Brief Report

Educational and practice needs of laboratory profession – findings from an IFCC survey

Hikmet Can Çubukçu[1], Smeralda Skenderaj[2], Adrian Park[3], Tze Ping Loh[*,4]
on behalf of the Task Force for Global Education and Learning and Task Force for Laboratory Medicine Practice Guidelines

[1]*Rare Diseases Department, General Directorate of Health Services, Turkish Ministry of Health, Türkiye*
[2]*International Federation of Clinical Chemistry and Laboratory Medicine, Milan, Italy*
[3]*Department of Clinical Biochemistry, Addenbrooke's Hospital, Cambridge, England*
[4]*Department of Laboratory Medicine, National University Hospital, Singapore*

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[*]***Corresponding Author:***
Tze Ping Loh
Department of Laboratory Medicine
E-mail: tploh@hotmail.com
Phone: +65 67724345
Address:
National University Hospital, Singapore

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Abstract

Introduction: Laboratory medicine is an evolving clinical specialty that is driven by technological advancements, availability of new evidence and new clinical workflows to cater to changing demographic and socioeconomic landscape. This report summarises the educational and practice needs based on the responses provided to a survey.

Method: The IFCC TF-GEL conducts regular educational webinars. At the end of the webinar, a participant survey is administered anonymously, which included an open-ended question for suggesting topics and areas in laboratory medicine for which future webinars can be organised for. This question was designed to take pulse of the educational and practice needs of the laboratory practitioners. All survey responses for this question between February 13 and September 23, 2024 were extracted from the online survey platform and objectively summarised using ChatGPT 4.o.

Results: Overall, 3902 comments were received from 12 webinars' global survey participants in 2024. Comments were qualitatively summarised into broad headings in laboratory medicine, including quality management and compliance, clinical chemistry and laboratory medicine, emerging trends and technologies, specialized testing and techniques, healthcare management and leadership, case studies and practical applications, public health and emerging health topics, innovation and future directions.

Discussion: Many of the topics highlighted by the laboratory practitioners have matching IFCC functional units. They can be engaged to developed freely accessible educational and practice guidelines resources to maintain the standards of profession of the laboratory practitioner globally. Additionally, the topics summarised here can also be used to develop local resource and curriculum.

Introduction

Laboratory medicine is a highly specialised area of clinical care involved in the laboratory testing of human samples to produce actionable information for clinical care [1]. It has significant breadth and depth in the scope of practice. Traditionally, laboratory medicine is divided into clinical chemistry, haematology, blood banking, microbiology and molecular diagnostics. Recent advances in technology has blurred the these boundaries and opened up new areas of practice such as precision medicine, immunology and stem cell therapy [2]. The rapid advancements in laboratory medicine requires constant education and re-education of the laboratory practitioners to keep pace with the evolving practice and ensure the best care for the patients. Additionally, appropriate evidence-based laboratory guidelines, recommendations and position statements can help anchor the laboratory practice [3,4].

The International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) is an apex organisation representing all regional federation and national societies of this specialty. It has formed two task forces to meet the educational and practice needs of laboratory practitioners – the Task Force for Global eLearning/ eAcademy (TF-GEL) and the Task Force for Laboratory Medicine Practice Guidelines (TF-LMPG). The main objective of these task forces is to produce content to meet the educational demands on laboratory professions.

In the recent years, e-learning technologies have been revolutionizing education by enabling individualized learning, fostering collaboration, and transforming the educators role [5]. In the same vein, TF-GEL's activities cover the key programs of the IFCC Webinar and recorded lectures (and courses) for the eAcademy. Both of these educational resources are freely available. On the other hand, the TF-LMPG seeks to coordinate the production of practice guidelines, recommendations and positions statements related to laboratory medicine through various IFCC functional units.

It is important to prioritise and develop relevant content to meet the demands of the laboratory profession. To this end, a survey is appended at the end of each IFCC webinar and includes a question asking for topics and areas in laboratory medicine that the participants would like to see IFCC organise. The findings of the surveys are summarised in this report.

Material and Methods

The IFCC Webinar series have been running since 2020 and has produced 85 webinars at the time of writing. At the end of each webinar, a survey feedback on the content of the webinar was administered to the participants. The survey was conducted anonymously. The last question of the survey asks the participants to suggest the topics and areas in laboratory medicine they hope the IFCC can organise in the future. The participants were allowed to write free text to this open question. This question was designed to take pulse of the educational and practice needs of the laboratory practitioners. All survey responses for this question were extracted from the online survey platform as 12 PDF files, representing 12 surveys conducted between February 13 and September 23, 2024.

The open-ended nature of the response field resulted in a diverse range of qualitative comments from survey participants, expressed in plain text format. To synthesize these varied responses, their comments were subjected to qualitative summarization using ChatGPT 4o. For this purpose, the 12 surveys were divided into two prompts, each containing 10 and 2 PDF files, respectively, due to ChatGPT 4o's file upload limit of ten. A prompt instructing the tool to "extract main topics for future webinars demanded by survey attendees, categorize them, and create a list" was then entered. ChatGPT 4o subsequently provided a comprehensive response.

Results

Overall, 3902 comments were received from 12 webinars' survey participants in 2024. Comments were summarised into broad headings in quality management and compliance, clinical chemistry and laboratory medicine, emerging trends and technologies, specialized testing and techniques, healthcare management and leadership, case studies and practical applications, public health and emerging health topics, innovation and future directions. As the surveys were conducted over 2024 and 12 webinars, it is possible for a participant to provide the same response multiple times – leading to potential over-representation. As all surveys were conducted anonymously, it was not possible to exclude duplicate entry from the same participant. To avoid misleading duplicate representation, only a qualitative summary is shown in Table 1.

Table 1: Qualitative summary of the educational and practice needs of the survey participants who attended the IFCC Webinars.

1. **Quality Management and Compliance**
   - **ISO 15189:2022 Compliance and Accreditation:** Updates on ISO standards, implementation strategies, and maintaining compliance for accreditation.
   - **Quality Control and Assurance:** Best practices for IQC and EQA, interpretation of EQA results, management of non-conformances, and troubleshooting.
   - **Measurement Uncertainty and Metrological Traceability:** Practical applications, uncertainty calculations, and impact on clinical decisions.
   - **Risk Management in Laboratories:** Application of risk-based quality management, documentation of, and risk assessment methodologies.
   - **Internal Audits and Proficiency Testing:** Planning, conducting, and improving internal audits and leveraging proficiency testing for performance evaluation.

2. **Clinical Chemistry and Laboratory Medicine**
   - **Clinical Chemistry:** Endocrinology, toxicology, cardiac biomarkers, liver enzymes, lipid profiles, and other analytes relevant to clinical chemistry.
   - **Hematology and Blood Disorders:** Diagnostic approaches for anemia, coagulopathies, and hematological malignancies.
   - **Cancer Diagnostics:** Tumor markers, liquid biopsy, and biomarkers for early cancer detection.
   - **Point-of-Care Testing (POCT):** Best practices, validation, and implementation challenges.
   - **Laboratory Testing for Metabolic and Kidney Diseases:** Diagnostic tools, interpretation of lab results, and emerging biomarkers.

3. **Emerging Trends and Technologies**
   - **Artificial Intelligence (AI) and Machine Learning:** Integration of AI in diagnostics, decision support systems, and its impact on laboratory processes.
   - **Genomics and Molecular Diagnostics:** New techniques in genetic testing, molecular diagnostics, and personalized medicine applications.
   - **Advanced Analytical Techniques:** Mass spectrometry, liquid chromatography, and tandem MS for clinical applications.
   - **Emerging Diagnostic Tools for Infectious Diseases:** Innovations in detecting infectious agents and antimicrobial resistance testing.

4. **Specialized Testing and Techniques**
   - **Newborn and Prenatal Screening:** Advanced screening techniques and interpretation for genetic disorders and metabolic diseases.
   - **Genetic Testing and Personalized Medicine:** Application of NGS, gene sequencing, and personalized medicine in clinical settings.
   - **Immunohistochemistry and Histopathology:** Techniques and diagnostic relevance in oncology and pathology.
   - **Advanced Techniques in Microbiology:** Molecular methods for pathogen detection and rapid testing for microbial resistance.

5. **Healthcare Management and Leadership**
   - **Laboratory Management and Leadership:** Strategies for effective management, financial optimization, and regulatory compliance.
   - **Total Quality Management (TQM):** Implementing and sustaining TQM, continuous improvement, and Lean Six Sigma methodologies.
   - **Health Economics and Operational Efficiency:** Cost analysis, budgeting, and business strategies for optimizing lab operations.

6. **Case Studies and Practical Applications**
   - **Real-life Case Studies in Laboratory Medicine:** Discussions on clinical cases and laboratory decision-making processes.
   - **Troubleshooting and Analytical Error Management:** Identifying and resolving analytical and pre-analytical errors.
   - **Application of Six Sigma and Lean Management:** Applying quality improvement tools and techniques in laboratory settings.

7. **Public Health and Emerging Health Topics**
   - **Cardiovascular Risk Assessment and Management:** Advanced cardiovascular biomarkers, risk assessment tools, and management strategies.
   - **Endocrine Disorders and Diabetes:** Diagnostics, monitoring, and management of diabetes and endocrine disorders.
   - **Biochemical Tests in Trauma Medicine:** Biomarkers and diagnostic tools for trauma and critical care medicine.
   - **Public Health and Disease Prevention:** Laboratory support for public health initiatives, disease outbreak management, and preventive healthcare.
   - **Non-Alcoholic Fatty Liver Disease (NAFLD) and Metabolic Disorders:** Emerging biomarkers, diagnostic approaches, and management strategies.

8. **Innovation and Future Directions**
   - **Integrating AI with Laboratory Medicine:** AI in quality control, predictive analytics, and result interpretation.
   - **New Biomarker Discovery and Validation:** Identifying and validating novel biomarkers for disease diagnosis and treatment.
   - **Standardization and Harmonization:** Ensuring consistency in lab results through data standardization and harmonization techniques.
   - **Sustainability and Green Laboratory Practices:** Strategies for implementing sustainable practices in laboratory environments.

Discussion

The survey results reflected the educational and practice needs identified elsewhere and outlined in the IFCC curriculum [6,7]. There remains strong interests in quality management and compliance, which are cornerstones of laboratory medicine to ensure laboratory results (information) that meets the clinical requirements are returned to clinicians for action. This area remains challenging in practice owing to evolving regulatory requirements (e.g. the In-Vitro-Diagnostics Regulation directives in the European Union)[8] and the continuous shift towards risk-based practice [9] and adoption of metrological concepts [10].

The clinical chemistry and laboratory medicine topics relate to specific areas of clinical care, such as disease-focused clinical specialty testing. They include the main drivers of global morbidity and mortality such as cardiac, kidney, cancer, endocrinology, anaemia, thalassemia conditions) and infectious diseases [11]. Important learning points in laboratory management and clinical testing topics may be best delivered in the form of case studies since they provide real-world examples and context, which laboratory practitioners can more easily relate to their own practice [12].

Point of care testing (POCT) is a laboratory modality that can help bridge the gaps in laboratory services due to geography, resource limitation or demanding service requirements (e.g. rapid turnaround time). It is an area in laboratory medicine that is seeing high rates of adoption. As such, it requires the same care and thoughtfulness in its implementation and a core laboratory. Yet, owing to issues specific to the technology, special considerations and local solutions may be required. These can represent significant challenge for implementation and management of the POCT service [13].

Significant errors can occur in the post-analytical phase of laboratory testing, particularly in the area of laboratory result presentation and interpretation [14]. There is increasing attention paid to the potential harms of using inappropriate significant figures, units, display format of laboratory results as well as the reference intervals and decision limits [15]. Efforts are underway to standardise these elements in laboratory reporting [15,16].

Laboratory medicine is at the forefront of technology adoption. Recent advances in machine learning, artificial intelligence, genomics, mass spectrometry and novel diagnostic tools have promised revolutionary breakthrough in laboratory diagnostics [2]. The advancements in emerging technology has opened up

new diagnostic avenues and clinical pathways such as newborn screening, personalised medicine, genomics, microbiology [2]. The developments can evolve rapidly and it can be challenging to keep abreast with the latest evidence base generated in these areas. A good appreciation of these technology is important for laboratory practitioners participate in conversations and make informed decisions about local adoption of these technologies to best serve their patients [17].

Finally, the running of a laboratory requires appropriate management and leadership skills to navigate an resource conscious environment with shrinking workforce, increasing clinical demands and complex regulatory requirements [18]. It is an area that laboratory practitioners may traditionally have limited formal training in academic setting (e.g. university) and may be required to learn on the job. Learning the necessary skills will help manage the often conflicting demands of the laboratory, the organisation, the staff, the patient and the clinicians.

Many of the topics highlighted by the laboratory practitioners have matching specialised IFCC functional units. The IFCC task forces are well positioned to meet the educational and practice demands of laboratory practitioners by engaging relevant functional units to developed suitable educational materials and practice guidelines/ position statements. These resources will help provide appropriate resources that are freely accessible to maintain the standards of profession of the laboratory practitioner globally. Additionally, the topics summarised here can also be used to develop local resource and curriculum.

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Author contributions
Tze Ping Loh: Conceptualisation, Development, Investigation, Write-up. Hikmet Can Çubukçu: Data Analysis, Write-up. Smeralda: Data Gathering, Administrative Support. Adrian Park: Reviewed and Edited First Draft.

Conflict of Interests
None to declare.

Ethics approval
Not applicable as this study only involved anonymised survey responses.

Consent for Publication
Consent to submit has been received explicitly from all co-authors, as well as from the responsible authorities. Authors whose names appear on the submission have contributed sufficiently to the scientific work and therefore share collective responsibility and accountability for the results.

Data availability
The data included in this study is available upon request to the corresponding author.

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