

Addressing the Molecular Diagnostic Workforce Gap: Development of a Post baccalaureate Certificate in Molecular Genetic Technology

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Background: Molecular diagnostic laboratories face a persistent shortage of skilled technologists that was exacerbated during the COVID 19 pandemic. Professional bodies have called for urgent expansion of accredited training programs.

Methods: A seven item survey was disseminated to alumni, clinical affiliates, advisory board members, and professional networks from October 23 to November 24, 2023.

Results: Of 300 responses, 291 were complete. Only 9.97 percent held a bachelor's in medical laboratory science and 5.15 percent in clinical laboratory science, yet 76.71 percent reported current involvement in molecular testing. Interest in an online certificate was high at 98.29 percent.

Discussion: Findings indicate a mismatch between workforce skills and service demand and support targeted, flexible upskilling.

Conclusions: A post baccalaureate certificate offers a pragmatic pathway to strengthen the molecular workforce and support quality patient care.

Keywords: Molecular diagnostics, clinical laboratory workforce shortage, online education, molecular technologist training, post-baccalaureate certificate

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Introduction

Molecular diagnostics has emerged as a cornerstone of modern laboratory medicine, enabling precise detection and characterization of genetic, infectious, and oncologic conditions. Over the past decade, rapid technological advancements including real time polymerase chain reaction (PCR), next generation sequencing (NGS), and digital PCR have transformed clinical workflows and accelerated the adoption of precision medicine. These innovations have expanded the scope of molecular testing beyond specialized reference laboratories into routine clinical practice, where timely and accurate results are critical for guiding therapeutic decisions, monitoring disease progression, and implementing personalized treatment strategies.

The COVID 19 pandemic underscored the indispensable role of molecular diagnostics in global health. Molecular laboratories were at the forefront of SARS CoV 2 detection, driving unprecedented testing volumes and operational demands. However, this surge in testing coincided with significant workforce disruptions. Many skilled technologists transitioned to pandemic related roles or left the profession entirely, exacerbating preexisting shortages in molecular diagnostic staffing. National surveys and professional organizations have documented these trends and warned of a crisis in laboratory medicine that threatens the timely delivery of essential diagnostic services.^{1,2} Beyond pandemic related attrition, structural challenges persist. The complexity of molecular platforms requires specialized competencies in assay design, nucleic acid extraction, amplification, sequencing, bioinformatics, and quality assurance. Yet, the number of accredited educational programs offering focused training in molecular diagnostics remains limited. The American Society for Clinical Pathology and its Board of Certification have repeatedly called for urgent action to expand training capacity, citing the negative impact of workforce shortages on patient care.¹ These concerns are amplified by growing demand for

molecular testing in oncology, infectious disease surveillance, pharmacogenomics, and hereditary disorders where accurate interpretation of molecular data directly influences clinical outcomes.³⁻⁵ In response to these challenges, innovative educational models are needed to bridge competency gaps and strengthen the molecular workforce. Post baccalaureate certificate programs represent a pragmatic solution, offering targeted, flexible, and scalable pathways for individuals with foundational scientific training to acquire specialized molecular skills. Such programs can enhance laboratory readiness, support career advancement, and serve as steppingstones to advanced degrees or certification. This manuscript describes the rationale, design, and implementation plan for a fully online Post baccalaureate Certificate in Molecular Genetic Technology, informed by a needs assessment survey conducted among stakeholders in clinical laboratory science.

Methods

We conducted an institutional needs survey to assess interest in and requirements for a Post baccalaureate Certificate in Molecular Genetic Technology. The survey contained seven items and was open from October 23 to November 24, 2023. The link was distributed via the alumni listserv, to program directors of clinical laboratory sciences within and outside the School of Health Professions, to advisory board members, clinical affiliate laboratory heads, and to professional organizations with requests to cascade to laboratory staff. Duplicate and incomplete responses were excluded prior to analysis.

Results

A total of 300 responses were received. After quality control, 291 responses were analyzed (Table 1). There were only 9.97% participants with a bachelor's in medical laboratory science and 5.15% participants with a Bachelor's in a Clinical laboratory sciences discipline (figure 1) yet 76.71% (224/291) were currently performing or involved in molecular testing in their

Table 1. Respondent characteristics and survey highlights (n = 291)

Measure	Count	Percent	95 percent CI lower	95 percent CI upper
Bachelor degree in medical laboratory science		9.97	7.03	13.95
Bachelor degree in clinical laboratory science		5.15	3.14	8.32
Currently involved in molecular testing Yes	224	76.71	71.52	81.20
Interested in online certificate Yes	287	98.29	96.05	99.27

Note: Counts for medical laboratory science and clinical laboratory science were not recorded in the dataset and are presented as percentages.

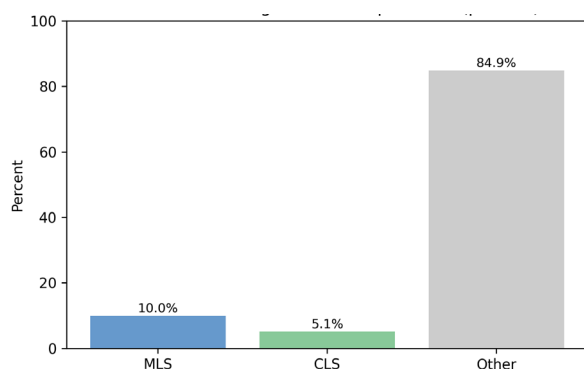


Figure 1. Educational background of respondents

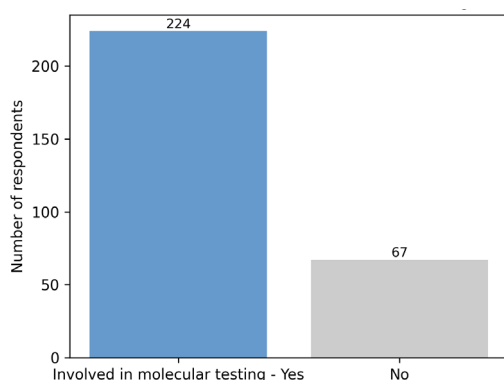


Figure 2. Current involvement in molecular testing

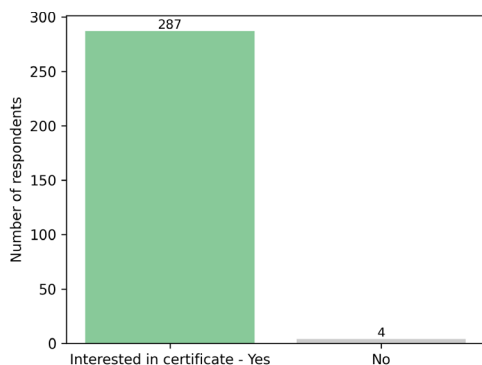


Figure 3. Interest in the online certificate program

current workplaces (figure 2). It is noteworthy that 98.29% (287/291) of participants expressed strong interest in online certificate program in molecular genetics to expand their knowledge and competency in molecular diagnostic testing (figure 3). These findings indicated two critical workforce gaps:

- A. A substantial shortage of qualified and formally trained molecular technologists at the local, state, and national levels. As a result, many molecular laboratories reported employing individuals trained in unrelated or loosely related scientific disciplines to meet staffing needs.
- B. A clear and significant need for additional structured education and skills development, reflected in the high level of interest in a molecular genetics certificate program among professionals currently engaged in molecular testing but lacking formal training.

Taken together, these results demonstrate a strong demand for targeted, high-quality education to support the expanding molecular diagnostics workforce. In response, school

leadership elected to develop a Post-Baccalaureate Certificate in Molecular Genetic Technology to help bridge this training gap.

Program Proposal: Post baccalaureate Certificate in Molecular Genetic Technology

As part of the school leadership's strategic response, the MGT faculty proposed the development of a Post-Baccalaureate Certificate in Molecular Genetic Technology.

Program structure: Four courses delivered fully online via the School of Health Professions learning management system and offered twice annually in fall and spring (table 2). Modules are self-paced and asynchronous with defined milestones and deadlines. Engagement includes weekly readings and video lectures, moderated discussion forums, graded assignments and exams, and virtual office hours (table 3).

This certificate, built on concentrated coursework in molecular genetics and diagnostic technologies, is designed to offer individuals with bachelor's degrees in traditional or labo-


Table 2. Curriculum overview and learning outcomes

Course	Brief description	Key learning outcomes
MG 4240 Introduction to Molecular Genetics	Foundational principles of nucleic acid chemistry, genome organization, gene expression, and genetic variation with clinical relevance to diagnostics.	Describe molecular genetics; articulate DNA and RNA structure function; recognize genetic bases of disease; explain inheritance and variation.
MG 4250 Fundamentals of Molecular Diagnostic Techniques	Core laboratory methodologies and their application to disease detection and personalized medicine; critical appraisal of strengths and limitations.	Recognize principles underpinning diagnostic molecular biology; summarize foundational techniques; examine clinical utility; assess strengths and limitations.
MG 4460 Advanced Concepts of Molecular Genetics	Complex molecular mechanisms, gene regulation, genome architecture, and emerging diagnostic paradigms across oncology, inherited, and infectious diseases.	Demonstrate advanced understanding; explain regulatory networks and genome organization; contextualize genomic variants and rearrangements.
MG 4470 Advanced Molecular Diagnostic Techniques	Advanced detection and characterization of genetic anomalies with emphasis on validation, verification, quality control, and troubleshooting.	Evaluate advanced techniques; analyze complex datasets; apply quality control; assess clinical relevance and limitations.


Table 3. Program structure and timing

Element	Details
Delivery	100 percent online and asynchronous
Cadence	Two intakes per year fall and spring
Load	One or two courses per semester
Time to completion	Two semesters minimum with up to two years allowed
Learner support	Virtual office hours, email, discussion boards, and formative feedback
Assessment	Assignments, quizzes, exams, and participation across the term


How to Apply to the Post Baccalaureate Certificate in Molecular Genetic Technology



Complete the online application form



Submit your official transcripts



Meet prerequisite requirements

Enrollment details and deadlines are posted on the School of Health Professions website.

Enrollment details and deadlines posted on the School of Health Professions website.

Figure 4. Steps to apply for the Post Baccalaureate Certificate in Molecular Genetic Technology⁶

ratory sciences a clear pathway to gain specialized competency, advance their careers, and pursue further graduate or clinical education. By implementing this program, the school aimed to establish a structured educational pipeline that equips technologists with the didactic foundation and practical understanding necessary to support molecular diagnostic testing in their current roles or successfully transition into dedicated molecular laboratory practice. Application Steps to apply for the Post Baccalaureate Certificate in Molecular Genetic Technology are provided in figure 4 and reference link.⁶

Discussion

The survey highlights the gap between current workforce preparation and the complexity of contemporary molecular diagnostics. As testing expands across infectious disease, oncology, and genetics, laboratories require staff who are comfortable with assay design, sequencing workflows, quality systems, and data interpretation.³⁻⁵ The proposed certificate offers a scalable pathway for scientists trained in adjacent disciplines to attain these competencies while maintaining employment. The online asynchronous format is designed to reduce access barriers and may help stabilize staffing by supporting upskilling without relocation or career interruption.⁶

Limitations

This needs assessment used convenience sampling and self report, limiting generalizability. The brief seven item instrument constrained granularity of competency mapping. Future evaluations should incorporate multi institution sampling, objective pre post competency measures, and longitudinal tracking of workforce and patient care outcomes.

Conclusion

A fully online post baccalaureate certificate in Molecular Genetic Technology is responsive to workforce needs and strongly supported by stakeholder interest. By emphasizing conceptual foundations, applied techniques, quality systems, and informatics, the program can enhance laboratory readiness and contribute to timely, high quality molecular testing.

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