

Factors Inhibiting Clinical Laboratory Science Directors' Using Distance Technology for Educational Purposes

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Problem: Workforce shortages in the diagnostic fields of health care prompted conducting a study about possible barriers or influences about using distance education for didactic delivery.

Methods: A cross-sectional study design was used. A population of 467 program directors was identified. Four hundred-sixty email addresses were functional. A convenience sample of 167 responded to an online survey about perceived barriers to using distance education for program delivery.

Results: Program directors responded about perceived barriers to using online, distance education as part of educational delivery for academic programming. Concerns included lack of quality of coursework, and students; along with lack of adequate equipment for offering distance education teaching, faculty workloads and lack of release time.

Conclusion: While distance education is a viable solution for offering diagnostic, didactic program content, perceived and real barriers to its use are impacting workforce development, especially in rural, health care and educational deserts.

Keywords: Workforce shortages; clinical laboratory; CLS programs; didactic delivery.

1. INTRODUCTION

Hospitals are experiencing a shortage of qualified Medical Laboratory Scientists (MLS), and Medical Laboratory Technicians (MLT) [1-8]. More people are requiring complex medical care, there are a significant number of individuals retiring from diagnostic professions, and fewer individuals are pursuing diagnostic degrees. All of which are contributing to the ongoing labor shortage in the clinical laboratory science fields) [1-3,5,7-9]. Simultaneously, approximately 67 percent of clinical laboratory science programs closed between 1975-2005; resulting in a 66 percent decrease in the number of graduates for available employment.² Professional diagnostic workforce shortages have been especially impactful in rural communities [1,3,8].

The United States Bureau of Labor Statistics projects an 11 percent increase in the number of positions available for MLS and MLT professionals between 2018-2028.⁹ The question becomes: "will there be enough qualified diagnosticians to fill projected workforce needs?" It has been posited laboratories are relying on automation for reducing the number of skilled professionals necessary for completing diagnostic testing, which could lessen the impact of the workforce shortage.⁶ However, critics argue automation will not completely alleviate the current national shortage of diagnostic professionals [10].

Clinical laboratory science programs offering education through traditional means have been steadily declining since the mid 1970's.¹⁻⁸ An educational opportunity exists for partially filling this void by considering using distance education (DE) as a delivery mechanism for didactic diagnostic coursework. The purpose of this study was examining what factors are barriers clinical laboratory science program directors' (CLS PDs) are facing, decisions being made, and consideration of potential issues identified related to using distance education for delivering academic content. The goal of this research was addressing a gap identified in the scientific literature about barriers CLS PDs identified about using distance education.

2. METHODS

A primary, cross-sectional study design was used. The population for the research included program directors at all two and four-year &

hospital based CLS programs. Total population for the study was 467 program directors. A convenience sample from this population was used, and 460 program directors received the data collection request for the study. Questionnaire was emailed to respondents. Response rate was impacted by incorrect emails, retirements, messaging delays or lack of interest in responding. Response rate was a methodological limitation. Of those, 163 responded for a response rate of 35%. The data collection tool was a questionnaire with 54 questions, divided into three components. A modified survey by Betts was used.¹² The instrument consisted of 54 questions divided into 1) demographic questions, 2) reasons for using DE, and 3) barriers to using DE. A four-point Likert scale (4 = strongly agree, 3 = agree, 2 = disagree, 1 = strongly disagree) along with a 'Not applicable' (N/A) option were used for responses. Directors were asked to rate how factors have or would influence their use of distance education in their general teaching experiences. Respondents could withdraw at any time during the anonymous survey process. Descriptive and inferential statistics were used for data analysis. Pearson correlation coefficients were used for inferential measures. P value was established at $p < 0.05$.

3. RESULTS

3.1 Demographics

Responses were collected from program directors in 43 states with the greatest number of respondents, 16, from Texas. One hundred sixty-three respondents returned completed questionnaires, resulting in a 35 percent response rate. As reported in Fig. 1, most directors had 10-20 years of teaching experience.

As reported in Fig. 2 (one respondent did not respond to the question for $n=162$) 89 respondents (roughly 55 percent) had previous experience using distance education, where at least 30 percent of content was delivered online. Thirty-three respondents indicated they teach web facilitated courses defined as face to face courses utilizing learning management systems for posting syllabi and assignments. Forty respondents (roughly 25%) indicated they teach traditional courses, where no content is delivered online. Nearly 59 percent of respondents

indicated most of their time was dedicated to teaching.

3.2 Barriers

Five of 20 barriers to using distance education were identified and ranked. A threshold was established at 3.0 for agreement with a statement, based on a four-point Likert scale. Barrier mean scores ranged from 2.04 to 3.11 with 'Concern about quality of courses' ranking highest (mean = 3.11, SD = 0.83). Table 1 ranks the barriers identified by program directors with means above 3.0. Program directors' selecting

'not applicable' responses were not included in the analysis.

Correlational analyses were limited to barriers with means above the established 3.0 threshold. Results are displayed in Table 2. Significant barriers identified by PDs included 'concern about quality of courses' and 'concern about quality of students' ($r = 0.545$, $p = 0.000$), and between 'lack of release time' and 'concern about faculty workload' ($r = 0.513$, $p = 0.000$). Findings were statistically significant and did not occur by chance as determined at both the 95 and 99 ($p=.01$) percent confidence intervals.

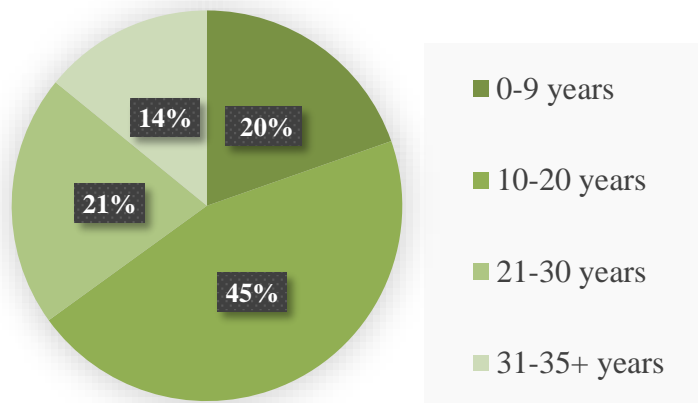


Fig. 1. Percentage of directors as related to years of teaching experience

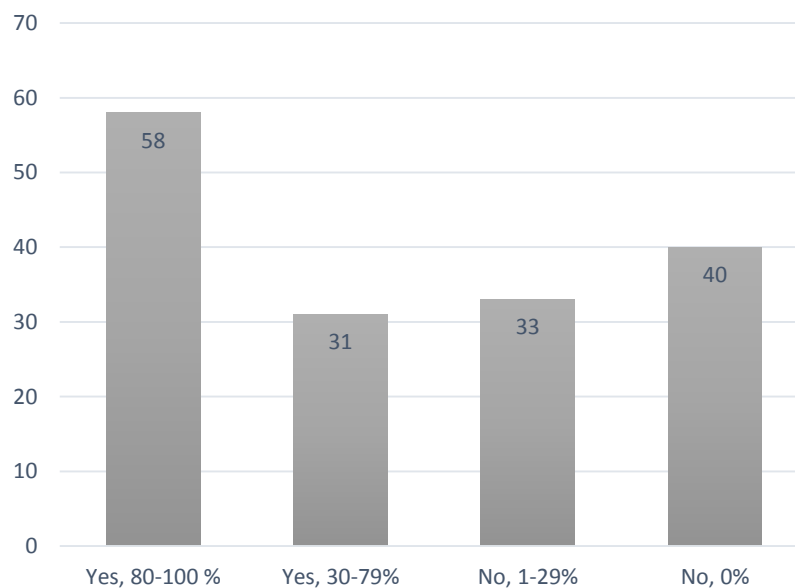


Fig. 2. Number of directors with distance education experience

Table 1. Ranked Summary of Barriers identified by Program Directors’ Using Distance Education

Variable	N	Mean	SD
Concern about quality of courses	163	3.11	0.83
Lack of adequate equipment to support distance education teaching	154	3.09	0.90
Concern about faculty workload	156	3.03	0.80
Lack of release time	154	3.03	0.80
Concern about quality of students	159	3.01	0.87

Note. N = Number of Respondents, SD = Standard Deviation

Table 2. Correlational Analyses of Barriers Identified

Barrier	Concern about quality of courses	Lack of adequate equipment to support distance education teaching	Concern about faculty workload	Lack of release time	Concern about quality of students
Concern about quality of courses	r = 1	r = 0.326 p = 0.000** n = 154	r = 0.044 p = 0.588 n = 156	r = 0.103 p = 0.204 n = 154	r = 0.545 p = 0.000** n = 159
Lack of adequate equipment to support distance education teaching	r = 0.326 p = 0.000** n = 154	r = 1	r = 0.348 p = 0.000** n = 149	r = 0.427 p = 0.000** n = 149	r = 0.298 p = 0.000** n = 151
Concern about faculty workload	r = 0.044 p = 0.588 n = 156	r = 0.348 p = 0.000** n = 149	r = 1	r = 0.513 p = 0.000** n = 151	r = 0.159 p = 0.50 n = 153
Lack of release time	r = 0.103 p = 0.204 n = 154	r = 0.427 p = 0.000** n = 149	r = 0.513 p = 0.000** n = 151	r = 1	r = 0.058 p = 0.475 n = 152
Concern about quality of students	r = 0.545 p = 0.000** n = 159	r = 0.298 p = 0.000** n = 151	r = 0.159 p = 0.50 n = 153	r = 0.058 p = 0.475 n = 152	r = 1

Note. r = Pearson’s Correlation Coefficient; p = probability, n = number of respondents; **denotes p < .01

4. DISCUSSION

Educational paradigms continue shifting. Results of this research surfaced some concerns program directors expressed about a variety of educational barriers to using distance education for delivery of academic content. Program directors responded about concerns related to equipment, lack of “quality” courses, lack of adequate institutional support for using distance education teaching, faculty workloads including work release time, and quality of students. All these issues are relevant while considering evolving educational landscapes. Aggregated demographic data identified 80% of PD

respondents have been educators from 10-35+ years, and roughly 55% of reported having distance education experience. Barriers identified about using distance education for academic delivery may potentially have come specifically from this cohort of survey respondents. Forty respondents (roughly 25%) indicated they teach traditional courses where no content is delivered online. Similar studies examined motivators and/or barriers faced by faculty at individual institutions or related allied health fields in relation to distance education participation [12-15]; however, none specifically studied the clinical laboratory sciences. This paper addresses barriers CLS PDs perceived are

relevant to using distance education. Additional findings will be reported in subsequent papers.

4.1 Educator & Student Perspectives

Significant changes have impacted education the past twenty years including using distance education technology for academic content delivery [16,17]. Limited amounts of published research into distance education experience in the clinical laboratory sciences exists [18-23]. The percentage of online, distance education CLS programs remains relatively small [24-25], when compared to other health professions including nursing, of which nearly 50 percent of degree completion programs are now offered online [26]. Related allied health programs including speech language pathology, occupational therapy, physical therapy, dental hygiene and clinical psychology have also experienced using distance education with success [27].

Exponential increases in numbers of academic programs using distance education has been documented across the U.S [16,17]. As technology increasingly impacts responsibilities and flow in all workforce sectors, similar impacts are felt as a ripple effect within education [17,28,29]. One ongoing assumption being made within the academy includes individual student's willingness to attend brick & mortar educational facilities for accessing new knowledge and workforce training for learning or changing careers [30]. Data bears out this is no longer the case, [31-32], and this assumption is problematic with the ubiquitous use of technology for offering access to educational opportunities [17,29]. Even Ivy League institutions are embracing using alternative forms of educational delivery [29].

4.2 Equipment Use

Administrators' and educators' are often slow to embrace change based on a variety of factors. Academia and academics are slow to embrace application of methodologic options differing from a traditional face to face lecture for delivering academic content.^{31,32} One barrier noted and reported by CLS PDs responding included the lack of adequate equipment available for providing distance education teaching (mean = 3.09). During the beginning of technology use in the early 1990's equipment cost was a significant issue when the primary means and approach to distance educational delivery was synchronous versus asynchronous methodology [29].

Alternative, distance educational systems included cameras, monitors, infrastructure cabling, proctors, room scheduling, and other miscellaneous requirements to be functional. With the advent of a variety of cloud-based platforms, course learning management systems, and other significantly less costly delivery mechanisms and tools, requiring little more than a computer to deliver educational content, alternative, distance delivery is nearly a non-issue. Younger learners and working adult professionals expect to have materials and information shared through a variety of media, including access to education [29,33]. It may be posited the perception of lack of adequate equipment for content delivery found during this research was from CLS PDs whom both originally were early technology adopters and are not currently aware of or using newer technology or distance educational delivery mechanisms available today. Clinical laboratory science program directors strongly agreed with barriers as potentially prohibitive to considering use of distance education. Only five of 20 potential barriers identified in the survey resulted in statistical means above the 3.0 baseline threshold for agreement. Only two barriers were identified 1) 'concern about quality of courses' (mean = 3.11) and 2) 'lack of adequate equipment to support distance education teaching' (mean = 3.09) before a considerable breakpoint in mean values occurred, indicating additional factors were less impactful on directors' consideration about use of distance education.

4.3 Course Quality

Academic content associated with health educational curriculum requires frequent revision and updates as new knowledge, techniques, and standards of care associated with practice continues evolving. Program directors surveyed indicated a barrier to using DE was "Quality of Courses" (mean 3.11). It can be posited respondents mentally correlated a lack of "Quality" if a course were being offered through an alternative means, although quality of course content itself is within the purview of the Institution, Program, PD and Instructor, not its mechanical or methodological delivery. Academic administrators need to support program directors acting as change agents within their organizations for assuring high quality, current, relevant and appropriate educational curriculum is being developed, offered, evaluated, revised, and modified according to

standards established by Accrediting bodies [34]. Academic curriculum should meet these standards, so although CLS PDs reported concern with quality of courses (mean = 3.11) the issue surfaced in this study may instead be perceptual related to methodologic delivery of the educational content, rather than actual course content itself. Analysis of the barriers related to quality of courses (mean = 3.11), and quality of students (mean = 3.01) who complete distance education programs was considered. Directors may agree with some aspects of using distance education but have reservations related to the perceptions related to quality. This could partially be due to lack of adequate equipment to support using distance education (mean = 3.09). However, this could also be the result of the applied and practical focus of education related to clinical laboratory sciences. Correlational analyses found significant inhibitory effects between 'concern about quality of courses' and 'concern about quality of students' ($r = 0.545$, $p = 0.000$) However, previous research indicated clinical laboratory science students completing distance courses are not significantly different from traditional students [21,33,35]. If program directors' concerns regarding course quality and having proper distance education or diagnostic equipment are not mitigated, they may be further driven not to consider using distance education for didactic content delivery.

Clinical laboratory science education emphasizes psychomotor skill development combined with cognitive knowledge. Due to the applied, practical, hands-on teaching and learning approach used, application of a distance educational model for delivery of the didactic content and curriculum would impact this methodological approach. The mean amount of time spent teaching as reported for all the PDs in this survey was approximately 18 years, indicating many directors were trained before distance education became mainstream for delivering education in the U.S. Thus, directors were likely prepared using a traditional educational model, including 'tell-show-do' as the basis for academic preparation. This long held, traditional approach to educational delivery could impact a CLS PDs perceptions related to the consideration of using distance education. Concerns expressed may not be based on actual data, but rather negative perceptions of distance education possibly due to either negative experiences during DE's early use in the 1990's or a lack of actual, direct experience.

4.4 Faculty Workload, Educational Access and the Rural Workforce

Educational access, especially in rural communities, is an ongoing issue, which is also mirrored in the health care sector [36-37] Program director's awareness of direct and indirect costs associated with higher education today, including faculty time and workload, was another significant issue identified during this study. Specific concerns CLS PDs articulated included release time for course development, and faculty workloads. This was statistically significant at the 99th percentile ($r = 0.513$, $p = 0.000^{**}$, $n = 151$).

Clearly, program directors identified these issues as significant barriers to using distance education methods for didactic delivery. Compensating faculty or academic adjunctive staff for the true time commitment required associated with development, offering and evaluating high quality educational curriculum, along with associated workload, are significant issues within the changing landscape of educational institutions. There is no doubt developing and offering distance education curricula can initially be time consuming, and during development, or revision, more expensive due to associated labor. Additional expenses may also be incurred when subject matter experts collaborate with an Instructional Designer to assure a quality instructional design based in andragogical principles is used while connecting program and course outcomes, content and student assessment. The resultant findings of this study verify what the researchers initially posited as perceived potential barriers to using distance education for academic, didactic delivery.

4.5 Student Abilities, 'Quality' and Educational Access

Clinical Laboratory Science Program directors during this study expressed concerns related to "quality of students". Defining "quality of students" as a reflection of learner's prior academic preparation is a significant challenge. A series of questions may need to be considered beyond these responses: are individuals being screened or asked to complete remedial content prior to program acceptance? Are learners changing careers or workforce sectors? If so, are they adequately prepared for basic skills including mathematics, communication, research and investigation as part of evidence-based practice, or demonstratable affective skills? More

importantly, are academic institutions accepting students that are not prepared for the rigors associated with health occupations academic coursework? As potential student enrollments continue declining across the US due to reduced numbers of younger college-aged students coupled with a strong economy and academic competition, the resultant findings of this study documenting PDs concerns with “quality of student” are relevant. The findings of this research point to a greater problem facing academia today, not just health care or the clinical laboratory diagnostic sector. One potential solution is assuring institutional academic requirements for admissions including ACT, SAT or other admissions criteria, are not being diluted. Another is assuring remedial options are available in educational intuitions prior to program admission for skill development in writing, mathematics, and sciences. And lastly, a potential solution for career development once students are admitted to diagnostic programs includes using distance education for didactic academic content which can provide interprofessional development of diagnostic care team members in rurally isolated educational and health care deserts.

4.6 Future Directions

Loss of institutions of higher learning is continuing across the country [31,32]. Higher education has never been in a more difficult position in the US at any time as it is today [31,32]. Ongoing declines in numbers of brick-and-mortar educational institutions and programs offering educational curriculum continues. Using distance education as a delivery mechanism for the didactic elements of a diagnostic curriculum, combined with the onsite laboratory and clinical teaching and learning, can be one potential solution for providing education necessary for meeting the needs of the 21st century health care diagnostic professional.

While “aging in place” may be desirable for individuals as they approach end of life, this is not necessarily the case for preparing the future health care workforce. Refraining from making methodological delivery adjustments may result in the ongoing loss of diagnostic programs at a time when the need for diagnostic and therapeutic care continues growing [38]. Evidence clearly illustrates learners wanting a different paradigm for accessing educational programs than full-time attendance at brick-and-mortar institutions [17,29].

Results of this study can be utilized by CLS PDs in their continued use of distance education. It may be especially useful for PDs to consider offering didactic elements of course offerings for programs while hybridizing and transitioning to using distance education programs. Hybridized models would still allow for psychomotor application of the hands-on elements of diagnostic training in an evening/weekend format, allowing for individuals to interact directly with faculty, staff and other students. This approach could allow for potential access to education and health care services in educational deserts across the U.S. As these models have been documented to provide the same educational training for therapeutic care providers,[27] these researchers posit these tools could similarly be used for diagnostic team’s development. Future research could also focus on the importance of developing crucial communication and teamwork skills which are critical to interprofessional practice in healthcare. This data could be useful for other groups/stakeholders who would likely become involved in the transition to or creation of distance courses/programs by clinical laboratory science directors including admissions, registration, program faculty, financial aid, library services, and career services. Opportunities exist for increasing the number of distance education clinical laboratory science programs, which could help address labor shortages of laboratory professionals [1-8].

5. CONCLUSION

A potential solution to combatting diagnostic clinical laboratory workforce labor shortages may be increasing the number of distance programs available for training individuals in clinical laboratory sciences. Factors examined through a survey of clinical laboratory science program directors’ as barriers to using distance education included concern about quality of courses, students, lack of time and lack of resources. Clinical laboratory science directors generally did not agree about which barriers impact their decision to use distance education as a tool for offering educational programming. While distance education is a viable solution for offering diagnostic, didactic program content, perceived and real barriers to its use are impacting workforce development, especially in rural, health care and educational deserts.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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