

# Assessment of the Graduate Studies Background of CLS Faculty in University-based Programs

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**OBJECTIVE:** To identify the degrees held and the graduate majors or fields of study for faculty teaching full-time and part-time in university-based, baccalaureate-degree clinical laboratory science/medical technology (CLS/MT) programs.

**DESIGN AND PARTICIPANTS:** A survey and letter of project explanation was sent electronically to the 110 program directors of NAACLS-accredited university-based CLS/MT programs in the United States in May, 2003. Program directors were requested to provide for each full-time and part-time faculty member the following information: titles for all degrees held, major/field of study for each degree held, all specialist certifications held, all other formal degrees or certificates held, and all courses/areas taught in the CLS curriculum.

**RESULTS:** Information was provided on 288 faculty in 52 CLS/MT programs, for a response rate of 47%. The majority of faculty (75%) described were full-time. A doctorate was held by 43% of the reported faculty, while 46% held a master's degree as their highest degree, and 11% only a BS in CLS or in biology plus a certificate from a hospital-based CLS/MT program. Graduate degrees in a science major or field represented 52% of the degrees held by the reported faculty, while 48% of the graduate degrees were in education, public health, or administration. Only 13% of the reported faculty held master's degrees specifically in CLS. Detailed results are provided for degrees held, majors/fields of study, and specialist certifications by specific courses/areas of the curriculum taught.

**CONCLUSIONS:** The results of this survey indicate that many faculty teaching in university-based CLS/MT programs are extending their preparation as scientists to the graduate level. This should prepare these faculty for their responsibilities in not only teaching but also research. A case cannot be made that a doctorate, as opposed to a master's degree, is viewed as the 'terminal degree' as less than half of the reported faculty in this study as well as others, held a doctorate. The results reported provide a national perspective on the graduate backgrounds of CLS faculty for comparison to an individual program's faculty during programmatic or institutional accreditation reviews.

**ABBREVIATIONS:** CLDir = Clinical Laboratory Director; CLS = clinical laboratory science; CLS/MT = clinical laboratory science/medical technology; CLSpH = Clinical Laboratory Specialist in Hematology; CLSup = Clinical Laboratory Supervisor; DABCC = Diplomat of the American Board of Clinical Chemistry; DHS = Doctor of Health Science; DLM = Diplomat in Laboratory Management; DrPH = Doctor of Public Health degree; DSc = Doctor of Science degree; EdD = Doctor of Education degree; MAEd = Master of Arts in Education; MAT = Master of Arts in Teaching; MBA = Master of Business Administration; MEd = Master of Education; MPH = Master of Public Health; MS = Master of Science; MSED = Master of Science in Education; MSPH = Master of Science in Public Health; MT = medical technology; NAACLS = National Accrediting Agency for Clinical Laboratory Sciences; SACS = Southern Association of Colleges and Schools; SBB = Specialist in Blood Bank; SC = Specialist in Chemistry; SH = Specialist in Hematology; SM = Specialist in Microbiology.

**Note:** The term clinical laboratory science is used to be synonymous with medical technology, and the abbreviation CLS is used to be synonymous with MT.

**INDEX TERMS:** CLS faculty; CLS faculty graduate degrees; CLS programs.

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**BACKGROUND**

The impetus for conducting this study was East Carolina University's reaccreditation site-visit by a team representing the Commission on Colleges of the Southern Association of Colleges and Schools (SACS). More specifically, the SACS team's review of faculty educational backgrounds and graduate degrees institution-wide was the catalyst for the assessment of graduate studies of CLS faculty teaching in baccalaureate-degree, university-based programs in the U.S.

SACS, as well as other organizations that award regional accreditation to institutions of higher education, have specific standards that must be met to maintain accreditation. The standards related to the graduate backgrounds of faculty teaching in baccalaureate degree programs vary among the regional accrediting bodies. Based on the author's review of these standards for six such organizations that are themselves accredited by the Council for Higher Education Accreditation, the SACS standards seem to be slightly more specific and stringent.<sup>1</sup>

The SACS faculty standards include guidelines that state: "[For] faculty teaching baccalaureate degree courses: a doctoral or a master's degree in the teaching discipline (minimum of 18 graduate semester hours in the teaching discipline). At least 25% of the discipline course hours in each undergraduate major are taught by faculty members holding the terminal degree – usually the earned doctorate – in the discipline."<sup>2</sup>

The other regional accrediting associations that were reviewed have faculty guidelines that could have a more liberal interpretation. The other associations' faculty guidelines include the following: "It employs a faculty that has earned from accredited institutions the degrees appropriate to the level of instruction offered by the institution."<sup>3</sup>; "The institution has an instructional staffing plan that includes a sufficient number of full-time faculty with appropriate backgrounds by discipline and degree levels."<sup>4</sup>; "...faculty and other professionals appropriately prepared and qualified for the positions they hold, with roles and responsibilities clearly defined, and sufficiently numerous to fulfill these roles appropriately"<sup>5</sup>; "The faculty is adequate in number and qualifications to meet its obligations toward achievement of the institution's missions and goals."<sup>6</sup>; "...faculty are qualified by academic background, degree(s), and/or professional experience to carry out their teaching assignment..."<sup>6</sup>; and "The preparation and qualifications of all faculty are suited to the field and level of their assignments. Qualifications are measured by advanced degrees held, evidence of scholarship, advanced study, creative activities, and relevant professional experience, training, and credentials."<sup>7</sup>

The three full-time Department of Clinical Laboratory Science faculty at East Carolina University (ECU) all hold their graduate degrees in fields other than CLS or MT, with two of the full-time faculty holding a PhD, and the third full-time faculty holding a MS. All three part-time faculty hold a BS in CLS as their highest degrees. Consequently, none of the CLS faculty was viewed by the site-visitors as being "in compliance" with the SACS faculty background requirements. In essence, the Department was being asked to justify to SACS why none of the CLS faculty holds a doctorate in his/her teaching field, i.e., specifically in CLS or MT. Secondary to this question was the requirement to justify the appropriateness of each faculty's "alternate qualifications" for teaching in CLS and for the specific courses he/she taught. To address these issues, the author sought to obtain information that could be used to compare ECU's CLS faculty with faculty teaching in the same type of CLS programs, i.e., BS degree and university-based in the U.S.

**SUPPORTING INFORMATION**

Several approaches to obtaining relevant information were pursued. First, an assessment of the availability of CLS doctoral programs in the U.S. was conducted. A search of the Thomson/Peterson website for Peterson's Guide to Graduate Programs was performed using the descriptors "clinical laboratory science" or "medical technology".<sup>8</sup> Only two doctoral programs specifically in CLS were found: a PhD in Biomedical Sciences/Track in Medical Laboratory Sciences at Northeastern University, Boston, Massachusetts, and a PhD in Clinical Laboratory Science at Catholic University of America in Washington, DC. Many doctoral degree programs were listed in the fields of "clinical chemistry" and "clinical microbiology" throughout the U.S. Only one doctoral program was found using the descriptors "hematology" or "immunohematology" which was a Doctor of Science program in Hematology and Transplantation Science at the University of Kentucky Medical Center in Lexington. Over 20 PhD programs in pathology with tracks in various CLS fields including clinical chemistry, clinical microbiology, immunology, and toxicology most frequently, and occasionally hematology or immunohematology, were also found. Interestingly, most of the PhD in pathology programs appeared to aim their student selection at predominantly biology and chemistry majors, though a few also listed CLS majors.

The most recent (2002) information from the Association of Schools of Allied Health Profession's (ASAHP) institutional profile database was accessed. Though these results did not include the fields or majors of graduate study, it did

indicate that of the full-time CLS faculty teaching in the 106 ASAHP-member institutions participating in the survey, 43% held a doctorate as their highest degree, 43% a master's degree, and 14% a baccalaureate degree.<sup>9</sup> The executive offices for both the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) and the American Society for Clinical Laboratory Science (ASCLS) were contacted for potential information, but both organizations indicated that they did not have CLS faculty backgrounds by graduate fields or majors in any of their databases.<sup>10,11</sup>

A literature search was performed to identify any previous assessments of CLS faculty backgrounds by fields or majors of study. Searching back to 1980, no published studies with this specific information could be found. The only study with any relevance to the specific information being sought was one conducted in 1987. As one component of the authors' study, 89 graduate programs in CLS, biomedical and biological fields; health science and public health fields; education; business administration, i.e., MBA, health services administration, computer science; and schools of medicine, dentistry, and veterinary medicine provided information on their students who held the undergraduate major in CLS or MT. The majority (70%) of the responding program directors indicated they had admitted BS-degree CLS students into their graduate programs, while 30% had not or did not know if they had. Most program directors (64%) rated the CLS-degree students as performing average or higher in their programs as compared to students with other degrees.<sup>12</sup> Several studies assessing the research experiences and scholarly productivity of CLS faculty were identified with one national study conducted in 1996 indicating that 46% of such faculty held doctorates and 50% were tenured.<sup>13,14</sup>

**STUDY PURPOSE**

As no current information on the graduate background of CLS faculty by fields or majors of study could be found after a multiple-source search was conducted, the author chose to obtain this information through an electronic or e-survey. The e-survey was designed to answer the following questions relative to CLS faculty teaching in baccalaureate, university-based programs in the U.S.:

1. What graduate degrees by title and major/field of study do the CLS faculty hold?
2. What specialist certifications do the CLS faculty hold?
3. What differences exist among the CLS faculty based on the courses/areas of the curriculum they teach and their employment status, i.e., full-time vs. part-time?

**METHODS**

The survey was designed as a Microsoft Word 2000 document that could be transmitted by e-mail, completed online, and then returned by e-mail. The survey consisted of a separate table for each full-time faculty member (including the program director or department chair), and each part-time faculty member that consistently taught at least one course each year. The survey did not identify the faculty members by name but anonymously by number. Tables for up to eight full-time and four part-time CLS faculty were provided in the e-survey. For each faculty member, the following information was requested with each point of information being a column of a table:

1. all graduate degree(s) held (check all that apply) with the choices being PhD, EdD, DSc, DHS, MD, DDS, MS, MA, MAT, MEd, MAEd, MEd, MBA, other (specify);
2. major or field of study for master's degree (fill in);
3. major or field of study for doctorate (fill in);
4. specialist certification(s) (list all, fill in);
5. other formal degrees or certificates (list all, fill in); and
6. courses/areas taught in CLS program (check all that apply) with the choices being hematology, hemostasis (coagulation), clinical chemistry, urinalysis, serology, immunohematology (blood bank), microbiology, clinical laboratory management, clinical laboratory teaching/education, molecular diagnostics, instrumentation, other (describe).

The survey was sent electronically on May 29, 2003 to the program director for each of the 110 NAACLS-accredited, university-based, i.e., baccalaureate degree CLS programs in the U.S. along with an e-mail explaining the reason for the requested information. The program directors were given the option of returning the completed survey by e-mail, fax, or postal system, and asked to respond within a week. A second request with the e-survey attached, was sent to non-respondents on June 12, 2003.

All data were entered and analyzed utilizing SPSS-PC+ version 11.5. Due to the fact that the respondents did not represent over 50% of the population, no statistical analyses were performed other than calculating average number of faculty reported per program, and comparing faculty from institutions within the SACS region versus those not in this region for selected characteristics. The data were analyzed based on frequencies and by cross-tabulations for comparing faculty descriptively by employment status (full-time versus part-time) and by courses/areas taught.

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### RESULTS

Almost half (52, 47%) of the program directors returned completed surveys with information on 288 faculty (217 full-time, 71 part-time). An average of 4.2 full-time and 1.4 part-time, or 5.6 total faculty members per CLS program were reported by the program directors. The largest number of reported faculty were in the states of Wisconsin, Texas, and North Carolina.

Upon entering the data, it became evident that that an oversight was that MPH, MSPH, and DrPH were omitted from the list of graduate degree choices, though this was provided by respondents under the "Other (specify)" choice. Faculty profiles by highest degree held, and by majors/fields of study for master's degrees and for doctorates are displayed in Tables 1 through 3 for full-time faculty, part-time faculty, and total

**Table 1.** Highest degree held by CLS faculty

Degree	Full-time faculty # (%)* (n = 217)	Part-time faculty # (%)*(n = 71)	Total faculty # (%)* (n = 288)
Doctorate <sup>†</sup>	103 (47%)	22 (31%)	125 (43%)
Master	102 (47%)	29 (41%)	131 (46%)
Baccalaureate	12 (6%)	20 (28%)	32 (11%)

\* % is percent of n for that column.

† Includes PhD, EdD, DSc, DrPH, and MD.

**Table 2.** Areas of study for CLS faculty holding master's degrees

Major/field for master's degree	Full-time faculty # (%)* n = 217	Part-time faculty # (%)* n = 71	Total faculty # (%)* n = 288
<b>Science total</b>	<b>87 (40%)</b>	<b>24 (34%)</b>	<b>111 (39%)</b>
Clinical laboratory science	31 (14%)	7 (10%)	38 (13%)
Microbiology	16 (7%)	2 (3%)	18 (6%)
Biochemistry or clinical chemistry	6 (3%)	1 (1%)	7 (3%)
Pathology (area not specified)	4 (2%)	2 (3%)	6 (2%)
Other majors/fields in biological or chemical sciences <sup>†</sup>	30 (14%)	12 (17%)	42 (15%)
<b>Public Health total</b>	<b>4 (2%)</b>	<b>2 (3%)</b>	<b>6 (2%)</b>
<b>Education total</b>	<b>55 (25%)</b>	<b>3 (4%)</b>	<b>58 (20%)</b>
Medical technology education	7 (3%)	0 (—)	7 (2%)
Allied health education	8 (4%)	0 (—)	8 (3%)
Health education	6 (3%)	0 (—)	6 (2%)
Other majors/fields in education <sup>†m</sup>	34 (16%)	3 (4%)	37 (13%)
<b>Administration total</b>	<b>14 (6%)</b>	<b>5 (7%)</b>	<b>19 (7%)</b>
<b>Major/field for master's degree not provided</b>	<b>45 (21%)</b>	<b>17 (24%)</b>	<b>62 (21%)</b>
<b>Total master's degrees</b>	<b>205 (94%)</b>	<b>51 (72%)</b>	<b>256 (89%)</b>

\* % is percent of n for that column. Percent is rounded to the nearest whole number. Percent is not provided if rounding to nearest whole number is <1%, denoted by (—). Column percents do not add to 100% because some faculty had a baccalaureate degree as the highest degree, or they matriculated directly to the doctorate without receiving a master's degree.

† Majors/fields listed under Other are each held by <1% of the reported faculty category.

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sample. The program directors reported 32 faculty (12 full-time, 20 part-time)(11%) who held the BS as their highest degree but were teaching in a baccalaureate program in CLS/MT. Majors/fields of study are categorized into science, public health, education, and administration. Degree title is not displayed as it was not found to offer useful information.

For faculty holding the BS as their highest degree, 28 of the 32 baccalaureate degrees were in CLS with the remaining BS degrees being 3 in biology and 1 in microbiology. Only the most frequently listed specific majors under the science and education categories are provided for graduate degrees in Tables 2 and 3. Specific majors/fields in public health and administration are not listed due to the small number of faculty holding graduate degrees in these categories.

Specialist certification was held by more of the full-time faculty (66, 30%) than the part-time faculty (13, 18%), or by 79 (27%) of the total faculty. Specialist certification in blood bank (SBB), hematology (SH or CLSpH), clinical chemistry (SC

or DABCC), and microbiology (SM) were the most commonly held with each of these specialties held by 6% to 7% of the total faculty. One percent or less of the faculty held each of the following specialty certifications: immunology (SI), clinical laboratory management (DLM, CLSup, or CLDir), molecular biology (CLSpMB or MP), and virology (SV).

A primary focus of the data analyses was the degree level, the specific graduate majors or fields of study, and specialist certifications in relation to the CLS course(s) or curriculum area(s) taught. For those curriculum areas where a technical specialist certification exists, none of these areas were taught by faculty with the majority of them holding the specialist credential. The curriculum areas with the highest proportion of faculty holding the specialist certification were immunohematology, i.e., SBB, with 18 (30%) of the 61 faculty teaching in this area holding the SBB and one additional person holding the SI; and hematology with 18 (25%) of the 68 faculty teaching this area holding a SH or CLSpH. For the 83 CLS faculty teaching microbiology (includes

**Table 3.** Areas of study for CLS faculty holding doctorates

Major/field for doctorate	Full-time faculty	Part-time faculty	Total faculty
	# (%) <sup>*</sup> n = 217	# (%) <sup>*</sup> n = 71	# (%) <sup>*</sup> n = 288
<b>Science total</b>	<b>67 (31%)</b>	<b>20 (28%)</b>	<b>87 (30%)</b>
Microbiology or microbiology and immunology	16 (7%)	6 (8%)	22 (8%)
Biochemistry or clinical chemistry	10 (5%)	2 (3%)	12 (4%)
Pathology (area not specified)	6 (3%)	4 (6%)	10 (3%)
Other majors/fields in biological or chemical sciences <sup>†</sup>	35 (16%)	8 (11%)	43 (15%)
<b>Public Health total</b>	<b>1 (—)</b>	<b>0 (—)</b>	<b>1 (—)</b>
<b>Education total</b>	<b>26 (12%)</b>	<b>1 (1%)</b>	<b>27 (9%)</b>
Higher education	7 (3%)	0 (—)	7 (2%)
Curriculum and instruction	4 (2%)	1 (1%)	5 (2%)
Other majors/fields in education <sup>†</sup>	15 (7%)	0 (—)	20 (7%)
<b>Administration total</b>	<b>4 (2%)</b>	<b>0 (—)</b>	<b>4 (2%)</b>
<b>Major/field for doctorate not provided</b>	<b>5 (2%)</b>	<b>1 (1%)</b>	<b>6 (2%)</b>
<b>Total doctoral degrees</b>	<b>103 (47%)</b>	<b>22 (31%)</b>	<b>125 (43%)</b>

\* % is percent of n for that column. Percent is rounded to the nearest whole number. Percent is not provided if rounding to nearest whole number is <1%, denoted by (—). Percents do not add to 100 because not all faculty held a doctorate.

† Majors/fields listed under Other are each held by <1% of the reported faculty category.

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courses in bacteriology, mycology, and/or parasitology), 12 (15%) held a SM and 1 additional faculty member held the SV. Only 13 (17%) of the 77 faculty teaching clinical chemistry held either the SC or DABCC. The curriculum areas with the lowest proportion of faculty holding the specialist certification were serology with only 3 (5%) of the 59 teaching this area having the SI; and only 2 (3%) of the 73 faculty teaching clinical laboratory management having the DLM, CLDir, or CLSup certification. Of 56 faculty teaching courses in molecular diagnostics, 2 (4%) held the CLSpMB or MP.

The highest degree held by faculty in relation to the courses or curriculum areas taught, is provided in Table 4. Microbiology, clinical chemistry, hematology, and immunohematology are traditionally viewed as the primary curriculum areas in a university-based CLS program with a full-time faculty member usually devoted to each of these areas. In none of the primary curriculum areas do the majority of faculty teaching that area, hold a doctorate. More of the faculty teaching microbiology (48%) and clinical chemistry (46%) hold doctorates as compared to hematology (37%) or immunohematology (36%)

faculty. Faculty teaching laboratory information systems and immunohematology have the highest percents with a BS as their highest degree at 50% and 15%, respectively.

Secondary curriculum areas/courses include urinalysis, hemostasis, serology, clinical laboratory management, clinical laboratory teaching/education, and CLS research. Molecular diagnostics, though not a primary curriculum area, is becoming more integrated into the CLS curriculum as is laboratory information systems. When tabulating the multiple courses taught by full-time faculty, faculty teaching microbiology most often also taught molecular diagnostics and serology. The hematology faculty most often also taught hemostasis, clinical laboratory management, and clinical laboratory teaching/education, while the faculty teaching clinical chemistry most often also taught clinical laboratory instrumentation and urinalysis. Immunohematology faculty who did teach a second course most often also taught serology.

Faculty graduate degree majors/fields were cross-tabulated with courses taught for the primary curriculum areas. These

**Table 4.** Highest degree level of CLS faculty by curriculum courses/areas taught

Course/area in CLS curriculum	Highest degree		
	Doctorate # (%) <sup>*</sup>	Master's # (%) <sup>*</sup>	Baccalaureate # (%) <sup>*</sup>
Microbiology <sup>†</sup> (n = 83)	40 (48%)	38 (46%)	5 (6%)
Clinical chemistry (n = 77)	35 (46%)	37 (48%)	5 (6%)
Clinical laboratory instrumentation (n = 56)	22 (39%)	28 (50%)	6 (11%)
Hematology (n = 68)	25 (37%)	36 (53%)	7 (10%)
Hemostasis, i.e., coagulation (n = 59)	23 (39%)	30 (51%)	6 (10%)
Urinalysis (n = 67)	24 (36%)	39 (58%)	4 (6%)
Immunohematology (i.e., blood bank) (n = 61)	22 (36%)	30 (49%)	9 (15%)
Serology (n = 59)	28 (47%)	30 (51%)	1 (2%)
Clinical laboratory management (n = 73)	28 (38%)	42 (58%)	3 (4%)
Clinical laboratory teaching/education (n = 63)	28 (45%)	31 (49%)	4 (6%)
Molecular diagnostics (n = 56)	38 (68%)	18 (32%)	0 (—)
Immunology (n = 11)	5 (45%)	5 (45%)	1 (10%)
Clinical laboratory science research (n = 9)	7 (78%)	2 (22%)	0 (—)
Laboratory information systems (n = 4)	1 (25%)	1 (25%)	2 (50%)

<sup>\*</sup> % is percent of total for that row. Percent is rounded to the nearest whole number. Percent is not provided if rounding to nearest whole number is <1%, denoted by (—).

<sup>†</sup> Microbiology includes courses in bacteriology, mycology, and/or parasitology.

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results are displayed in Table 5 for master's degrees and in Table 6 for doctoral degrees.

Faculty in institutions within the SACS accreditation region (n = 116) were compared to faculty in institutions not in this region (n = 172). The two groups were compared for total number of faculty, number of part-time faculty, and number of full-time faculty by the independent samples T-test with no significant differences in means found at  $p < .05$ . Cross-tabulation with calculation of the Pearson Chi-square statistic was performed for 15 nominal variables comparing the SACS versus non-SACS faculty and, again, no significant differences were found at  $p < .05$ .

### DISCUSSION

The percentage of CLS faculty with doctorates as their highest degree (43%) reported in this survey was identical or similar

to that found for CLS faculty in the 2002 ASAHP-member institutional profile (43%) and in a 1996 assessment of university-based CLS faculty (46%).<sup>9,13,14</sup> The proportion with doctorates increases to 47% for this survey if only full-time CLS faculty are examined. The 11% of reported faculty with a baccalaureate as the highest degree were found to be predominantly part-time faculty.

Relative to the specific graduate degree majors/fields, 69% of the faculty held at least one graduate degree in a biological or chemical science, while 29% held a degree in a field of education. The number of faculty with graduate degrees in either of these categories may be higher as 21% of the faculty did not provide the major/field for his/her master's degree. For master's degrees, 39% of the CLS faculty held the degree in a biological or chemical science, 20% in a field of education, and 9% in a public health or administration field.

**Table 5.** Areas of study for CLS faculty holding master's degrees by curriculum courses/areas taught

Master's degree major/field	Curriculum course/area taught			
	Microbiology*	Clinical chemistry	Hematology	Immuno-hematology
	# (%) <sup>†</sup> n = 83	# (%) <sup>†</sup> n = 77	# (%) <sup>†</sup> n = 68	# (%) <sup>†</sup> n = 61
Clinical laboratory science	12 (15%)	7 (9%)	13 (19%)	9 (15%)
Microbiology or microbiology and immunology	19 (23%)	1 (1%)	1 (2%)	1 (2%)
Clinical chemistry or biochemistry	0 (—)	5 (6%)	1 (2%)	0 (—)
Pathology (area not specified)	0 (—)	3 (4%)	3 (4%)	0 (—)
Medical biology/clinical chemistry track	0 (—)	1 (1%)	0 (—)	0 (—)
Medical biology/hematology track	0 (—)	0 (—)	1 (2%)	0 (—)
Immuno-hematology	0 (—)	0 (—)	0 (—)	1 (2%)
Other major/field in biological or chemical sciences‡	6 (7%)	12 (16%)	12 (18%)	13 (21%)
Public health major/field	5 (6%)	3 (4%)	2 (3%)	2 (3%)
Medical technology education	2 (2%)	3 (4%)	3 (4%)	1 (2%)
Other major/field in education‡	14 (17%)	14 (18%)	17 (25%)	17 (28%)
Administration major/field	4 (5%)	4 (5%)	3 (4%)	4 (6%)
Major/field for master's degree not provided	16 (19%)	19 (25%)	5 (7%)	4 (6%)

\* Microbiology includes courses in bacteriology, mycology, and/or parasitology.

† % is percent of n for that column. Percent is rounded to the nearest whole number. Percent is not provided if rounding to nearest whole number is <1%, denoted by (—). Column percents do not add to 100% because some faculty had a baccalaureate degree as the highest degree.

‡ Majors/fields included under Other are each held by <1% of the reported faculty category.

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Only 13% of reported faculty held their master's degree specifically in CLS. At the doctoral level, 30% of the reported faculty held a PhD or ScD in a science, 9% a PhD or EdD in a field of education, and 2% a PhD or DrPH in an administration or public health major. In comparing full-time versus part-time faculty, there were no noteworthy differences in type of graduate degrees by major/field.

The most prevalent science degrees at the master's level were ones in CLS and in microbiology, while master's degrees in education were most frequently in allied health education, MT education, or health education. As there are only three doctoral programs in CLS or a primary CLS curriculum area currently in the U.S., faculty usually must pursue programs in either another science or education at the doctoral level. The most prevalent science doctorates were ones in microbiology or microbiology and immunology, followed by ones in clinical chemistry or biochemistry and in pathology. The doctorates in education were most frequently in higher education or in curriculum and instruction.

Relative to primary curriculum areas or courses taught, no faculty group had more than 50% with a doctorate. Some of the secondary curriculum areas or courses did have faculty with more than half holding the doctorate including molecular diagnostics (68%) and CLS research (78%). These two areas may be taught by faculty from other departments such as biology or biostatistics where close to 100% of the faculty traditionally hold the doctorate.

Relative to having a master's degree specifically in CLS, faculty teaching clinical chemistry had the lowest proportion (9%) with this graduate major, while hematology faculty had the highest proportion (19%). Faculty teaching microbiology and immunohematology each had 15% with a master's degree in CLS. Less than a third of the reported faculty teaching each primary curriculum area held specialist certification in that technical area.

Faculty teaching microbiology had the highest percentage with a doctorate in the teaching field of microbiology (22%), followed by clinical chemistry faculty who held a doctorate

**Table 6.** Areas of study for CLS faculty holding doctorates by curriculum courses/areas taught

Doctorate major/field	Curriculum course/area taught			
	Microbiology*	Clinical chemistry	Hematology	Immuno-hematology
	# (%) <sup>†</sup> n = 83	# (%) <sup>†</sup> n = 77	# (%) <sup>†</sup> n = 68	# (%) <sup>†</sup> n = 61
Microbiology or microbiology and immunology	18 (22%)	1 (1%)	1 (2%)	2 (3%)
Clinical chemistry or biochemistry	1 (1%)	8 (11%)	0 (—)	2 (3%)
Pathology (area not specified)	1 (1%)	3 (4%)	3 (4%)	1 (2%)
Hematology	0 (—)	0 (—)	2 (3%)	0 (—)
Immunology	0 (—)	1 (1%)	0 (—)	1 (2%)
Other major/field in biological or chemical sciences <sup>‡</sup>	9 (11%)	14 (18%)	5 (7%)	4 (6%)
Public health major/field	0 (—)	0 (—)	1 (2%)	0 (—)
Education major/field	8 (10%)	7 (9%)	11 (16%)	11 (18%)
Administration major/field	1 (—)	1 (1%)	2 (3%)	1 (2%)
Major/field for doctorate not provided	2 (3%)	0 (—)	0 (—)	0 (—)

\* Microbiology includes courses in bacteriology, mycology, and/or parasitology.

† % is percent of n for that column. Percent is rounded to the nearest whole number. Percent is not provided if rounding to nearest whole number is <1%, denoted by (—). Column percents do not add to 100% because not all faculty held a doctorate.

‡ Majors/fields included under Other are each held by <1% of the reported faculty category.



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in clinical chemistry or biochemistry (11%). Faculty teaching in each of these two curriculum areas had 35% of faculty with a doctorate in a science and only about 10% with doctorates in an education major/field. Faculty teaching hematology or immunohematology each had 16% with doctorates in a science, though in only two instances was the degree in hematology, and 16% and 18% respectively, with doctorates in an education major/field.

The graduate science majors/fields included under "other" were quite varied, though only one or two faculty held degree(s) in each field, and included analytical chemistry, toxicology, biomedical science, cell biology, genetics, nutrition, physiology, anatomy, and molecular biology. Graduate degrees in pathology also offer a viable option for CLS faculty as these degrees usually have clinically-relevant tracks in areas such as clinical chemistry, toxicology, and hematology, though these degrees are not as widespread as microbiology or biochemistry doctorates. The graduate degrees in administration were most often either a master of business administration or in health services administration. The public health degrees included majors/fields in public health laboratory science, epidemiology, and health policy and administration. Majors/fields for education degrees combined under "other" included science education, adult education, educational psychology, educational leadership, instructional technology, counseling, and distance education.

### CONCLUSIONS

The application of these results to education settings for the preparation of CLS/MTs is limited to university-based programs, and further limited by the fact that faculty information was provided by slightly less than half of this population of CLS programs. Within these limitations, the results do offer a national perspective of the graduate backgrounds of CLS university-based faculty to which individual programs can compare their faculty for self-review related to programmatic or institutional accreditation.

Though the percentage of the reported faculty holding a doctorate was not higher than previous assessments of such faculty, this data indicates that almost half of the reported CLS faculty in U.S. universities are preparing themselves as scientists for their roles in teaching and, increasingly, in research. Slightly over half (52%) of the total graduate degrees reported for the 288 CLS faculty were in a field of biological or chemical science as opposed to fields of education, public

health, or administration, but only 13% had a master's degree specifically in CLS. This cadre of basic science CLS faculty should aid in CLS academic units becoming integral components and peers with their colleagues in other professional units. The wide variety of degrees reported and the lack of a substantial number of doctorates in CLS or in primary CLS curriculum areas, does not support a doctorate in the teaching field as the standard for faculty teaching in baccalaureate CLS programs.

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