, and physicians, which fosters teamwork and mutual respect between the various health care professionals. Rural facilities offer students unique perspective that they would not get at an urban facility. While most of the laboratory managers agreed that a rural facility may not be ideal for the entire duration of clinical rotations, they felt strongly that the inclusion of a short rural rotation, would greatly benefit students by allowing them to see what rural facilities have to offer in comparison to larger, urban hospitals.

Quality of Care: “Education as a Commodity”

The quality of patient care appeared to be a common concern for both program directors and rural laboratory managers. A distinct lack of MLSs in the rural setting, proved to be a major problem for laboratory managers who indicated concern for recruitment of employees to fill positions in both management and specialized areas of

testing, including microbiology and immunohematology. Both groups also indicated a growing anxiety that the workforce shortage of qualified laboratory professionals may lead to an increase in the number of laboratories forced to hire individuals without specific clinical laboratory science education. One survey respondent noted that instead of focusing on quality, rural laboratories have been forced to simply focus on recruiting "bodies." Another program director indicated that higher education is more focused on the bottom line than ensuring an adequate clinical laboratory workforce, stating, "I have concluded that US higher education's modus operandi follows a business model, specifically it treats education as a commodity. Consequently, its response to shortages of MLTs and MLSs in rural area is poor at best."

To manage problems encountered with the workforce shortage, many rural laboratories are forced to employee travel techs instead of full-time employees, while others succumb to outsourcing of laboratory testing. The use of travel techs was mentioned by both program directors and laboratory managers and presents a special problem for rural laboratories. To adequately staff their clinical lab, managers often find it necessary to employee travel techs. While the use of travel techs may help laboratories to avert a staffing crisis, it can lead to issues with quality of testing, as well as significant budgetary concerns due to the high wages for which travel techs are typically contracted. One laboratory manager shared a scenario that they experienced where a MLT left the laboratory to become a travel tech, then later contracted to work for the same laboratory for travel tech wages, making as much as three to four times their normal hourly wage. As rural laboratories have trouble recruiting MLTs and MLSs,

they may also find it necessary to outsource some testing to larger health systems or reference laboratories. Both program directors and laboratory managers noted that outsourcing could have a negative effect on patient care by delaying diagnosis and treatment, while some laboratory managers also indicated a fear that more laboratory testing would be performed by nursing in the future.

Summary

The purpose of this study was to determine if higher education institutions are meeting the employment needs of rural clinical laboratories. The study was conducted utilizing a survey of 429 NAACLS accredited MLT and MLS program directors, in addition to face-to-face interviews with 10 clinical laboratory managers in rural West Virginia hospitals. Survey participation yielded a 39% response rate, while extensive qualitative data were collected through open-ended survey questions and interviews. Four prominent cross-themes were identified between survey respondents and interview participants: partnership, promotion of the profession, environment, and quality of care. The following research questions were addressed:

1. What formal relationships, if any, exist between rural clinical laboratories and MLT/MLS programs?
2. To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?
3. To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

The first research question explored the existence of formal relationships between MLT/MLS programs and rural clinical laboratories. Data revealed that higher education institutions are more apt to create affiliation agreements with nearby health care facilities. The research findings further suggested that community and technical colleges and predominately four-year colleges were more likely than universities to establish clinical affiliation agreements with rural hospitals. MLT programs were also more likely than MLS programs to have affiliations with rural clinical laboratories. While rural laboratory managers were eager to accept students, there was a glaring deficiency of affiliation agreements between rural laboratories and MLS programs. Community and technical colleges and higher education institutions offering MLT programs also included rural laboratory representation on advisory committees more often than did universities and MLS programs.

The second research question investigated the extent to which higher education institutions were addressing the staffing needs of rural laboratories. Again, community and technical colleges were more likely than four-year colleges and universities to have graduates working at a rural facility. Data further indicated that MLT graduates that completed rural clinical rotations were the most likely to be employed in a rural laboratory. Although both MLT/MLS program directors and laboratory managers noted that rural facilities may not be ideal for all clinical rotations, the laboratory managers felt strongly that the inclusion of a short rural rotation was beneficial to students by allowing them to see the different environment and dynamics of rural health care facilities. Interview data revealed that 70% of rural clinical laboratory managers described the rural laboratory workforce shortage as severe, with some experiencing the inability to fill

positions for as long as seven years. Rural laboratory managers also indicated that they were greatly concerned about filling positions in microbiology, immunohematology and management in the future. The inability of rural laboratories to effectively recruit MLS job candidates was a major issue for most managers.

Rural laboratory managers indicated that the majority did not feel that higher education had adequately responded to the laboratory workforce shortage. The managers expressed a general opinion that higher education institutions focus on their local area, while giving no attention to the needs of rural health care facilities. Similarly, MLT/MLS program directors noted frustration with recruitment activities at the institutional level. Low numbers of MLT and MLS graduates, along with sparse programs and a perceived lowering of curriculum requirements, were major concerns for rural laboratory managers. Interview responses further indicated that rural laboratory managers desired better communication with higher education institutions, as well as enhanced use of targeted recruitment in rural areas. Both MLT/MLS program directors and laboratory managers signified that promotion of the profession was paramount to building a future clinical laboratory workforce.

The third research question examined the extent to which MLT and MLS programs were addressing the professional development needs of incumbent workers in rural clinical laboratories. MLS programs were more likely than MLT programs to offer fully online curriculum. This was a noteworthy finding since rural laboratory managers suggested online programs were more practical for incumbent workers who wished to further their education. Laboratory managers also indicated they would like to

see more MLT and MLS programs offer continuing education for incumbent workers who are required to have a set number of annual continuing education hours for national certification and state licensure renewal. Universities were more likely to offer continuing education opportunities than were predominately four-year colleges and community and technical colleges.

The results of this study revealed that higher education institutions are not adequately meeting the employment needs of rural clinical laboratories. The data revealed key areas for improvement, including communication, partnership, and promotion of the profession. As the clinical laboratory workforce continues to shrink, it is essential that higher education institutions acknowledge the employment needs of rural laboratories to ensure quality patient care in underserved areas with limited access to health care.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Purpose

The purpose of this non-experimental mixed-method study with correlational analysis was to examine the extent to which higher education institutions are meeting the employment needs of rural clinical laboratories. Amid a nationwide shortage of Medical Laboratory Technicians (MLTs) and Medical Laboratory Scientists (MLSs), rural clinical laboratories are highly dependent on partnerships with higher education institutions to ensure and sustain a qualified rural workforce. This study analyzed the perceptions of rural clinical laboratory managers toward higher education's response to the shortage of MLTs and MLSs, as well as the extent to which MLT and MLS programs are meeting the staffing and professional development needs of rural clinical laboratories. As more emphasis is placed on higher education institution mission and service to the community, as well as job placement rates (HLC, 2016), the magnitude of higher education institution collaboration with rural health care facilities plays an important role in securing a clinical laboratory workforce and quality rural health care for the future. The following research questions were addressed:

1. What formal relationships, if any, exist between rural clinical laboratories and MLT/MLS programs?
2. To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?
3. To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

Population and Sample

This descriptive mixed-method research study examined two different populations: directors of National Accrediting Agency for Clinical Laboratory Science (NAACLS) accredited MLT and MLS programs and clinical laboratory managers of rural hospitals. For this research study, the term "rural" was defined as an area located at least 40 miles from cities having a population of 25,000 or greater. The decision to study both populations allowed for the examination of perspectives from higher education institutions and rural clinical laboratories.

The quantitative research sample was comprised of program directors of NAACLS accredited MLT and MLS programs from across the United States, with participants from 47 states and the District of Columbia. Program director contact information was manually retrieved from the NAACLS website. Military programs were excluded from this research. A total of 439 survey invitations were delivered with 167 responses, yielding a 39% response rate. Participation of community and technical colleges was slightly higher than that of universities. Predominately four-year colleges and hospital-based programs were also included in the data collection process. More than half of the respondents represented higher education institutions located in urban areas, while MLT and MLS program representation was nearly equally distributed.

The qualitative portion of the study concentrated on a sample of 10 clinical laboratory managers from West Virginia, a state that is predominately rural and requires state licensure of clinical laboratory professionals. Input from the West Virginia Office of Laboratory Services was utilized to identify rural hospitals recognized as having issues with MLT and MLS recruitment. Thirteen rural clinical laboratory managers were initially

invited to participate in the research, while 10 granted facility access and agreed to participate in face-to-face interviews.

Methods

An online survey, created with Qualtrics software, was utilized to collect the quantitative data for this study. The survey remained open for a period of six weeks. Descriptive and correlational statistics were derived using IBM SPSS Statistics Version 22.0. Demographics, frequency distributions, and correlational analysis were used to examine the quantitative findings. In addition to objective questions, two open-ended questions were included in the survey to determine targeted recruitment methods and the general concerns of MLT and MLS program directors regarding higher education's response to shortage of MLTs and MLSs in rural areas.

The qualitative portion of the research study examined the same topics as the program director survey. Face-to-face interviews of rural clinical laboratory managers were used for the collection of qualitative data. Utilizing the six-step approach outlined by Creswell (2014, pp. 197-201), qualitative findings were transcribed, organized, categorized, and coded for identification of common themes. Qualitative data from the program director survey were examined in the same manner as that collected through face-to-face interviews. Cross-themes were then identified between the program director and laboratory manager responses.

Summary of Research Findings

Quantitative and qualitative findings from both the program director surveys and clinical laboratory manager interviews were addressed collectively in relation to each of

the stated research questions. Quantitative data were examined based on three variables: higher education institution type and geographical location, as well as program type. Distinct categories were identified among the qualitative data collected for *Research Question One* and *Research Question Two*. In addition, four cross-themes were recognized in the responses of program directors and rural laboratory managers.

RQ1: What formal relationships, if any, exist between rural clinical laboratories and MLT/ MLS programs?

As a means of determining how well higher education institutions satisfy the employment needs of rural clinical laboratories, it was necessary to first examine the degree of formal relationships between the two groups. Two primary topics, clinical affiliation agreements and program advisory committee participation, were investigated to determine the extent to which rural clinical laboratories and MLT/MLS programs establish formal relationships. Qualitative data relevant to the first research question revealed three categories: barriers, environment, and partnership.

One of the primary relationships formed between MLT/MLS programs and clinical laboratories revolved around clinical affiliation agreements. Survey results showed that only 22.8% of respondents indicated that at least half of their clinical affiliates were in rural areas. The survey data also revealed that rural higher education institutions were more likely to use rural clinical sites. A strong negative correlation further suggested that higher education institutions tend to utilize clinical affiliates located nearby. Community and technical colleges and predominately four-year colleges were more likely to establish clinical affiliations with rural health care facilities than were

universities. The data also demonstrated that MLT programs were more likely than MLS programs to use rural clinical affiliates. This finding may be explained due to rural facilities' general lack of high-complexity and specialized testing, both of which are required components of MLS clinical education.

Qualitative data revealed two categories related to clinical affiliation agreements: barriers and environment. Program directors noted that they were often unable to place students at rural facilities due to low facility staffing and inadequate exposure to areas of high-complexity testing, specifically microbiology and immunohematology. This finding supported the literature, which indicated general difficulty securing clinical rotation placement for MLT and MLS students (Bennett et al., 2014; Malone, 2011; Scott, 2015). Conversely, rural laboratory managers demonstrated an eagerness to accept students for clinical training. Only one out of 10 rural laboratory managers indicated that they had no clinical affiliations with any MLT or MLS program. While 90% of the laboratories participating in this study did have clinical affiliation agreements, they noted that MLT and MLS student placement at their facility was sporadic and that they were mostly limited to accepting only one student at a time. One of the most concerning findings regarding clinical affiliations was that only 20% of the laboratories participating in this study had agreements to accept MLS students. When asked why they didn't have an affiliation agreement with any MLS programs, they stated that they had never been approached by MLS programs to take students for clinical rotations. Rural laboratory managers also noted that the unique environment of rural facilities offered students a different perspective on health care in comparison to what they may experience at urban facilities. Laboratory managers further described that rural facilities offer students

the opportunity to become more directly involved in patient care through an environment that promotes inter-departmental teamwork, critical thinking, and problem solving, while offering an employee community that is more like family than co-workers.

The second type of relationship between MLT/MLS programs and clinical laboratories is fostered through program advisory committee participation. Hammerling and Van Der Heyden (2011) emphasized the importance of including a wide range of clinical affiliates on program advisory committees. Survey findings revealed that higher education institutions located in rural areas were significantly more likely to include rural laboratory representatives on their MLT/MLS program advisory committee. The data further demonstrated that community and technical colleges, and those institutions offering MLT programs or both MLT and MLS programs, were significantly more likely to include rural laboratory representation on MLT/MLS program advisory committees. Qualitative data indicated that partnership was important to rural laboratory managers and that there was a glaring deficiency in rural facility representation on MLS advisory committees. Three out of 10 rural laboratory managers noted that they were not a member of any MLT/MLS advisory committee, while only one out of 10 was a member of an MLS advisory committee. Several of the rural laboratory managers noted that a newly established MLT program in their area was a welcomed addition. At the time of this research study, the program had not yet achieved NAACLS accreditation, however, the first group of program graduates had recently completed clinical rotations. One manager further noted that prior to the creation of that new MLT program, “We had nothing.”

RQ2: To what extent are MLT and MLS programs addressing the staffing needs of rural clinical laboratories?

A large portion of the data collected for this study were utilized to examine the extent to which MLT and MLS programs are addressing the staffing needs of rural clinical laboratories. To answer this research question, participants were asked questions regarding graduate employment at rural facilities, the relationship between rural employment and completion of rural clinical rotations, rural clinical laboratory workforce issues, and recruitment of future clinical laboratory professionals. Additionally, qualitative findings delved into rural laboratory manager perceptions of higher education's response to the rural laboratory workforce shortage, as well as general concern for the future of rural clinical laboratories. Responses to the open-ended questions on the MLT/MLS program director survey fell into two categories: workforce demand and quality of patient care, as well as student recruitment and program survival. Rural laboratory manager interviews revealed four categories of data: workforce management, employee recruitment barriers, communication and engagement, and concern for the future of rural laboratories.

Graduate employment rates at rural facilities were determined using the MLT/MLS program director survey. Overall, only 17.36% of respondents indicated that at least half of MLT/MLS program graduates work at a rural facility. Exactly half of rural higher education institutions indicated that 75% or more of MLT/MLS program graduates work at rural health care facilities. In comparison, 79% of urban and somewhat urban higher education institutions noted that less than one-fourth of MLT/MLS program graduates secure employment at a rural facility. A significant

correlation was revealed between the geographical location of MLT/MLS programs and rural job placement for graduates, with rural MLT/MLS programs exhibiting much higher rural placement of graduates. In addition, 28.77% of community and technical colleges, compared to only 8.33% of universities, demonstrated that at least half of their MLT/MLS program graduates obtained employment at a rural facility. Overall, the data revealed that community and technical colleges are addressing the staffing needs of rural facilities more effectively than are universities and MLT programs are the primary source for rural clinical laboratory professionals. This finding was similar to that of Slagle (2013), who found that most rural clinical laboratories in Tennessee targeted community colleges for prospective employees.

Survey data was also used to investigate the correlation, if any, between rural employment of MLT/MLS program graduates and completion of rural clinical rotations. According to the literature, completion of rural clinical rotations in health care related fields has a positive effect on the decision to practice in a rural location after graduation (Chen et al., 2010; Coyle & Narsavage, 2012; Quinn et al., 2011; WVHEPC, 2015). When asked to identify the percentage of program graduates that both worked in and completed clinical rotations at a rural facility, 34.18% of MLT/MLS program directors indicated that at least half of those graduates working in rural facilities had completed clinical rotations at a rural health care institution. Rural institutions, and community and technical colleges, were the most likely type of higher education institutions to have students completing rural rotations and subsequently obtaining employment at a rural location post-graduation. Data also revealed that MLT graduates were more likely than MLS graduates to work in rural facilities after having completed a rural clinical rotation.

Astoundingly, 70.51% of MLS program directors noted that less than one-fourth of program graduates working in rural facilities had completed a rural clinical rotation as a student. It should be noted, however, that the conclusion that MLT graduates are more likely to pursue rural employment after completing rural clinical rotations may be misleading due to the low number of MLSs working in rural areas and the arguable suitability of rural facilities for MLS clinical rotations, as described in the findings for *Research Question One*.

Directors of MLT/MLS programs recognized several issues involving workforce demand and the quality of patient care. Several program directors noted that the primary problem with employee recruitment in rural health care facilities is undesirable location. Feedback from program directors also included statements regarding MLT/MLS recruitment from other countries, specifically the Philippines, as a common method that rural laboratories use to fill staffing vacancies. Program directors further signaled a "disconnect" between the staffing needs of rural clinical laboratories and the willingness to participant in the clinical education of students. To help combat the rural laboratory workforce shortage, some survey respondents noted that they were either developing or had implemented alternative pathways, including hybrid programs and career ladder pathways for clinical laboratory science education. Survey respondents also signaled a concern for the quality of patient care amid growing workforce shortages, inconsistency in employment requirements and professional licensure for MLTs and MLSs, and the exponential rise in outsourcing of clinical laboratory testing from rural facilities, which can potentially delay diagnosis and treatment.

Workforce management was identified as a key component for controlling staffing needs amidst a prominent shortage of MLTs and MLSs in rural areas. When asked how they would rate the shortage of rural clinical laboratory professionals, 70% of laboratory managers said that the workforce shortage was severe, while 30% noted a moderate shortage in their local area. Clinical laboratory managers noted the dramatic effect that losing only one or two MLTs or MLSs could have on small rural laboratories. Rural laboratory managers indicated staff vacancies lasting from two months to over a year, with long-term openings observed for as long as two to four years. One laboratory manager noted that their clinical laboratory had consistently remained short staffed for the past seven years, while another manager acknowledged an additional problem in which hospital administration eliminates positions that are not filled within a period of 90 days.

Due to the inability to recruit MLT and MLS job candidates, 50% of the rural laboratory managers indicated that they had resorted to employing travel techs in recent years. Those managers who had employed travel techs shared mixed feelings regarding both competency and efficiency and noted that the most prominent problem with using travel techs is that it creates a significant budgetary burden for the laboratory. As MLTs and MLSs leave full-time positions in rural laboratories to become travel techs, the rural laboratories are left unable to recruit new employees and are, therefore, forced to hire travel techs at three to four times the normal pay rate. Several of the managers also acknowledged concern for an aging workforce, upcoming retirements, and a low number of MLT/MLS program graduates.

Interview participants were asked to identify the barriers that make employee recruitment difficult for their facility. Location was noted as the primary barrier to finding qualified MLTs and MLSs by 60% of rural laboratory managers, with most indicating that rural life is not a "good fit" for everyone. Salary was also recognized as a recruitment barrier by 50% of laboratory managers, with the availability of spousal employment also playing a role in recruitment for rural facilities. Laboratory managers also showed frustration with hospital administration's emphasis on the nursing shortage, while paying little attention to the shortage of qualified MLTs and MLSs.

A distinct shortage of MLSs was noted as a concern for rural laboratories. Of the 10 managers that were interviewed, only four indicated a staff mix consisting of at least 50% MLSs. One of the rural laboratories included in this study previously had a NAACLS accredited MLS program. That program had closed eight years prior to this study due to the inability to recruit a program director and the high cost associated with sustaining the program. Laboratory managers also pointed to additional concern for MLS recruitment because many MLS program graduates choose to pursue a graduate degree in a health care field, rather than seeking employment in the clinical laboratory.

To examine rural laboratory hiring practices, laboratory managers were asked if they require national certification for MLTs and MLSs and if they employed individuals who had not graduated from a traditional MLT or MLS program. All the laboratory managers indicated that they prefer MLT and MLS program graduates, however, some of them did employee individuals who were grandfathered under WV state licensure requirements. Two of the laboratory managers stated that they had hired individuals with a Bachelor of Science degree because of the workforce shortage, while one rural

laboratory manager noted that they had employed an individual trained through the military. The most significant finding related to employment of alternatively eligible individuals involved a Medical Assistant who met the requirements for WV state licensure as a clinical laboratory technician because she had an associate degree in a biological science combined with on-the-job training. Under WV state licensure, the medical assistant was qualified to perform moderate complexity testing, including limited immunohematology. Her job duties also included quality assurance and quality control oversight, as well as review of Levey-Jennings charts.

A focus on recruitment of future clinical laboratory professionals was noted by MLT and MLS program directors. Only 28.14% of MLT and MLS programs indicated that they use targeted recruitment efforts. When asked to identify the types of targeted recruitment activities that they use, program directors identified high school recruitment events, a focus on pipeline and STEM programs, health care related events, job shadowing, as well as targeted use of social media. This data supported the literature, which placed an emphasis on high school recruitment, promotion of the profession, and targeting of students in STEM programs (Rothenberg, 2016; Bennett et al., 2014). Program directors also indicated that they often target phlebotomists and encourage them to pursue an MLT degree.

MLT/MLS program directors indicated a concern for student recruitment and program survival. The need for promotion of the profession was a recurrent notation among survey responses. Numerous MLT/MLS program directors recognized problems with student recruitment at the institutional level related to a lack of understanding from higher education administrators regarding the important role that clinical laboratory

professionals play in patient care. This finding supported Linder (2012), who noted that higher education administrators often lacked knowledge about the clinical laboratory science field. Several program directors noted that institutional recruitment efforts are highly focused on nursing, with little to no attention given to MLT and MLS programs. Program directors signaled frustration with recruitment of students into MLT and MLS programs, as many students seek out other professions having a higher salary. As higher education institutions continue to face remarkable budget cuts, program directors also indicated an ongoing fear of program closure related to the high cost and low enrollment of MLT and MLS programs. This finding echoed Beckering and Brunner (2003), who noted higher education's increased scrutiny of low enrollment, high cost clinical laboratory science programs. Additionally, some program directors noted that they not only have trouble recruiting students, but that it is often an arduous task to find qualified instructors to teach in MLT and MLS programs.

Rural laboratory managers demonstrated a strong desire for increased communication and engagement with MLT and MLS programs. When asked if they were aware of higher education institution recruitment activities in their local area, 90% of interview participants indicated that they were unaware of any recruitment activities. A lack of programs was also noted, with only 50% of rural laboratory managers indicating that a MLT or MLS program was located within 45 miles of their facility.

Rural laboratory managers were also asked if higher education institutions had done enough to address the shortage of MLTs and MLSs in rural areas. Seventy-percent of the laboratory managers strongly disagreed that higher education had adequately responded to the laboratory workforce shortage, while 20% expressed a

mixed opinion. Subjective research data revealed a strong desire by rural laboratory managers for higher education to do more to address rural workforce shortages. There was also a general opinion that most higher education institutions focus solely on their local areas. A lack of MLT and MLS programs, along with a low number of graduates, was a major concern for rural laboratories who indicated that they often have only one or two pools of students to draw from. To the consternation of many rural laboratory managers, declining curriculum requirements and a diminished focus on critical thinking and problem-solving skills represented additional areas of concern regarding the future of clinical laboratory science.

When asked what steps that they would like for higher education to take to address the rural clinical laboratory workforce shortage, most laboratory managers suggested increased recruitment efforts at middle and high schools. Other recruitment suggestions included displays at local events and attractions, overall public promotion of the profession, and communication with school counselors. Rural laboratory managers also indicated that they would like to see higher education institutions work more closely with rural clinical laboratories that are struggling to find MLTs and MLSs to target local high school students and aid rural students in overcoming any obstacles that may prohibit them from pursuing a college degree. Rural laboratory managers further stated they would like to see improvement in communication from higher education institutions and they do not feel that higher education pays adequate attention to the needs of rural clinical laboratories. For instance, 60% of rural laboratory managers participating in this research study were unaware of an online MLS program available in their state.

Suggestions for communication also included the sharing of rural clinical laboratory employment opportunities with students.

Program directors and rural laboratory managers indicated a deep concern for the future of rural laboratories. Responses focused on the inability to effectively recruit MLTs and MLSs to rural areas and the subsequent effects on the quality of health care and patient safety. There was a general feeling among both MLT/MLS program directors and clinical laboratory managers that some clinical laboratories had already been forced to lower employment standards out of desperation. Some research participants noted that focus was sometimes placed on finding "bodies" to fill positions, rather than on the quality of a job candidate. More specialized areas of laboratory testing and management positions were key areas of concern for laboratory managers as they looked toward the future. Fifty-percent of the laboratory managers noted a concern for staffing in the microbiology department, while 20% stated they were concerned about filling immunohematology positions. Recruiting MLS candidates to fill future management and supervisory positions was a major concern for 30% of rural laboratory managers.

Clinical laboratory managers recognized that they also have a role to play in the recruitment of future clinical laboratory professionals. Qualitative findings revealed the need to promote the profession to hospital administrators and the public as a method of fortifying clinical laboratory control of testing and avoiding encroachment of nursing by means of point-of-care testing. Potential revision to CLIA regulations by the Centers for Medicare and Medicaid Services (2018) was also seen as a future threat to clinical

laboratories, as currently proposed amendments would allow nurses to supervise and perform moderate and high-complexity laboratory testing

RQ3: To what extent are MLT and MLS programs addressing the needs of rural clinical laboratories regarding professional development of incumbent employees?

Higher education plays a vital role in the professional development of incumbent clinical laboratory professionals. Linder (2012) noted that online curriculum, career ladder programs, and opportunities for professional development, all play a role in the retention of current clinical laboratorians. Many clinical laboratorians pursue career advancement through continued education within the field of clinical laboratory science. MLTs wishing to pursue an MLS degree, as well as phlebotomists who wish to attain an MLT degree, depend upon availability of MLT and MLS programs close to home or online. Higher education institutions may also play a role in fulfilling continuing education requirements needed for certification and professional licensure renewal for MLTs and MLSs. There were no obvious categories among the qualitative data collected for this research question; however, the need for stronger communication and partnership between rural clinical laboratories and higher education institutions was indicated.

Program directors were asked to identify the percentage of their program courses available online. Survey data revealed that only 34.41% of MLT and MLS programs offered online courses. There was no significant correlation noted between program type (MLT or MLS) or higher education institution type and the use of online components. Survey respondents were also asked to specify if program courses were

offered in a blended or fully online format. Blended course formats were used by 70.91% of MLT/MLS programs, while only 29.09% of MLT/MLS programs were fully online. Findings further revealed that 32.00% of MLS programs, in comparison to only 17.39% of MLT programs, were offered in a fully online format. There was no significant correlation between the type of higher education institution and the use of blended versus fully online courses in MLT/MLS programs.

Several of the laboratory managers noted that they encourage current employees to further their education. Fifty-percent of the hospitals participating in the qualitative portion of this study offered funding for employees wishing to pursue an MLT or MLS degree. Two out of 10 managers stated that some supervisors in their laboratory had been forced to pursue a MLS degree due to changing educational requirements for general and technical supervisors under CLIA guidelines. The rural laboratory managers unanimously indicated that online programs were the best option for employees to further their education in clinical laboratory science, while 80% of the managers indicated that online was the only option due to distance between their facility and the closest MLT/MLS program. Only two out of 10 laboratory managers stated that internet service was a potential barrier to online education in their local area.

Survey respondents were also asked to share the rate at which they secure articulation agreements with rural MLT/MLS programs. This question was intended to gauge the use of articulation agreements between associate degree and bachelor's degree programs. For instance, MLS programs sometimes form articulation agreements with MLT programs to increase student enrollment, while creating a seamless transition from one higher education institution, or program, to another.

Statistical analysis revealed no correlation between type or geographical location of the higher education institution, or type of program offered, and the implementation of articulation agreements. Only 13.33% of MLT/MLS programs indicated that they frequently establish articulation agreements with programs located in rural areas.

Annual continuing education within the field of clinical laboratory science is required for national certification and most state licensure renewals. When survey respondents were asked how often they offer continuing education, including workshops, conferences, and online training modules, only 9.04% of MLT and MLS programs indicated that they offer continuing education on a frequent basis. More than 54% of MLT and MLS programs stated that they never offer continuing education. When examined by type of institution, 25.42% of universities and 12.33% of community and technical colleges indicated that they occasionally or frequently offer continuing education. Overall, this study revealed that universities were significantly more likely to offer continuing education than community colleges.

When rural laboratory managers were asked if higher education institutions offered adequate options for continuing education, 50% stated that they would like to see MLT and MLS programs offer more options for incumbent workers. This finding was like that of Slagle (2013), who determined that just 39.1% of rural laboratories indicated “adequate” access to professional development. The other 50% of laboratory managers participating in this study indicated that vendor-sponsored continuing education met the needs of their employees. Several laboratory managers did note that online modules would be the most beneficial format for continuing education offerings,

because staffing concerns often prohibit rural clinical laboratorians from attending seminars and conferences at other locations.

Themes

Four cross-themes emerged from the qualitative data of this mixed-method study. Although contrasting views were apparent on some topics, such as rural clinical rotations, MLT/MLS program directors and rural laboratory managers shared many of the same concerns regarding staffing and the future of rural clinical laboratories. The overarching themes of partnership, promotion of the profession, environment, and quality of care were evident among the research findings.

Partnership was the first theme that materialized among the findings. Rural clinical laboratory managers noted a distinct lack of communication from higher education institutions and indicated a strong desire for more engagement by MLT and MLS programs. A lack of awareness regarding program availability, as well as course delivery and curriculum, were troublesome for rural laboratory managers. Clinical rotations were one area of contrasting opinion between rural laboratory managers and MLT/MLS program directors. While program directors indicated that rural facilities were unwilling or unsuitable for student clinical rotations, the rural laboratory managers were excited by the opportunity to host students for rotations. As MLT and MLS programs face issues with program viability, partnerships with rural laboratories can be beneficial to both parties. The formation of strong working relationships between MLT and MLS programs and rural laboratories will play a vital role in combatting the shortage of clinical laboratory professionals in the future.

Promotion of the profession was a paramount concern for MLT/MLS program directors and rural clinical laboratory managers. Both groups acknowledged that a general lack of public knowledge regarding the field of clinical laboratory science was a major obstacle to strengthening the workforce. While laboratory managers noted that hospital administrators were more focused on the nursing shortage than the shortage of MLTs and MLSs, program directors noted the same about higher education administrators and those individuals involved in the marketing of programs and student recruitment. One of the most prominent suggestions for promotion of the profession among program directors and laboratory managers involved targeted recruitment in areas struggling to find qualified job candidates.

Environment was identified as the third cross-theme. Rural location was noted by both program directors and laboratory managers as a major barrier to recruitment of MLTs and MLSs to rural areas. While obstacles including location and low wages make it difficult for rural laboratories to recruit MLTs and MLSs, rural laboratory managers noted the unique perspective that spending time at a rural facility can bring to students in clinical laboratory science programs. Most of the laboratory managers agreed with program directors that rural facilities may not be suitable for all clinical rotations, however, they suggested that even a short rural rotation could greatly influence a student's view of the health care system while offering them an option other than working in large, departmentalized hospitals found in urban settings.

Quality of care was an evident concern for both MLT/MLS program directors and rural laboratory managers. A prevailing fear that the growing shortage of MLTs and MLSs in rural areas may lead to the lowering of expectations and employment

requirements was observable with both program directors and laboratory managers. The outsourcing of laboratory testing due to the inability to recruit qualified laboratorians, a growing dependence on travel techs, and a higher education system that is more focused on the "bottom line" than the needs of clinical laboratories, all represent noteworthy issues that potentially threaten the quality of health care in rural areas.

Conclusions and Implications for Higher Education Institutions

This research study offered valuable information to higher education institutions, MLT/MLS programs, rural health care facilities, and clinical laboratories, regarding higher education's response to the rural clinical laboratory workforce shortage. As Rohde (2014) stated, clinical laboratory science is "one of the most under-recognized health professions." The findings of this study revealed the exceptional need for better promotion of the clinical laboratory science profession, as well as collaboration between higher education institutions and rural clinical laboratories.

The research findings demonstrated significant correlations between three higher education institution variables (location, institution type, and program type), the frequency with which affiliation agreements are created with rural clinical laboratories, and the frequency of rural laboratory representation on MLT/MLS program advisory committees. Hammerling and Van Der Heyden (2011) noted the important role that advisory committees play in program creation and sustainability. The data from this study revealed that community and technical colleges and MLT programs were more likely than universities and MLS programs to use rural clinical laboratories as clinical

affiliates for student rotations. Although MLT/MLS program directors shared concern regarding the inability to secure rural clinical sites, rural laboratory managers welcomed the opportunity to teach students. Community and technical colleges and MLT programs were also significantly more likely to include rural laboratory representatives on program advisory committees. Advisory committees can often serve as an ally when MLT or MLS programs are faced with the possibility of closure due to low student enrollment. These findings suggested a compelling need for universities and MLS programs to bolster relationships with rural clinical laboratories.

Significant correlations were also noted regarding rural employment of graduates, as well as the connection between rural clinical site placement and subsequent rural employment. As somewhat expected, rural higher education institutions were most likely to have MLT and MLS graduates working in rural facilities. Again, community and technical colleges and MLT programs were the primary source for rural clinical laboratory professionals. These findings were like those of Reid (2005) who discovered that rural health care institutions heavily rely on community colleges for nurse recruitment. Similarly, in a study of Tennessee laboratories, Slagle (2013) suggested that most rural laboratories targeted community colleges for potential job candidates. The link between rural clinical rotations and rural employment of graduates was notable for MLT programs, while universities and MLS programs were notably less likely to have program graduates working in rural facilities.

Laboratory managers expressed that although a rural facility may not be suitable for all rotations, a partial rotation in a rural clinical laboratory can enlighten students as to the unique atmosphere that rural hospitals offer. In a study of past graduates who

had completed a limited rural clinical rotation as an MLS student, Kirby (2007) found that 50% of respondents worked at a rural facility and 73.4% felt that completing a rural clinical rotation helped them to understand the distinctive needs of rural clinical laboratories. Another study that focused on allied health students from multiple disciplines found that students who completed rural clinical rotations on a voluntary basis were more likely to obtain employment in a rural facility after graduation (Playford et al., 2006). Allowing students, especially at the MLS level, to complete a partial rotation at a rural location could not only help those locations to attract job candidates who may otherwise not have considered working at a rural hospital, but it could diversify students' backgrounds to better prepare them for the workplace.

Rural laboratory managers indicated a moderate to severe clinical laboratory workforce shortage in their local area, with some locations having positions that went unfilled for up to seven years. Managers also noted the shortage of MLS job candidates was a prominent concern for the future of their laboratory, most notably due to lack of qualified individuals to fill supervisory and management positions. When considered in conjunction with the findings for rural clinical site placement and graduate employment, the need for better partnership between universities and MLS programs and rural clinical laboratories was once again indicated. It is also important for MLS program directors and higher education administrators to realize the influence that a shortage of bachelor's degree Medical Laboratory Scientists may potentially have on the future of rural clinical laboratories.

Research data further revealed an overall lack of engagement and communication between higher education institutions and rural clinical laboratories.

Laboratory managers indicated that they were unaware of student recruitment in rural areas and many were unware of program availability in their own state. Seventy-percent of the laboratory managers felt that higher education institutions had not adequately responded to the rural laboratory workforce shortage. Concern over the low number of available programs, a declining number of graduates remaining in the field, and decreased curriculum requirements for MLT and MLS programs increased the anxiety of laboratory managers as they looked toward the future. Increasing communication, such as the sharing of job opportunities in rural areas, between program directors and rural laboratory managers would be beneficial to both entities. Ideally, higher education institutions should make more of an effort to recognize the needs of rural clinical laboratories. Building relationships with rural clinical affiliates ensures a qualified clinical laboratory workforce while serving rural communities and the needs of rural health care institutions.

Similar to the feelings of laboratory managers, MLT/MLS program directors noted recruitment activities at the institutional level were both inadequate and heavily biased toward nursing. Program directors noted marketing and recruitment offices often focus on generalized recruitment for the institution and there was a lack of knowledge or desire to promote MLT and MLS programs. The use of targeted recruitment was suggested by several of the laboratory managers. By working with rural areas known to suffer from a shortage of MLTs and MLSs, programs could target rural students and aid them in overcoming any obstacles that may deter them from pursuing a college education.

Many program directors also indicated a fear of program closure due to low enrollment, high program cost, and a general lack of knowledge about the field of clinical laboratory science among higher education administrators, who often only look at the "bottom line." Promotion of the profession efforts should not only target the public and hospital administrators, but higher education administration as well. As more programs are threatened with program closures, it is imperative that higher education governing bodies understand the vital role that the clinical laboratory plays in patient diagnosis and treatment, as well as the drastic effect that program closure may have on both rural and urban health care facilities. The marketing of MLT and MLS programs to raise awareness of the profession is imperative to the recruitment of students, who otherwise may not realize the opportunities available in clinical laboratory science.

Rural laboratories also need avenues that allow incumbent workers to further their education with the goal of career advancement. Relevant to the findings of Anderson (2016), which showed a general lack of options when searching for 2+2 programs that allow for career advancement from MLT to MLS, the current study revealed that only 34.41% of MLT and MLS programs offered online courses. MLS programs were significantly more likely to offer online courses than were MLT programs. While this is helpful for MLTs who wish to pursue their MLS degree, there is a seeming lack of opportunities for phlebotomists who wish to pursue a MLT degree, unless there is a MLT program within reasonable distance. Increasing the availability of online programs, as well as supporting the creation of hybrid programs and career pathways for education in clinical laboratory sciences is one way that MLT and MLS

programs can better serve the workforce needs of rural laboratories, while increasing student enrollment and ensuring program viability.

Continuing education is one area that could also benefit both rural laboratories and higher education institutions. MLTs and MLSs require annual continuing education hours to renew national certification and professional licenses. Although community and technical colleges are often more focused on workforce development initiatives, universities were significantly more likely to offer continuing education opportunities to incumbent employees of rural clinical laboratories. Overall, however, more than half of MLT and MLS programs indicated that they never offer continuing education opportunities for rural clinical laboratories. This finding supported information gathered from the laboratory manager interviews. When asked if higher education institutions offered adequate continuing education opportunities, half of the laboratory managers indicated that current offerings were not sufficient. If higher education institutions, or MLT/MLS programs, placed more emphasis on continuing education it could strengthen the partnership between rural clinical laboratories and higher education institutions while augmenting institutional revenue.

Both laboratory managers and MLT/MLS program directors signaled a fear that the quality of patient care would greatly suffer if the workforce shortage is not addressed. The lack of a stable, qualified clinical laboratory workforce can potentially lead to the lowering of employment standards, especially in non-licensure states. It can be inferred that both program directors and laboratory managers feel that the actions of higher education institutions appear more focused on the financial aspects of the institution, rather than the delivery of quality health care. This is glaringly apparent

when considering the comments of program directors indicating a fear of program closure due to low student enrollment. The need for promotion of the profession cannot be understated. To ensure the delivery of quality health care to rural communities, it is essential that higher education institutions recognize their role in the fortification of a competent and efficient clinical laboratory workforce.

Recommendations for Future Research Studies

This research added to the limited literature in the clinical laboratory science field by addressing workforce issues specific to rural clinical laboratories. The study also provided useful information to higher education institutions by identifying problems with recruitment and retention of students, as well as concerns for the future of rural clinical laboratories that may influence MLT/MLS program creation and sustainability. The findings revealed the importance of partnership between higher education institutions and rural clinical laboratories. In addition, the research provided valuable information for states that plan to establish legislation for clinical laboratory personnel licensure, as well as organizations such as the American Society for Clinical Laboratory Sciences, which sets standards for professional scope of practice and supports efforts for professional licensure at the state level.

Based on the findings of this study, future research in the following areas is recommended:

1. The qualitative portion of this research focused on West Virginia, a state that requires licensure of clinical laboratory professionals. Future research might compare the perspectives of licensure and non-licensure states to determine if

the perception of higher education's response to the clinical laboratory workforce shortage differs between states that require licensure and those that do not.

2. Survey respondents from four states indicated that they had developed, or were in the process of developing, hybrid or career ladder programs of study specifically designed to target rural areas. Future qualitative research might examine the success of those programs and the perceptions of rural laboratories as to program effectiveness.
3. A distinct shortage of MLSs in rural facilities was noted in this research study. Future research might specifically investigate the issue of MLS shortages in rural laboratories. The results of such a study would be interesting, considering the wide range in the number of available programs between states and that West Virginia is fortunate to have seven clinical laboratory science programs, two of which are MLS programs, in a primarily rural state.
4. Based on the results of this study and the findings of Kirby (2007), future qualitative research might examine the perceptions of graduates who work in rural areas and who performed either a full or partial rural clinical rotation. Since this study demonstrated a shortage of MLSs in rural areas, a focus on MLS program graduates would be recommended.
5. This study revealed that some MLT and MLS programs utilize targeted recruitment efforts. Future research might examine specific examples of targeted recruitment and the impact that such recruitment has had on the rural workforce shortage in those areas.

6. The qualitative portion of this study involved interviews with rural laboratory managers from only one state. Replication of this study using a sample from multiple states, specifically rural states, would add to the literature in the field of clinical laboratory science. The comparison of perceptions of rural clinical laboratory managers from various states would also be advantageous since there is such a wide variation in program availability between states.

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APPENDICES

Appendix A: Institutional Review Board Approval

MARSHALL UNIVERSITY
www.marshall.edu

Office of Research Integrity
Institutional Review Board
One John Marshall Drive
Huntington, WV 25755

FWA 00002704

IRB1 #00002205
IRB2 #00003206

November 14, 2017

Eugenia Damron, Ed.D.
Leadership Studies, MUGC

RE: IRBNet ID# 1150799-1
At: Marshall University Institutional Review Board #2 (Social/Behavioral)

Dear Dr. Damron:

Protocol Title:	[1150799-1] Are Higher Education Institutions Addressing the Employment Needs of Clinical Laboratories in Rural Areas?	
Expiration Date:	November 14, 2018	
Site Location:	MUGC	
Submission Type:	New Project	APPROVED
Review Type:	Exempt Review	

In accordance with 45CFR46.101(b)(2), the above study and informed consent were granted Exempted approval today by the Marshall University Institutional Review Board #2 (Social/Behavioral) Designee for the period of 12 months. The approval will expire November 14, 2018. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date.

This study is for student Pamela Meadows.

If you have any questions, please contact the Marshall University Institutional Review Board #2 (Social/Behavioral) Coordinator Bruce Day, ThD, CIP at 304-696-4303 or day50@marshall.edu. Please include your study title and reference number in all correspondence with this office.

Appendix B: Informed Consent Form (Survey)

Marshall University IRB

Approved on:	11/14/17
Expires on:	11/14/18
Study number:	1150799

Anonymous Survey Consent

You are invited to participate in a research project entitled *"Are Higher Education Institutions Addressing the Employment Needs of Clinical Laboratories in Rural Areas?"* designed to analyze the extent to which Medical Laboratory Technician and Medical Laboratory Scientist programs are meeting the employment and professional development needs of rural clinical laboratories. The study is being conducted by Eugenia Damron and Pamela Meadows from Marshall University and has been approved by the Marshall University Institutional Review Board (IRB). This research is being conducted as part of the dissertation requirements for Pamela Meadows.

This survey is comprised of 14 questions and will take approximately 15 minutes to complete. Your replies will be anonymous, so do not type your name anywhere on the form. There are no known risks involved with this study. Participation is completely voluntary and there will be no penalty or loss of benefits if you choose to not participate in this research study or to withdraw. If you choose not to participate you can leave the survey site. You may choose to not answer any question by simply leaving it blank. Once you complete the survey you can delete your browsing history for added security. Completing the on-line survey indicates your consent for use of the answers you supply. If you have any questions about the study, you may contact Eugenia Damron at (304) 746-8959 or webb24@marshall.edu, or Pamela Meadows at (304) 696-6596 or pam.meadows@marshall.edu .

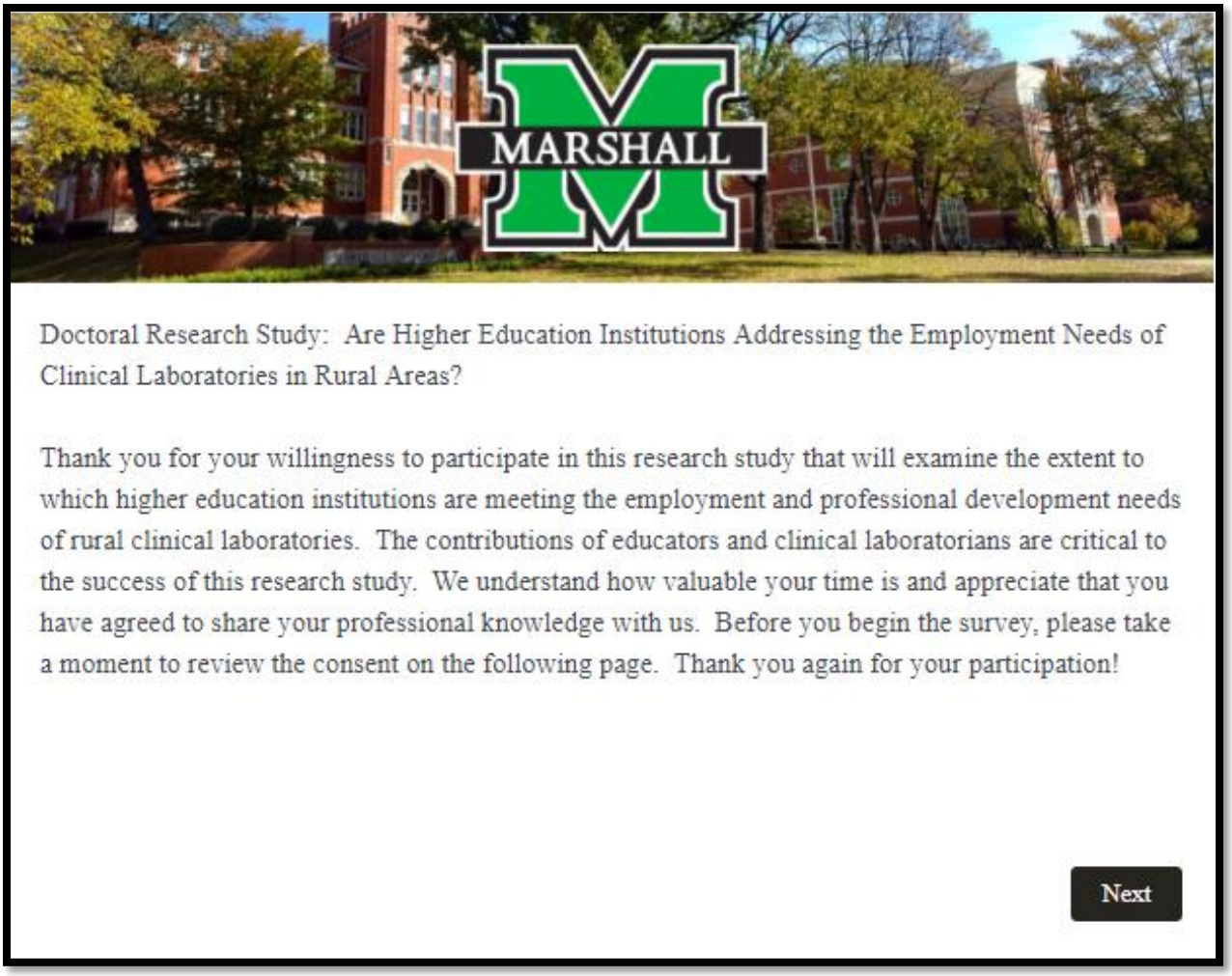
If you have any questions concerning your rights as a research participant, you may contact the Marshall University Office of Research Integrity at (304) 696-4303.

By completing this survey, you are also confirming that you are **18** years of age or older.

Please print this page for your records.

If you choose to participate in the study, you will find the survey at www.xxxxxxx.com

Appendix C: Survey Instrument



Voluntary Consent to Participate

You are invited to participate in a research project entitled "Are Higher Education Institutions Addressing the Employment Needs of Clinical Laboratories in Rural Areas?" designed to analyze the extent to which Medical Laboratory Technician and Medical Laboratory Science programs are meeting the employment and professional development needs of rural clinical laboratories. The study is being conducted by Eugenia Damron and Pamela Meadows from Marshall University and has been approved by the Marshall University Institutional Review Board (IRB). This research is being conducted as part of the dissertation requirements for Pamela Meadows.

This survey is comprised of 14 questions and will take approximately 15 minutes to complete. Your replies will be anonymous, so do not type your name anywhere on the form. There are no known risks involved with this study. Participation is completely voluntary and there will be no penalty or loss of benefits if you choose to not participate in this research study or to withdraw. If you choose not to participate you can leave the survey site. You may choose to not answer any question by simply leaving it blank. Once you complete the survey you can delete your browsing history for added security. Completing the on-line survey indicates your consent for use of the answers you supply. If you have any questions about the study, you may contact Eugenia Damron at (304) 746-8959 or webb24@marshall.edu, or Pamela Meadows at (304) 696-6596 or pam.meadows@marshall.edu .

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By completing this survey, you are also confirming that you are 18 years of age or older.

Please print this page for your records.

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In what state is your program located?

Alaska	Kentucky	New York
Alabama	Louisiana	Ohio
Arkansas	Massachusetts	Oklahoma
Arizona	Maryland	Oregon
California	Maine	Pennsylvania
Colorado	Michigan	Rhode Island
Connecticut	Minnesota	South Carolina
District of Columbia	Missouri	South Dakota
Delaware	Mississippi	Tennessee
Florida	Montana	Texas
Georgia	North Carolina	Utah
Hawaii	North Dakota	Virginia
Iowa	Nebraska	Vermont
Idaho	New Hampshire	Washington
Illinois	New Jersey	Wisconsin
Indiana	New Mexico	West Virginia
Kansas	Nevada	Wyoming

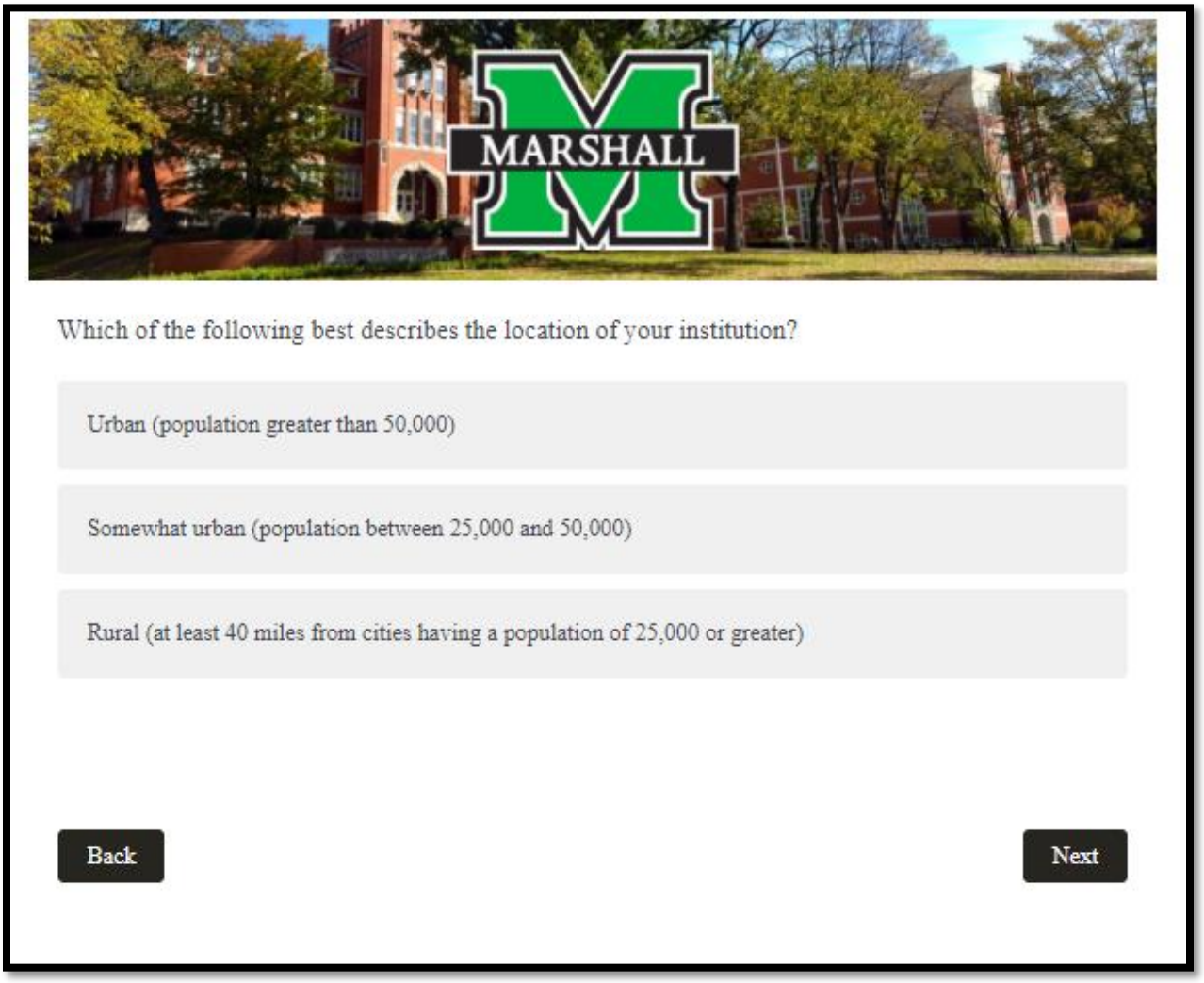
Which of the following best describes your institution?

- Community and technical college
- Predominately four-year college
- University
- Hospital-based program

Which of the following clinical laboratory science programs do you offer?

- MLT
- MLS
- MLT and MLS

Back Next



For the purpose of this research study, the term rural is defined as an area located at least 40 miles from cities having a population of 25,000 or greater.

What percentage of your current clinical sites are considered "rural?"

>75%

50-75%

25-49%

<25%

Back

Next

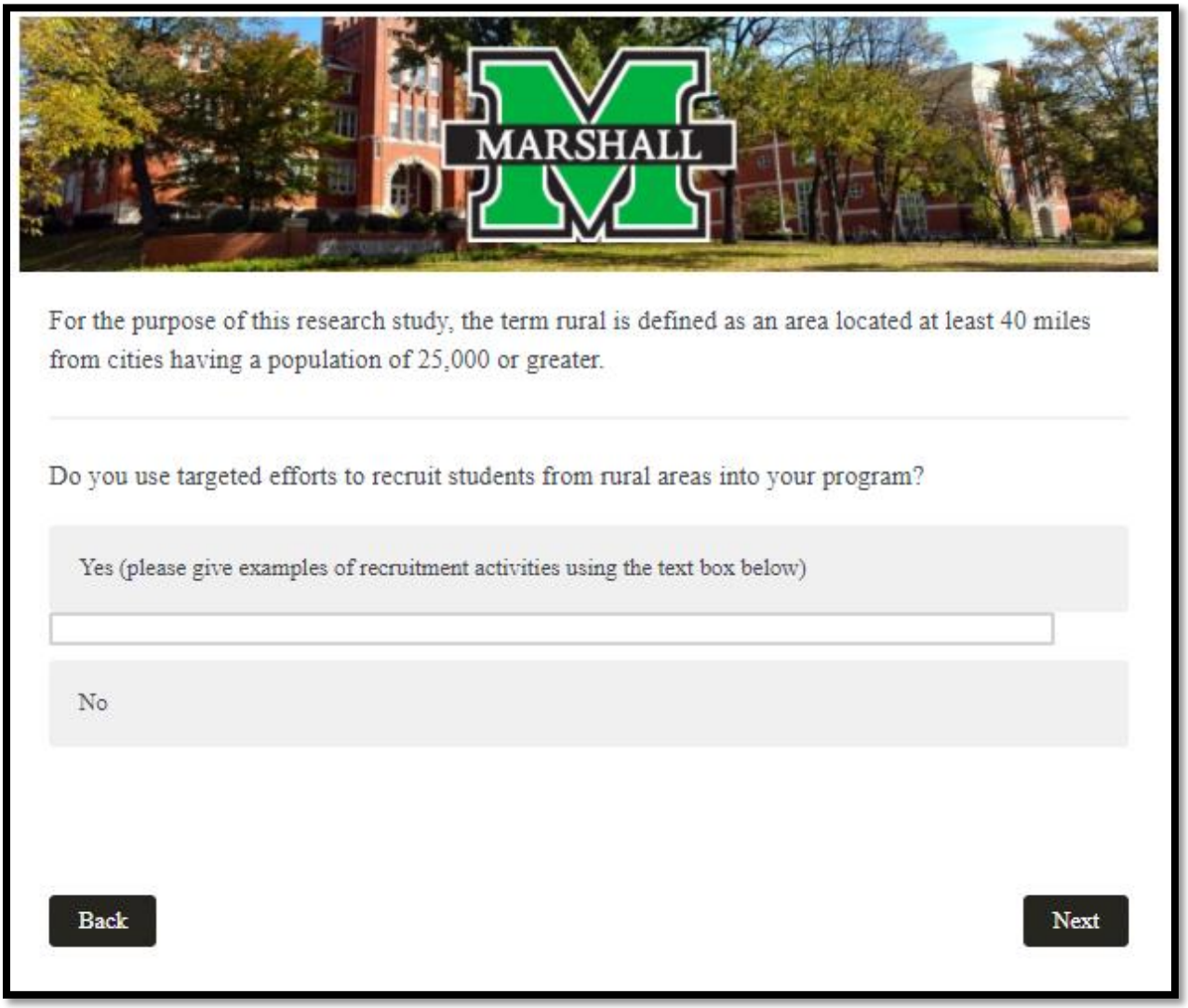
For the purpose of this research study, the term rural is defined as an area located at least 40 miles from cities having a population of 25,000 or greater.

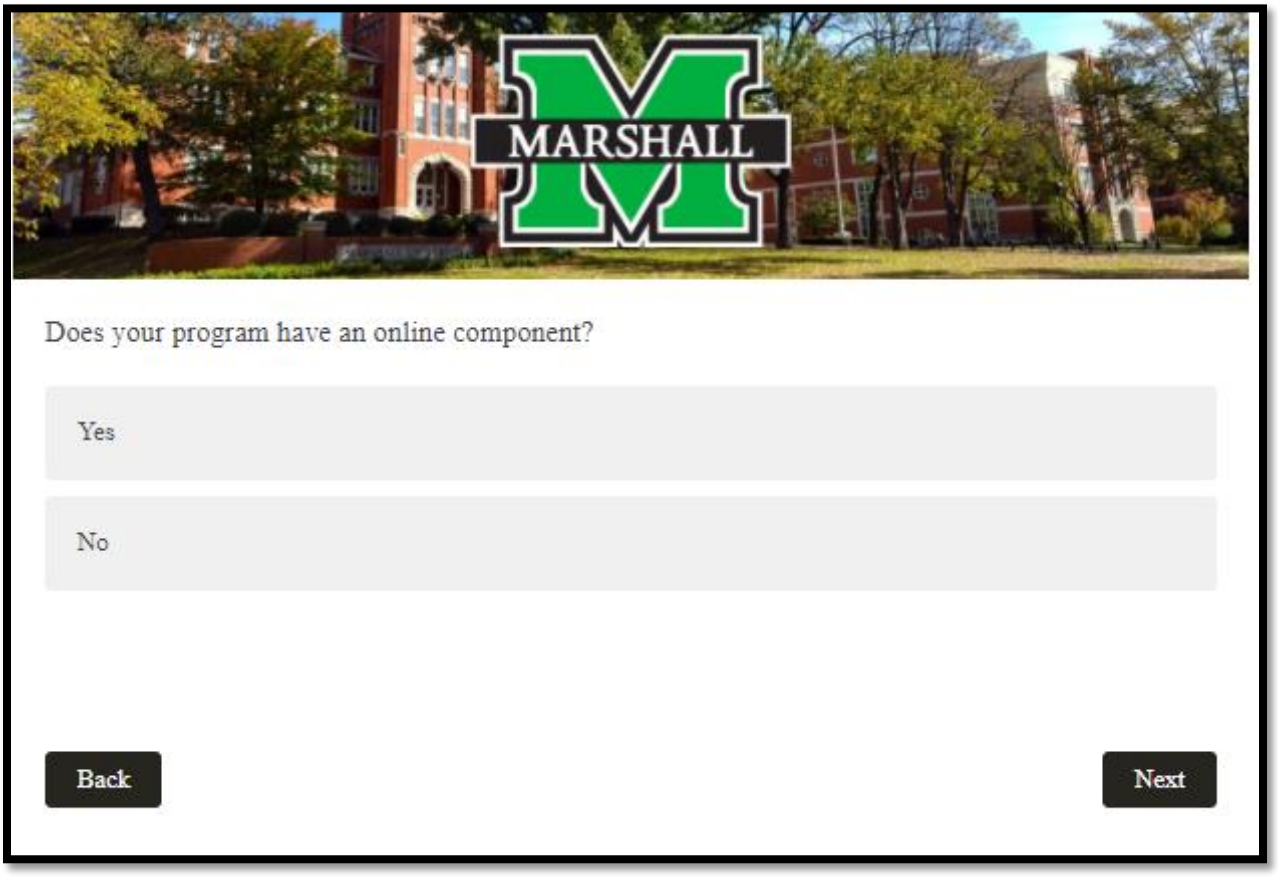
What is the approximate percentage of your program graduates that work at a rural facility?

- >75%
- 50-75%
- 25-49%
- <25%

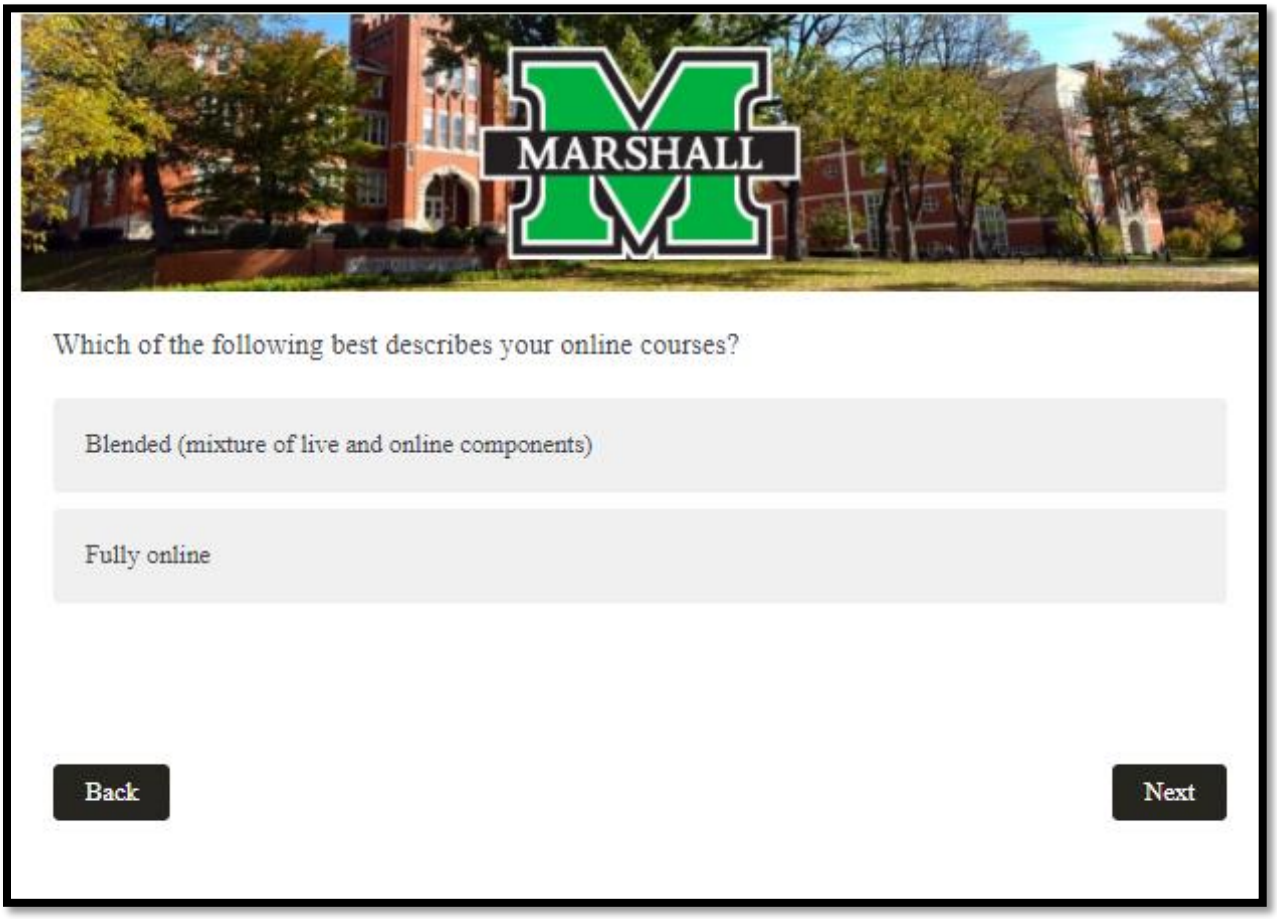
Of the graduates that work at rural locations after graduation, what percentage of those graduates completed clinical rotations at a rural facility?

- >75%
- 50-75%
- 25-49%
- <25%





Note: Skip logic question. If participant response is "yes," survey skips to the following question: "Which of the following best describes your online courses?" If participant response is "no," survey skips to the following question: "How often does your program secure articulation agreements with MLT or MLS programs in rural areas?"



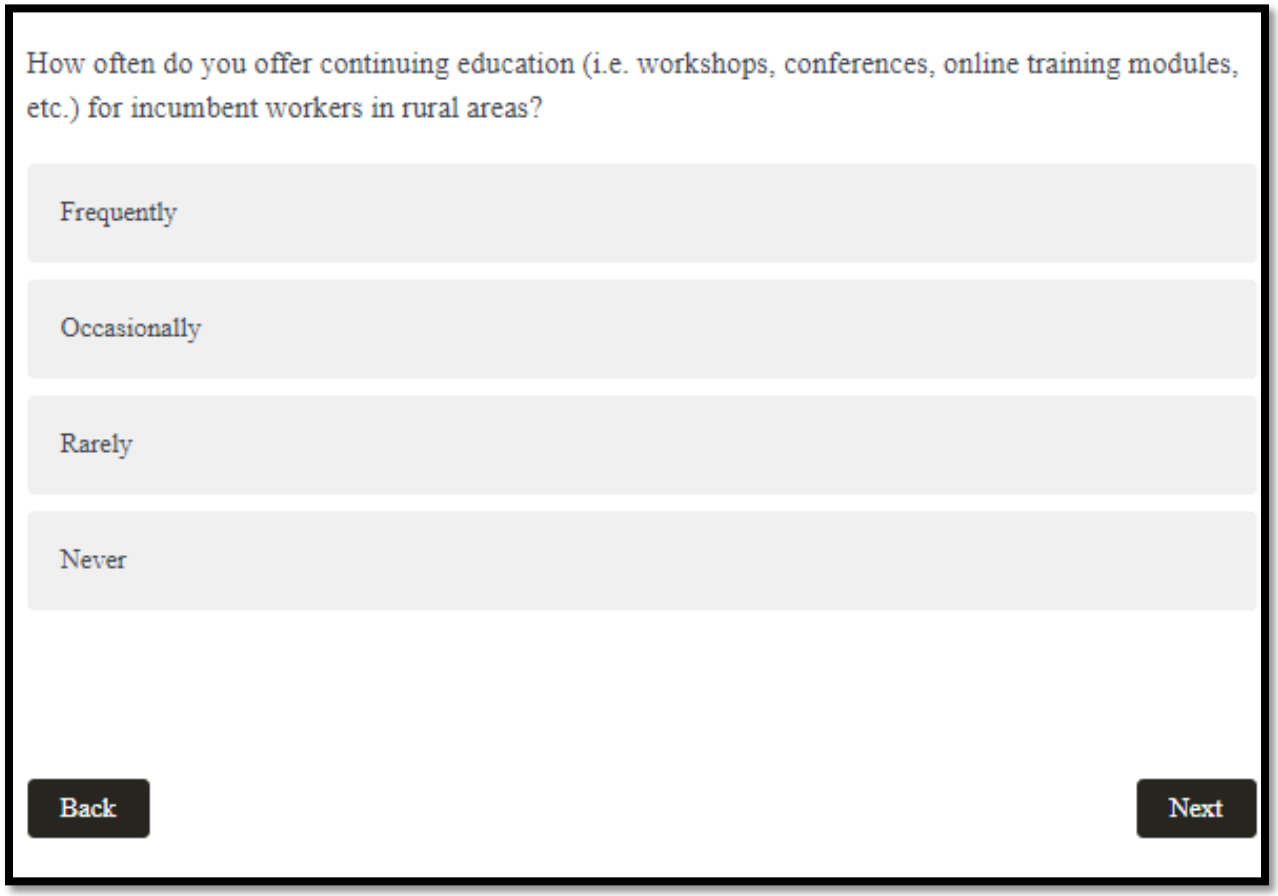
For the purpose of this research study, the term rural is defined as an area located at least 40 miles from cities having a population of 25,000 or greater.

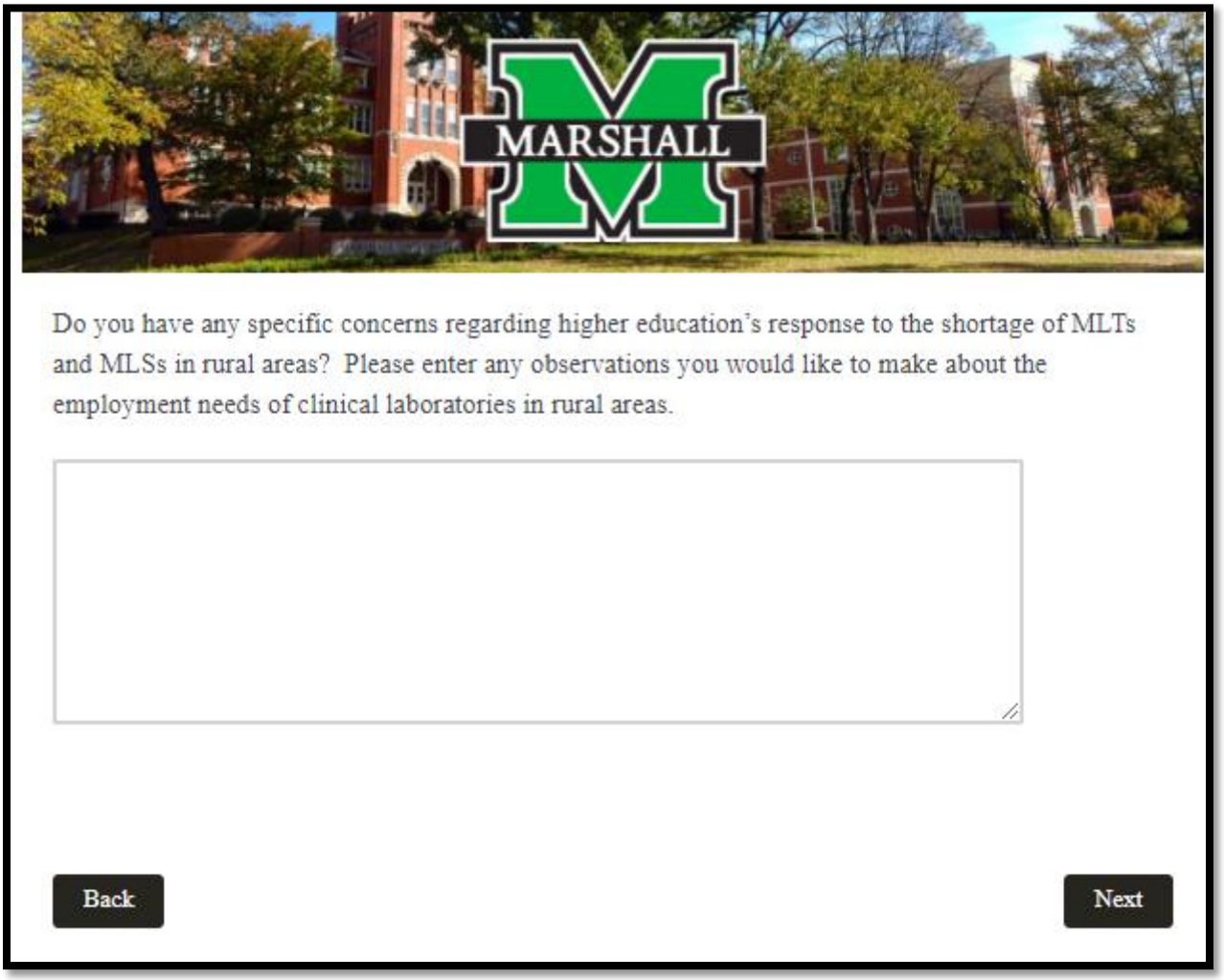
How often does your program secure articulation agreements with MLT or MLS programs in rural areas? For instance, if you have a MLS program, do you establish articulation agreements with rural MLT programs?

- Frequently
- Occasionally
- Rarely
- Never

How often do you include representatives from rural hospitals/clinics as members of your program advisory committee?

- Frequently
- Occasionally
- Rarely
- Never





Appendix D: Permission Form for Facility Access (Interview)

[FACILITY NAME]

[DATE]

This letter is to document that Pamela Meadows has permission to conduct a research study at ***[FACILITY NAME]***, once Marshall University Institutional Review Board (IRB) approval has been obtained. I understand that this study will examine the extent to which MLT and MLS programs are meeting the employment and professional development needs of rural clinical laboratories and will involve an interview with the clinical laboratory manager. I also understand that this project is part of Pamela's doctoral research requirements at Marshall University Graduate College and will be overseen by Dr. Eugenia Damron, doctoral research committee chair.

I will act as both the on-site supervisor and participant for this research. I can be contacted by phone at [phone number] or by email at [email address] .

Signed,

_____

(Authorized Representative Signature)

_____

(Authorized Representative Printed Name)

_____

(Title)

Appendix E: Informed Consent Form (Interview)

Informed Consent to Participate in a Research Study

Are Higher Education Institutions Addressing the Employment Needs of Clinical Laboratories in Rural Areas?

Eugenia Damron, Ed.D., Principal Investigator
Pamela Meadows, MS, BSMT(ASCP), Co-Investigator

Introduction

You are invited to be in a research study. Research studies are designed to gain scientific knowledge that may help other people in the future. You may or may not receive any benefit from being part of the study. There may also be risks associated with being part of research studies. If there are any risks involved in this study, they will be described in this consent. Your participation is voluntary. Please take your time to make your decision, and ask your research doctor or research staff to explain any words or information that you do not understand.

Why Is This Study Being Done?

Clinical laboratories across the nation are faced with a shortage of qualified medical laboratory technicians and scientists. An aging clinical laboratory workforce and general increase in requests for laboratory testing have intensified the demand for medical laboratory technicians and medical laboratory scientists. While there is a moderate amount of literature that addresses the shortage of clinical laboratory professionals in general, there is an inadequate quantity of literature that specifically addresses those shortages as they affect rural communities. The purpose of this research study is to examine the perceptions of rural clinical laboratory managers toward higher education's response to the shortage of medical laboratory technicians and medical laboratory scientists. This research will investigate to what extent medical laboratory technician and medical laboratory science programs are meeting the employment and professional development needs of rural clinical laboratories.

How Many People Will Take Part In The Study?

About ten people will take part in the interview process for this study. A total of fifteen subjects are the most that would be able to enter the study.

What Is Involved In This Research Study?

This research study will require that you participate in one face to face interview. The interview should last approximately one hour and will be recorded using a voice recorder. During the interview I will ask you questions regarding the extent to which medical laboratory technician and medical laboratory science programs are meeting the employment and professional development needs of your clinical laboratory.

Subject's Initials _____

How Long Will You Be In The Study?

You will be in the study for one day. You can decide to stop participating at any time. If you decide to stop participating in the study, we encourage you to talk to the study investigator or study staff as soon as possible. The study investigator may stop you from taking part in this study at any time if he/she believes it is in your best interest; if you do not follow the study rules; or if the study is stopped.

What Are The Risks Of The Study?

There are no known risks to the participants of this study.

Are There Benefits To Taking Part In The Study?

If you agree to take part in this study, there may or may not be direct benefit to you. We hope the information learned from this study will benefit other people in the future. The benefits of participating in this study may be: research findings could influence professional licensure regulations for clinical laboratory practitioners, research data may be beneficial to higher education organizations that are evaluating the benefits and barriers to implementing a new medical laboratory technician or medical laboratory science program, and findings may prove useful to current medical laboratory technician or medical laboratory science programs that are faced with possible program closure.

What About Confidentiality?

We will do our best to make sure that your personal information is kept confidential. However, we cannot guarantee absolute confidentiality. Federal law states that we must keep your study records private. Nevertheless, certain people other than your researchers may also need to see your study records. By law, anyone who looks at your records must keep them completely confidential. Voice recordings for this study will be stored in a locked cabinet and destroyed once all results and findings have been summarized and the study has concluded.

Those who may need to see your records are:

- Certain university and government people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. These include the Marshall University Institutional Review Board (IRB) and the Office of Research Integrity (ORI).
- The federal Office of Human Research Protection.

This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.

What Are The Costs Of Taking Part In This Study?

There are no costs to you for taking part in this study. All costs will be paid for by the study.

Subject's Initials _____

Will You Be Paid For Participating?

You will receive no payment or other compensation for taking part in this study.

What Are Your Rights As A Research Study Participant?

Taking part in this study is voluntary. You may choose not to take part, or you may leave the study at any time. Refusing to participate or leaving the study will not result in any penalty or loss of benefits to which you are entitled. If you decide to stop participating in the study, we encourage you to talk to the investigators or study staff to address any concerns that you may have.

Whom Do You Call If You Have Questions Or Problems?

For questions about the study or in the event of a research-related injury, contact the study principal investigator, Eugenia Damron, at 304-746-8959 (office) or the co-investigator, Pamela Meadows, at 304-696-6596 (office) or 304-550-4439 (cell). You should also call the investigator if you have a concern or complaint about the research.

For questions about your rights as a research participant, contact the Marshall University IRB#1 Chairman Dr. Christopher LeGrow or ORI at (304) 696-4303. You may also call this number if:

- You have concerns or complaints about the research.
- The research staff cannot be reached.
- You want to talk to someone other than the research staff.

You will be given a signed and dated copy of this consent form.

SIGNATURES

You agree to take part in this study and confirm that you are 18 years of age or older. You have had a chance to ask questions about being in this study and have had those questions answered. By signing this consent form, you are not giving up any legal rights to which you are entitled.

_____
Subject Name (Printed)

_____ _____
Subject Signature Date

_____ _____
Person Obtaining Consent Date

_____ _____
Investigator Date

Subject's Initials _____

Appendix F: Semi-Structured Interview Questions

The following questions were used as a guide for face-to-face interviews:

1. In your opinion, is there a shortage of qualified MLT and MLS job candidates in your local area? On a scale of 1 to 10, with 10 being severe, how would you rate the shortage of MLTs and MLSs is in your local area?

2. How long do MLT and MLS staff vacancies typically remain open at your facility?

3. Have you ever employed travel techs? If so, was their employment the result of local MLT and MLS shortages?

4. What are the key barriers to recruitment and retention at your facility?

5. Do your employees all have a MLT or MLS degree from an accredited program? Do you find it necessary to hire individuals who have not attended a traditional MLT/MLS program? If so, does that raise any concerns for you as a laboratory manager?

6. What is the education mix of your laboratory staff? How many MLS (four-year degrees) vs MLT (two-year degree)? Do you require your employees to be nationally certified (ASCP, AMT, etc.)?

7. To your knowledge, do any higher education institutions actively recruit students in your local area? How many miles away is the closest higher education institution from your facility? How many miles away is the closest MLT/MLS program from your facility?

8. Some higher education institutions now offer online MLT and MLS programs. Is this an option for individuals in the local area or are there barriers, such as the availability of high-speed internet that may impede residents from attending those programs?

9. Does your facility have clinical affiliation agreements to accept MLT or MLS students for clinical rotations? If so, what types of higher education institutions do you have agreements with? CTC, university, etc.?

10. Are there any specific barriers that hinder you from accepting students for clinical rotations? How many students can you typically accommodate for clinical rotations at one time? If you do not currently accept students for clinical rotations, would you be willing to do so?

11. How likely are you to hire students if they complete a clinical rotation at your facility?

12. Are you a member of any MLT/MLS program advisory committee?

13. Are you aware of the recent Centers for Medicare and Medicaid Services memorandum (April 2016) that requires certain categories of laboratory supervisors to have a bachelor's degree in a physical, chemical, or biological science? Has this regulation had an adverse effect on your laboratory? Has any supervisory staff been required to go back to school as a result?

14. If staff members wish to pursue further education in clinical laboratory science, for instance an MLT who wants to pursue an MLS degree, do they have adequate access to higher education programs?

15. Do you feel that higher education institutions offer adequate access to continuing education opportunities (workshops, conferences, online training modules, etc.)? What can higher education institutions do to better meet your needs regarding professional development of current employees?

16. What are your primary concerns regarding the ability to effectively staff your laboratory in the future? Are you specifically concerned about staffing for a certain area of the laboratory or filling supervisory positions?

17. Do you feel that higher education institutions have done enough to effectively address the shortage of MLT's and MLS's in rural areas?

18. What steps would you like to see higher education institutions take to address the shortage of MLT's and MLS's in rural areas? Do you have any suggestions that may help address the workforce shortage?

Appendix G: Survey Sample Representation by State

Demographics: Survey Representation by State

	n	Percent		*n*	Percent
Alabama	2	1.20%	Mississippi	5	2.99%
Arkansas	4	2.40%	North Carolina	7	4.19%
Arizona	2	1.20%	North Dakota	3	1.80%
California	6	3.59%	Nebraska	1	0.60%
Colorado	4	2.40%	New Hampshire	1	0.60%
Connecticut	1	0.60%	New Jersey	2	1.20%
District of Columbia	1	0.60%	New Mexico	1	0.60%
Delaware	2	1.20%	Nevada	1	0.60%
Florida	5	2.99%	New York	8	4.79%
Georgia	5	2.99%	Ohio	8	4.79%
Hawaii	1	0.60%	Oklahoma	4	2.40%
Iowa	3	1.80%	Pennsylvania	3	1.80%
Idaho	1	1.60%	Rhode Island	1	0.60%
Illinois	3	1.80%	South Carolina	2	1.20%
Indiana	2	1.20%	South Dakota	2	1.20%
Kansas	3	1.80%	Tennessee	9	5.39%
Kentucky	4	2.40%	Texas	15	8.98%
Louisiana	5	2.99%	Utah	3	1.80%
Massachusetts	4	2.40%	Virginia	1	0.60%
Maryland	2	1.20%	Vermont	1	0.60%
Michigan	5	2.99%	Washington	4	2.40%
Minnesota	2	1.20%	Wisconsin	6	3.59%
Missouri	5	2.99%	West Virginia	7	4.19%

Appendix H: Demographics of Rural Laboratories Participating in Study

Demographics: Total Number of MLTs and MLSs Employed by Rural Clinical Laboratories Participating in Research Study Interviews

	Total # of MLTs and MLSs	# of MLTs	% MLT	# of MLSs	% MLS
Laboratory 1	20	7	35.00%	13	65.00%
Laboratory 2	23	15	65.22%	8	34.78%
Laboratory 3	15	13	86.67%	2	13.33%
Laboratory 4	16	15	93.75%	1	6.25%
Laboratory 5	15	2	13.33%	13	86.67%
Laboratory 6	7	3	42.86%	4	57.14%
Laboratory 7	10	4	40.00%	6	60.00%
Laboratory 8	10	8	80.00%	2	20.00%
Laboratory 9	6	4	66.67%	2	33.33%
Laboratory 10	9	8	88.89%	1	11.11%

Appendix I: Curriculum Vitae

PAMELA D. MEADOWS, Ed.D. CANDIDATE

EDUCATION AND CERTIFICATION

Doctor of Education-2018
Major: Educational Leadership
Marshall University Graduate College

Master of Science-2012
Major: Health Care Administration
Marshall University Graduate College

Bachelor of Science-1999
Major: Medical Technology
Marshall University

Associate of Applied Science-1997
Major: Medical Laboratory Technician
Marshall University

Certification: American Society for Clinical Pathology
Medical Technologist-1999; Medical Laboratory Technician-1997

PUBLICATIONS

Nicholson, B., Inghram, C.S., Meadows, P., Saunders, A., Stadler, C. (2016). The bubble-wrapped student: Are trigger warnings necessary in higher education? *Southern Regional Council of Educational Administration Journal*, *16*(2).

Coustasse-Hencke, A.M., Cunningham, B., Deslich, S., Wilson, E. and Meadows, P. (July 2, 2015). Benefits and barriers of implementation and utilization of RFID systems in transfusion medicine. *Perspectives in Health Information Management,* 3rd Quarter/Summer.

Coustasse-Hencke, A.M., Meadows, P., Hall, R., Hibner, T. and Deslich, S. (June 26, 2015). Utilizing radio frequency identification technology to improve safety and management of blood bank supply chains. *Telemedicine and ehealth.*

Meadows, P., Miller, B. and Coustasse-Hencke, A.M. (December 15, 2014). Surveillance of foodborne illness in the United States. *Insights to a Changing World Journal.*

PROFESSIONAL MEMBERSHIP & SERVICE

- American Society for Clinical Pathology
- American Society for Clinical Laboratory Sciences
- American Society for Clinical Laboratory Sciences Patient Safety Committee
- West Virginia Society for Clinical Laboratory Sciences-State President (2016-2018)

PROFESSIONAL EXPERIENCE

Marshall University Clinical Laboratory Science Department-Huntington, WV
Assistant Professor: August 2012-Present

Mountwest Community and Technical College-Huntington, WV
Clinical Assistant Program Coordinator/Instructor: August 2007-August 2012

Charleston Area Medical Center-Charleston, WV
Clinical Laboratory Technologist Level III: August 2006-Present

Thomas Memorial Hospital-South Charleston, WV
Laboratory Supervisor/Point of Care Testing Coordinator: May 1997-August 2006