

An Entry-Level MS Degree in Clinical Laboratory Science: Is It Time?

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OBJECTIVE: The study was undertaken to address the following questions: 1) Does the scope of practice of the clinical laboratory scientist require an entry-level master's (MS) degree? 2) How would a change to an entry-level MS degree in clinical laboratory science (CLS) affect educational programs, the practice field, and students? and 3) Based on this study, what recommendations can be made to CLS educators?

DESIGN: Surveys were developed to assess the opinions of educators, managers, and practitioners on the need for an entry-level MS degree in CLS. Surveys were also sent to students to assess their interest in an entry-level MS degree and their perceptions of the advantages and disadvantages of this type of program. Surveys sent to educators included questions addressing the effect of a change to an entry-level MS degree in CLS on enrollment and program viability. Managers were asked questions concerning job expectations and compensation for graduates with an entry-level MS degree and practitioners were asked about their interest in this type of program.

PARTICIPANTS: The sample for the survey included 280 directors of National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) educational programs, 600 managers randomly selected from the Clinical Laboratory Management Association (CLMA) mailing list, 600 practitioners randomly selected from the American Society for Clinical Laboratory Science (ASCLS) mailing list, and 1400 CLS students selected by program directors.

MAIN OUTCOME MEASURES: Educators, managers, and practitioners were asked to read 12 statements related to educational preparation for entry into CLS and indicate their level of agreement on a five point scale. Mean responses to these questions were compared for educators, managers, and practitioners, for educators in hospital-based and university-based programs, and for managers with BS and advanced degrees. Responses to demographic and other forced-choice type questions related to entry-level MS programs were counted and reported.

RESULTS: Response rates of 58% (educators), 28% (practitioners), 39% (managers), and 40% (students) were obtained. Educators, managers, and practitioners all agreed that the scope of practice of CLS does not require an entry-level MS degree and that the MS degree is appropriate for those practitioners who wish to further their education. There were no major differences in educators', managers', and practitioners' responses to questions on the need for an MS in CLS. Students indicated that they would be interested in an entry-level MS program if the additional education would give them higher salaries and more job opportunities. Students who entered their CLS program with a baccalaureate (BS) degree were more interested in the entry-level MS option than students who entered with an associate degree or high school diploma. Managers indicated that they would not pay a graduate with an entry-level MS degree more than a graduate with a baccalaureate degree.

CONCLUSION: There is currently no support for an overall change from the BS degree to the MS degree as the entry-level requirement for CLS practitioners. Entry-level MS programs in CLS may be attractive to students who already have BS degrees.

ABBREVIATIONS: ASCLS = American Society for Clinical Laboratory Science; BS = baccalaureate; CLS = Clinical Laboratory Science; CLS/MT = clinical laboratory scientist/medical technologist; CLT = clinical laboratory technician; MS = master's of science; MT = medical technologist; NAACLS = National Accrediting Agency for Clinical Laboratory Sciences; Pharm D = Pharmacy Doctorate.

INDEX TERMS: clinical laboratory science; curriculum; education; laboratory personnel; medical technologist.

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Rapid changes in the clinical laboratory have prompted educators to question the current preparation of clinical laboratory science (CLS) graduates. Technical skills, which have long been the main focus of CLS education, are becoming less important in the current highly automated clinical laboratory setting. The roles of the CLS practitioner and the associate-degree clinical laboratory technician (CLT) practitioner are less distinct in these technical areas and more distinct in areas of management and education.^{1,2} Financial, regulatory, and personnel management issues have increased in importance as clinical laboratories struggle to compete in the healthcare environment. A recent American Society for Clinical Laboratory Science (ASCLS) Position Paper states that the CLS curriculum should include information management, disease state management, epidemiology, clinical decision analysis, and outcomes assessment. The position paper states that the “traditional clinical laboratory science curriculum is inadequate for preparing graduates for competent clinical practice in the future”.³ In response to expected changes in practice, the recently adopted National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) Standards of Accredited Education Programs for the CLS/MT add more curriculum requirements in non-technical areas including laboratory operations, financial management, and human resource management.⁴

CLS educators have responded to changes in the healthcare environment by adding management content, adding molecular biology, and decreasing clinical rotation time.⁵ Too often, however, educators have not anticipated change, but have reacted to changes in the environment.⁶ As CLS educators seek to be pro-active in curricular decisions, an entry-level master's of science (MS) degree in CLS is frequently discussed as the next step in preparing students for future practice obligations.

Other healthcare professions have struggled with the issue of the appropriate education for entry-level practice and have moved to advanced degrees. In 1979, physical therapy began a ten-year transition to the entry-level MS degree. Reasons for raising the educational requirements included the acknowledgment that the obligations of the profession and the education objectives of professional entry were too extensive to be realized at the baccalaureate (BS) level.⁷ In addition, credibility in the eyes of the physician was considered unattainable at the BS level.⁸ The next step for physical therapists is described in the vision statement of the American Physical Therapy Association, articulated in June, 2000; “By 2020, physical therapy will be provided by physical therapists who are doctors of physical therapy”.⁹ Other professions are also revising the educational requirements for entry-level practice. Occupational therapy will require MS degrees for career entry by 2007 and audiologists will be required to obtain a doctorate in audiology by 2012.^{10,11}

In CLS, the BS degree is currently the standard educational requirement for entry-level practitioners and graduate programs are available for practitioners who wish to further their education.

There is some evidence that graduate programs enhance practitioners' careers and advance the profession of CLS.¹² Compared to clinical laboratory scientists (CLSs) without an MS degree, CLSs who pursued an MS degree had more managerial level jobs, increased earnings per year, and more publications and professional contributions. Currently most certified CLS practitioners are pursuing an MS degree for their own personal satisfaction rather than for expected career advancement.¹³

CLS education is now at a crossroads of educational preparation and professional obligations. The knowledge base and expectations of the CLS practitioner are expanding and may outgrow the traditional four-year BS level preparation. Educators are questioning whether the current BS-level programs should change significantly to emphasize non-technical competencies and de-emphasize technical skills or whether it is time to move to entry-level MS degree programs for the CLS level practitioner. The purpose of this study was to collect and analyze information needed to guide decisions on the appropriate level of education for CLSs at this critical point in the history of the profession. The study sought to answer the following research questions: 1) Does the scope of practice of the CLS require an entry-level MS degree? 2) How would a change to an entry-level MS degree in CLS affect educational programs, the practice field, and CLS students? and 3) Based on this study, what recommendations can be made to CLS educators?

METHOD

An advisory board, composed of laboratory practitioners, managers, and educators, was formed to guide the development of the surveys, review results, and make recommendations. The authors, in consultation with the advisory committee, developed definitions of key terms and survey instruments for educators, managers, practitioners, and students. Definitions used in the surveys included:

Clinical Laboratory Scientist/Medical Technologist: A clinical laboratory scientist/medical technologist (CLS/MT) has a baccalaureate degree and national certification, e.g., CLS(NCA) or MT(ASCP). This laboratory practitioner uses independent judgment to provide laboratory information and services.

Entry-level Master's Degree Program: In this type of program, students receive the academic and clinical background in all major areas of the clinical laboratory typical of a BS CLS/MT program. In addition, students complete advanced coursework in laboratory administration, education, or advanced laboratory sciences, e.g., molecular genetics. Practical experiences may include laboratory management, research, or advanced clinical practice. Students receive a master's degree and are eligible for national certification examinations, e.g., CLS(NCA) or MT(ASCP).

Advanced Master's Degree Program: In this type of master's degree program, students typically have certification as a CLS/MT before they enter the program. Students complete advanced coursework in areas such as laboratory administration, education,

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or laboratory sciences. Programs generally last two years and students often complete a research project or defend a thesis.

Surveys for educators, managers, and practitioners included demographic questions on geographic region, work settings, annual volume of tests, primary job function, highest degree, and years of paid experience. Surveys for these three groups also included 12 Lickert-type questions designed to assess the respondents' opinions on entry-level education in CLS (Table 4). Respondents were asked to read each statement and indicate their opinion using a scale on which 1 = strongly disagree and 5 = strongly agree.

Surveys contained additional questions that were specific for each group. Educators were asked questions on the type of program(s) offered, the type of program(s) planned for the next five years, the effect of a change to an entry-level MS degree on enrollment and program viability, and the resources needed to add an entry-level MS CLS program. Managers were asked whether they would hire a graduate with an entry-level MS degree in CLS, pay that individual more than a graduate with a BS degree, have higher expectations for a graduate with an entry-level MS degree, assign more administrative tasks to a graduate with an entry-level MS degree, or hire a graduate with an entry-level MS degree with no work experience for a supervisory position. Practitioners were asked if they would have been interested in an entry-level MS degree in CLS at the beginning of their CLS education.

Students were asked questions on geographic region, highest degree before entering the CLS program, and the type of program in which they were enrolled. In addition, students were asked for their views on the advantages and disadvantages of entry-level MS CLS programs and they were asked to indicate whether they would have been interested in an entry-level MS when they were applying to a CLS program.

The surveys and cover letters, including the definitions of terms, were tested in a pilot study using a sample of educators, managers, practitioners, and students from across the United States. The surveys and definitions were revised based on the comments from participants in the pilot study.

In March 2000, surveys were sent to CLS students, educators, managers, and practitioners. Responses were requested from 280 directors of NAACLS accredited CLS/MT programs. Educators were also asked to distribute surveys and cover letters with stamped return envelopes to five students in the final year of their CLS programs. Based on response rates in other national surveys of managers and practitioners, the authors included 600 CLS managers and 600 CLS practitioners in this study to attain a sufficient number of respondents from each group.¹ Managers were randomly selected from the Clinical Laboratory Management Association (CLMA) membership list and practitioners were randomly selected from the ASCLS membership list. Surveys received within six weeks were included in the data analysis.

DATA ANALYSIS

SPSSX 9.0 for Windows[®] was used to analyze the data collected in this study. The means of the responses to the Lickert-type questions were calculated for all respondents, for each group of respondents (educators, managers, and practitioners), for educators in hospital-based and university-based programs, and for managers with BS degrees and with advanced degrees. Participants' responses to the Lickert-survey questions were classified using the following criteria: disagree = mean score of 2.5 or less, undecided = mean score greater than 2.5 and less than 3.5, and agree = mean score of 3.5 or higher. T-tests and analysis of variance (ANOVA) tests were used to assess differences in responses among groups. The level of significance was set at a *p* value of 0.01. Significant differences detected in ANOVA tests were analyzed using the Tukey method. Chi-square analysis was used to compare interest in an entry-level MS CLS program among students with different degrees.

RESULTS

Response rate

Usable surveys were received from 163 educators (58%), 231 managers (39%), and 166 practitioners (28%). A total of 1400 student surveys were distributed to CLS program directors; 556 (40%) were returned and usable.

Demographic information

Demographic data on educators, managers, and practitioners are shown in Table 1. All geographic regions were represented. The majority of managers (74.9%) and practitioners (63.1%) worked in hospitals or medical centers. Most educators indicated that they worked either in a hospital/medical center (46%) or an educational program (41.1%). Respondents listing their work setting as "other" described settings such as private/non-profit health systems, laboratory information companies, patient education, and clinical trials.

Respondents from institutions of all sizes were included in the study. Over half (55.9%) of the managers indicated that they were in laboratories performing fewer than 500,001 tests per year. Most educators were from institutions performing over 1,000,000 tests per year (42.9%) or they indicated that this question was not applicable to them (37.6%).

The survey question on primary job function verified that the populations chosen for this study did represent targeted groups of educators, managers, and practitioners. Eighty-eight percent of the respondents to the survey of CLS program directors indicated that their primary job function was "educator". Over 95% of the surveys sent to CLMA members were returned by respondents who listed their job function as supervisor, administrator, or director. Most of the respondents in the practitioner survey (55.4%) listed CLS/MT as their primary job function. Respondents in the practitioner group also included some supervisors and administrators (22%) and educators (10.1%).

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Table 1. Demographic characteristics of educator, manager and practitioner respondents

	Educators		Managers		Practitioners	
	#	%	#	%	#	%
Geographic Region						
MA, ME, RI, CT, NH, VT, NY	14	8.6	23	10.0	21	12.7
DE, DC, MD, NJ, PA, VA, WV	25	15.4	18	7.8	20	12.0
FL, GA, MS, NC, PR, SC, TN, AL	27	16.7	36	15.7	16	9.6
MI, IN, OH, KY	23	14.2	25	10.9	21	12.7
MN, WI, ND, SD	15	9.3	34	14.8	18	10.8
IL, IA, KS, MO, NE	22	13.6	38	16.5	16	9.6
AR, LA, OK, TX, NM	19	11.7	22	9.6	18	10.8
CO, ID, MT, UT, WY	5	3.1	14	6.1	12	7.2
AK, WA, OR, AZ, CA, HI, NV	12	7.4	20	8.7	24	14.5
Work Setting						
Hospital/medical center	75	46.0	173	74.9	106	63.1
Academic health center	17	10.4	4	1.7	4	2.4
Reference laboratory	2	1.2	12	5.2	15	8.9
POL/group practice	0	0	33	14.3	9	5.4
Educational program	67	41.1	1	0.4	13	7.7
HMO/health system	0	0	5	2.2	0	0
Industry/sales	0	0	0	0	8	4.8
Blood center	0	0	1	0.4	4	2.4
Other	1	0.6	2	0.9	10	6.0
Annual Volume of Tests						
Fewer than 100,000	1	0.6	42	18.2	21	12.5
100,001-500,000	11	7.1	87	37.7	33	19.6
500,001-1,000,000	18	11.5	39	16.9	34	20.4
Greater than 1,000,000	67	42.9	56	24.2	40	23.8
Not applicable	59	37.8	3	1.3	26	15.5
Primary Job Function						
CLS/MT	5	3.1	5	2.2	93	55.4
CLT/MLT	0	0	0	0	7	4.2
Research technologist	0	0	0	0	6	3.6
Laboratory supervisor	3	1.8	43	18.6	16	9.5
Laboratory director/administrator	10	6.1	177	76.6	21	12.5
Educator	144	88.3	4	1.7	17	10.1
Sales/marketing	0	0	0	0	3	1.8
Other	0	0	2	0.9	4	2.4
Highest Degree						
HS/GED	0	0	0	0	1	0.6
Associate degree	0	0	10	4.3	7	4.2
Baccalaureate degree	26	16.3	139	60.4	116	69.5
Master's degree	89	54.9	77	33.5	37	22.2
Doctorate	47	29.0	4	1.7	6	3.6
Years of Paid Experience						
Fewer than 2	0	0	0	0	10	6.0
2 to 5	1	0.6	2	0.9	14	8.3
6 to 10	6	3.7	4	1.7	13	7.7
11 to 20	25	15.3	71	30.7	46	27.4
Greater than 20	130	79.8	154	66.7	84	50.0

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The majority of the managers (60.2%) and practitioners (68.5%) indicated that a BS degree was their highest degree. Respondents in the educator group had the highest percent of MS degrees (54.6%) and doctorates (28.8%). The educator group was also the oldest group of respondents with 79.8% reporting that they had over 20 years of paid experience. The practitioner group was younger than the educator and manager groups, with 50% of practitioners indicating that they had fewer than 20 years of experience.

The 556 students who responded to the survey were distributed across all geographic regions. Forty-three percent (43.7%) of the students had a high school diploma before entering their CLS program and 19.7% had an associate degree on program entry. Over one-third of students (35.4%) entered a CLS program with a BS degree and 1.3% had an MS degree. Fifty-six percent of the student respondents were from university-based programs and 42.2% were from hospital-based CLS programs. A few students (1.4%) indicated that they were from other types of programs and they described these programs as entry-level MS program (5),

advanced MS program (1), reference laboratory (1), and non-profit community foundation (1).

Student specific responses

Students' views on the benefits of an entry-level MS CLS program and their concerns about this type of program are shown in Table 2. The students' greatest concerns were that there would be no gain in salary and no difference in job opportunities for the entry-level MS degree. Benefits that would encourage students to enroll in an entry-level MS CLS program were better job opportunities and higher salaries.

Approximately one third (30.5%) of the students indicated that they would have been very interested in an entry-level MS in CLS when they were considering a CLS program and 18.7% indicated that they would have had no interest in this type of program. Half of the students (50.5%) said they would have been somewhat interested in an entry-level MS in CLS.

Chi-Square analysis indicated significant differences in how students responded to the question on interest in an entry-level MS degree depending on the degree they

held when they entered the CLS program (Table 3). Students who entered the CLS program with a BS degree appeared to be most interested in the entry-level MS degree. Approximately 40% of these students indicated they would have been very interested in this type of program if it had been available. Only 20.4% of students with associate degrees and 27.7% of students with high school degrees at program entry would have been very interested in the entry-level MS CLS option. Students who entered a CLS program with an associate degree appeared to be the least interested in an entry-level MS option.

Educator specific responses

Over half of the educators (54.3%) were from hospital-based programs and 43.8% were from university-based programs. One program director was from a five-year integrated program and two were from universities with both BS and MS entry-level CLS programs. The types of programs that the respondents indicated they will offer in the next five years included:

- BS entry-level program only (72.4%)
- BS entry-level and advanced MS degree (10.4%)
- BS entry-level and MS entry-level programs (3.7%)
- BS entry-level, MS entry-level, and advanced MS (2.5%)
- Advanced MS only (1.8%)
- Other combinations including doctorates (1.8%)
- MS entry-level only (0.6%)

A few program directors (2.5%) reported that they expect to be closed in the next five years.

The responses of educators to questions on student enrollment and program viability differed depending on whether they were from hospital-based programs or university-based programs. Half of the hospital-based educators indicated that an entry-level MS degree was not possible at their institution and, of the hospital-based educators who thought a program might be possible, most thought this type of program would lead to decreased enrollment (98%) and threatened program viability

Table 2. Students' views on the entry-level MS in CLS: concerns and benefits

Concern	#	%
No expected salary gain	197	35.7
No difference in job opportunities	111	20.1
Cost	95	17.2
Length	73	13.2
Other	37	6.7
Difficulty/academic demands	18	3.3
Content (administration/ management emphasis)	14	2.5
Content (advanced laboratory science emphasis)	7	1.3
Benefits		
Better job opportunities	190	34.4
Higher salary for MS vs. BS	189	34.2
Value (getting an MS instead of a BS)	72	13.0
Content (advanced laboratory science emphasis)	61	11.1
Challenge (academic demands of a graduate program)	15	2.7
Other	14	2.5
Content (coursework in administration)	11	2.0

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(86%). No hospital-based educators thought that an entry-level MS program would enhance enrollment or improve program viability. Only 11% of the university-based educators stated that an entry-level MS program was not possible. Most of the university-based educators indicated that converting to an entry-level MS program would result in declining enrollment (88.7%) and threatened program viability (77.7%). A small percent of the university-based educators thought that an entry-level MS program would enhance enrollment (6.4%) and improve program viability (12.6%).

Educators were asked to identify the additional resources that would be needed if they converted their BS programs to entry-level MS programs or added the option of entry-level MS programs. Resources needed included:

- more opportunities for management based practical experiences (87.9%)
- more opportunities for advanced laboratory experiences such as molecular diagnostics (73.5%)
- additional funding for graduate students (72.7%)
- additional faculty expertise from outside the CLS program (62.9%)
- more CLS faculty (62.1%)
- expanded faculty expertise within the CLS program (60.9%)
- more support from the dean (60.6%)
- add additional facilities (46.2%).

Practitioner specific responses

If entry-level MS programs in CLS had been available when they were beginning their education, 18.6% of the practitioner respondents indicated they would have been very interested in this option. Forty six percent of the practitioners would have been somewhat interested and 35.4% indicated they would have had no interest in an entry-level MS in CLS.

Manager specific responses

Most laboratory managers (70.3%) indicated that they would hire a graduate with an entry-level MS degree in CLS; however, 75.5% also said that they would not pay a higher salary for entry-level MS practitioners. The majority of laboratory managers (59.6%) would have higher expectations of a graduate with an entry-level MS degree than a graduate with a traditional BS degree in CLS. If the entry-level MS program emphasized administration and management, 64.9% of the laboratory managers would assign more administrative tasks to the new MS CLS graduate. Only 7.4% of the laboratory managers, however, would hire a graduate with an entry-level MS degree in CLS who had no work experience for a supervisory position.

Opinions on an entry-level MS degree in CLS

The responses of educators, managers, and practitioners to 12 questions on educational requirements for CLSs are shown in Table 4. All groups agreed that the BS

degree is most appropriate for entry-level practice (statement 2), that MS degrees are not needed for entry-level practice (statement 12) and that the MS degree is most appropriate for people who wish to advance their careers beyond staff-level positions (statement 11). All groups disagreed with replacing BS programs with entry-level MS programs (statement 4) and requiring entry-level MS degrees in the future (statements 6, 10).

Educators disagreed with the statement suggesting that entry-level MS degrees would better prepare students for future laboratory jobs (statement 1) and the statement asserting that a CLS with an entry-level MS degree will have an advantage over a CLS with a BS degree when seeking his or her first job (statement 7). Managers and practitioners were undecided in their responses to these statements; however, their responses were not significantly different from the educators' responses.

Statements 3, 5, 8, and 9 addressed the impact of an entry-level MS degree on the practice field. All groups agreed that changing to entry-level MS degrees would decrease the supply of practitioners (statement 3). All groups were undecided in their responses to questions on the impact of the entry-level MS on role differentiation (statement 5) and professional respect (statement 8). Managers and practitioners were undecided in their responses to statement 9 which asserted entry-level MS degrees would improve salaries. Educators disagreed with this statement, however, the differences in responses were not statistically significant.

Significant differences in responses among managers, educators, and practitioners were only found in responses to statement 2. All groups agreed that the BS degree is currently the most appropriate degree for entry-level CLS practitioners; however, educators rated this statement significantly higher (more in agreement) than managers or practitioners.

Table 3. Comparison of interest in entry-level MS CLS programs by academic degree upon entering a CLS program

Degree	Very interested		Somewhat interested		Not interested		Total number
	#	%	#	%	#	%	
High School	67	27.7	130	53.7	45	18.6	242
Associate	22	20.4	60	55.6	26	24.1	108
BS	78	39.8	86	43.9	32	16.3	196
Total	167	30.5	276	50.5	103	18.7	546

Pearson Chi-Square = .005

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The responses to the 12 opinion statements for hospital-based and university-based educators are shown in Table 5. Significant differences were detected in responses to statements 2, 6, and 10. Both groups agreed that the BS degree is currently the most appropriate degree for entry-level CLS practitioners; however, hospital-based educators rated this statement higher than university-based educators. Hospital-based educators disagreed with the suggestion that MS degrees would be needed for practice in the next 5 to 10 years (statements 6 and 10). University-based educators were undecided in their responses to these statements.

The educational background of managers did not influence their opinions. No significant differences were detected when the responses of managers with BS degrees were compared to those with advanced degrees for each of the 12 statements shown in Table 4.

DISCUSSION

This study provided answers to several questions concerning entry-level MS degrees from the perspectives of educators, managers, practitioners, and students. Educators, managers, and practitioners agreed that the current scope of practice of the CLS does not require an entry-level MS degree, that the BS degree is appro-

Table 4. Educators (EDU), managers (MAN), and practitioners (PRAC) views on entry-level MS CLS programs

Statement	Total sample mean	EDU mean	MAN mean	PRAC mean	SIGN
1. If entry-level master's degree programs were available, CLS/MT students would have a better preparation for laboratory jobs.	2.60	2.44	2.64	2.69	0.08
2. Currently, the most appropriate entry level preparation for CLS/MT practitioners is a baccalaureate degree.	4.22	4.40	4.14	4.17	0.01
3. Changing entry-level education in CLS/MT from a BS degree to an MS degree would decrease the supply of practitioners.	4.28	4.38	4.31	4.15	0.11
4. Entry-level master's degree programs should replace the current baccalaureate level programs.	1.83	1.80	1.77	1.95	0.18
5. Changing the entry-level education in CLS/MT from a BS degree to an MS degree would better differentiate the job functions of the CLT/MLT and the CLS/MT practitioner.	2.83	2.99	2.73	2.80	0.12
6. Master's degree programs in CLS/MT will be needed for entry level CLS/MT practice in the next 5-10 years.	2.26	2.36	2.17	2.30	0.17
7. In the future, a CLS/MT with an entry level master's degree will have an advantage over a CLS/MT with a baccalaureate degree when seeking his or her first laboratory job.	2.52	2.40	2.52	2.63	0.15
8. If CLS/MT practitioners had master's degrees, they would be more respected by physicians and other healthcare workers.	2.60	2.55	2.66	2.56	0.55
9. Changing the entry-level CLS/MT education from a BS degree to an MS degree will improve salaries.	2.54	2.43	2.59	2.58	0.28
10. In the next 5 – 10 years, the scope and depth of knowledge required for entry-level practice at the CLS/MT will require an entry-level master's degree.	2.38	2.44	2.33	2.39	0.57
11. Currently, master's degrees are most appropriate for people who wish to advance their career beyond staff-level laboratory positions.	4.15	4.23	4.07	4.17	0.20
12. Master's degree programs in CLS/MT are not needed for current entry-level practice.	4.24	4.26	4.20	4.29	0.62

Disagree = ≤ 2.5 , Undecided = > 2.5 and < 3.5 , Agree = ≥ 3.5 ; SIGN = level of significance

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appropriate for entry-level practitioners, and that the MS degree is most appropriate for those practitioners who wish to further their education. There were no major differences in the opinions of educators, managers, and practitioners on these questions related to CLS education. This degree of agreement was impressive given the divide that is often described between the academic world and the 'real world' of clinical practice.

While students were not directly asked for their opinions on the advisability of an entry-level MS in CLS, they were asked about their interest in this type of program. Students indicated that they would be interested if the additional education would give them higher salaries and more job opportunities. The information gathered from managers indicated that this would not be the case. The majority of the managers in this study would not pay a new practitioner with an entry-level MS in CLS more than a new practitioner

with a BS degree. Also, managers would not hire, for a supervisory position, a graduate with an entry-level MS degree with no work experience.

The concept of an entry-level MS degree requirement for CLS practitioners raised many concerns for the respondents in this study. Half of the hospital-based programs indicated that an entry-level MS program was not an option at their institution. The majority of educators in both hospital-based and university-based programs indicated that a change to an entry-level MS degree would require a significant amount of new resources including faculty, opportunities for graduate practical experiences, and funding for students. Educators in both types of programs also expressed concerns about enrollment and program viability if their program changed to an entry-level MS degree. Managers and practitioners appear to share the opinion of educators that a change to an entry-level MS in

Table 5. Hospital-based (HOSP) and university-based (UNIV) educators' views on entry-level MS/CLS programs

Statement	HOSP mean	UNIV mean	SIGN
1. If entry-level master's degree programs were available, CLS/MT students would have a better preparation for laboratory jobs.	2.24	2.62	0.02
2. Currently, the most appropriate entry-level preparation for CLS/MT practitioners is a baccalaureate degree.	4.57	4.25	0.01
3. Changing entry-level education in CLS/MT from a BS degree to an MS degree would decrease the supply of practitioners.	4.55	4.20	0.20
4. Entry-level master's degree programs should replace the current baccalaureate-level programs.	1.59	1.96	0.02
5. Changing the entry-level education in CLS/MT from a BS degree to an MS degree would better differentiate the job functions of the CLT/MLT and the CLS/MT practitioner.	2.86	3.13	0.18
6. Master's degree programs in CLS/MT will be needed for entry-level CLS/MT practice in the next 5-10 years.	2.13	2.57	0.01
7. In the future, a CLS/MT with an entry-level master's degree will have an advantage over a CLS/MT with a baccalaureate degree when seeking his or her first laboratory job.	2.33	2.39	0.70
8. If CLS/MT practitioners had master's degrees, they would be more respected by physicians and other healthcare workers.	2.46	2.66	0.27
9. Changing the entry-level CLS/MT education from a BS degree to an MS degree will improve salaries.	2.41	2.39	0.91
10. In the next 5 – 10 years, the scope and depth of knowledge required for entry-level practice at the CLS/MT will require an entry-level master's degree.	2.21	2.66	0.01
11. Currently, master's degrees are most appropriate for people who wish to advance their career beyond staff-level laboratory positions.	4.21	4.28	0.55
12. Master's degree programs in CLS/MT are not needed for current entry-level practice.	4.35	4.17	0.23

Disagree = ≤ 2.5 , Undecided = >2.5 and <3.5 , Agree = ≥ 3.5 ; SIGN = level of significance

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CLS would decrease the supply of practitioners. This concern is especially important in a time of declining enrollments, program closures, and staffing shortages.

The finding that half of the hospital-based educators thought entry-level MS programs were not possible at their institutions needs further analysis. This may have been a difficult question for hospital-based educators to answer because, in most cases, the academic affiliate rather than the hospital grants the academic degree. Because the survey did not probe deeper, it is unclear whether the impossibility of offering an MS degree is true at any given institution or merely unexplored. Hospital-based programs could participate in MS degree education in the same way they are involved in BS programs. They could continue to offer the professional phase of the program with lectures and laboratory clinical experiences. The additional graduate course work in management, education, or advanced science could be provided by the degree granting institution and/or by the hospital. The types of projects CLS students often complete in their clinical rotations would be acceptable for MS projects, if not theses. It may be that hospital-based educators expect that any greater involvement of their institution in teaching is not possible, and hence their responses to the question. However, the added courses for the MS degree would not have to be provided by the hospital. So in fact, more hospital-based programs may be able to participate in an entry-level MS degree than the data suggest.

Educators, managers, and practitioners disagreed with statements suggesting that an entry-level MS degree would be needed in the next 5 to 10 years; however, some differences were detected when educators in hospital-based and university-based programs were compared. Hospital-based educators did not see the need for the entry-level MS degree in the future while university-based educators were undecided. It is possible that university-based educators are more receptive to an entry-level MS degree in the future because they are in closer contact with other allied health faculty and are aware of the trend toward increasing educational standards in other professions. It is also possible that hospital-based educators' views of the future are more realistic or more strongly influenced by practical concerns about program survival and enrollment.

The conclusion from the data presented here, that there is no place for an entry-level MS degree in CLS at this time, may be simplistic. It is true that the survey respondents do not imagine the need; however, that does not mean that if such individuals existed, they would not find a place in the clinical laboratory. The history of the development of the Pharmacy Doctorate (Pharm D) is a case in point. Roughly fifty years ago, the need for any role other than that of the familiar dispensing pharmacist was not established. However, faculty at the University of California, San Francisco, believing that pharmacists could provide a broader set of services to healthcare providers and patients, undertook an experiment.¹⁴ They found the necessary approval to place small dispensaries on

hospital floors and staffed them with qualified pharmacists. Not surprisingly, over time, the pharmacists became more accepted and even relied upon by the providers, so that when the experiment was over and the floor dispensaries were closed, providers demanded that pharmacists be available on the floors as consultants. Thus was born the Pharm D. Over time the number of Pharm D programs has grown and as of 2004, it will be the entry-level degree.

The Pharm D story is illustrative because, had anyone asked providers about the need for the individuals like the consulting pharmacist, they would not have seen the need. Similarly, in the clinical laboratory, it is easy to understand why most people would not see the need for individuals prepared at career entry to take on significant management tasks. For several decades, management skills such as determining test costs, writing procedures, developing job descriptions, scheduling staff, and managing inventory have been included in the CLS curriculum. Yet, most graduates are not given such responsibilities in the first year on the job.² Laboratory employers who are currently not using the management skills of their entry-level employees may not be able to imagine using individuals with an even more sophisticated set of skills. But that does not mean that there is no place for individuals with that skill set. Rather, it may mean that there are only a few laboratory managers who can see the potential for such individuals. Waiting until the majority of individuals see the need may be too late. It will be important for those contemplating, or currently offering, entry-level MS degrees, to find the few visionary employers who will provide work experiences that will match student preparation. If the pharmacy experience is any guide, it may take some time before the entry-level MS degree becomes *de rigueur*, but individuals and institutions willing to take the first steps in that direction may lead the profession to a new level of practice.

The inability to visualize a new type of practitioner may have affected the respondents answers to questions addressing the impact of entry-level MS personnel on the practice field. Educators, managers, and practitioners were undecided when responding to statements suggesting that entry-level MS practitioners would have a positive impact on role differentiation, professional respect, and salaries. Without direct experience, respondents appeared to be reluctant to predict the effect of entry-level MS practitioners on the laboratory profession.

It is interesting to speculate as to why the clinical laboratory would be resisting the trend toward enhanced entry requirements seen in other health professions, when the expansion of knowledge is so dramatic. In fact, in CLS, there has been something of a trend toward 'de-skilling' over the last decade as managers have sought to constrain personnel costs. Individuals with fewer skills and less education have been hired to take limited roles in the clinical laboratory. That such hiring practices go unchecked by the profession is probably in part attributable to the failure of the laboratory profession to have gained adequate control over its scope of practice

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and entry to the profession. Advances in technology may also play a role. The 'technology' dependent professions are probably more susceptible to 'de-skilling' and thus to market influences, than the 'therapies'. Further, the role of generalist laboratory professionals in advanced consultative roles, analogous to the Pharm D, has not developed, in part because such roles have been usurped by doctorates, chiefly in clinical chemistry and microbiology. This combination of factors creates an environment for the clinical laboratory profession that is distinctly different than in the other professions that have successfully, if slowly, advanced their entry-level educational requirements.

LIMITATIONS

Any survey of the practice field is limited by the date of sampling. The authors attempted to extend the usefulness of this survey by asking respondents to project needs in the next five to ten years. Although the healthcare system has not changed significantly since this survey was conducted, future changes in how laboratory services are delivered could require new approaches to CLS education. This type of survey should be repeated in five to ten years to again assess the need for an entry-level MS degree.

The respondents in this study were grouped as educators, managers, practitioners, and students. The practitioner group, taken from the ASCLS mailing list, was the least homogeneous with some respondents indicating that they were supervisors and educators. Because the educator, manager, and practitioner groups probably all had respondents who wore 'many hats', the authors did not exclude the ASCLS respondents who indicated their primary job responsibility was in management or education. The response rates for managers and practitioners were lower than that of educators; however, they were comparable to response rates from managers and practitioners in other national unsolicited surveys.^{1,2} The demographic information indicated that respondents in each of these groups were well distributed across geographic region, work settings, and institutions of various sizes.

RECOMMENDATIONS FOR CLS EDUCATORS

There is no widespread support for an overall change from the BS degree to the MS degree as the entry-level requirement for CLS practitioners at this time. CLS educators' responsibility to ensure that BS level graduates are well prepared for professional practice will continue. For those laboratory professionals who are interested in offering or attending entry-level MS CLS programs, there are some positive signs in this study. Some entry-level MS pro-

grams in CLS currently exist and approximately 6% of the educators who responded to this study expect to be offering this type of program in the next five years. Responses from students indicate that an entry-level MS in CLS might be most attractive for students who already have a BS degree when they are looking for a CLS program. In a time of personnel shortage, a variety of career entry options may help attract students and prepare practitioners for the challenges of the future.

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