Point-of-Care Testing in modern healthcare: the need for educational innovation

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Abstract

Point-of-Care Testing (POCT) has become an essential component of modern healthcare by enabling rapid diagnostic testing near the patient and supporting timely clinical decision-making across hospital and community settings. The widespread adoption of POCT has highlighted its potential to improve accessibility, reduce turnaround times, and optimize patient management. However, the decentralized nature of POCT also introduces important challenges related to diagnostic quality, procedural errors, quality assurance, and operator competency. This essay discusses the expanding role of POCT in contemporary healthcare and reviews the principal factors influencing its safe and effective implementation. Particular attention is devoted to the importance of structured education and continuous professional training for healthcare professionals involved in POCT, including biomedical laboratory scientists, nurses, and physicians. Strengthening undergraduate education, postgraduate programs, and continuing professional development is essential to ensure appropriate use of POCT technologies, minimize diagnostic errors, and maintain high standards of patient safety and analytical quality. As technological innovation continues to expand the applications of decentralized diagnostics, integrating education, quality management, and multidisciplinary collaboration will be fundamental for the sustainable implementation of POCT within modern healthcare systems.

Introduction

In recent years, the growing demand for timely diagnostic and rapid clinical decisionmaking has profoundly transformed the healthcare delivery system. This evolution has been driven by an increasingly patient-centred approach and by the progressive shift from hospital-centred models toward integrated territorial and community-based healthcare [1]. Laboratory medicine, which plays a key role in clinical decision-making, has evolved accordingly. Importantly, it is estimated that over 70% of clinical decisions are supported by laboratory test results [2]. Consequently, laboratory networks have been reorganized through the centralization of diagnostic activities into hub facilities equipped with highly automated analytical systems, improving efficiency and standardization. However, while centralization has improved analytical efficiency and standardization, it has also increased the physical distance between testing facilities and patients, creating the need for faster diagnostic alternatives [3].

In parallel with this centralization process, laboratory medicine has also undergone progressive decentralization through the widespread adoption of Point-of-Care Testing (POCT). Originally confined to emergency departments, intensive care units, and operating rooms, POCT adoption expanded considerably during the SARS-CoV-2 pandemic and is now routinely employed in community healthcare settings, including general practitioners' offices, pharmacies, and residential care facilities [4,5]. This transition has highlighted the advantages of POCT, particularly its rapid turnaround time (TAT), ease of use, and ability to support prompt clinical decision-making [6].

POCT refers to diagnostic analyses performed near the patient's location, allowing immediate availability of test results without the delays associated with conventional laboratory workflows. POCT devices are generally compact, require only a limited amount of biological sample (blood or urine), and can provide results within minutes [1]. As illustrated in Figure 1, eliminating delays associated with specimen transport and laboratory processing may contribute to improved medical outcomes and greater healthcare efficiency [7]. Beyond improving patient outcomes, the successful implementation of POCT should also optimize healthcare workflows and resource utilization, ensuring that diagnostic services remain safe, clinically effective, and cost-effective for healthcare systems [1,8].

Despite these advantages, the successful implementation of POCT requires robust governance and quality management. Compared with conventional laboratory testing, decentralized testing is more susceptible to errors occurring during the pre-analytical, analytical, and post-analytical phases. Incorrect patient identification, inadequate sample collection, improper device maintenance, insufficient quality control procedures, inaccurate interpretation of results and inadequate operator training may all compromise diagnostic reliability and patient safety. Therefore, POCT should be integrated into healthcare systems only through structured quality assurance programs and standardized operating procedures to ensure the same standards of reliability, traceability,

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and documentation required for conventional laboratory testing [1,8].

Against this background, the present essay explores the expanding role of POCT in contemporary healthcare systems and examines the educational challenges requirements necessary to ensure analytical quality, patient safety, and sustainable implementation. Drawing upon the available literature and current professional recommendations, this manuscript highlights the importance of strengthening both undergraduate and continuing professional education to ensure the safe, effective, and sustainable integration of POCT into modern laboratory medicine.

Despite these differences, all POCT devices share the common objective of providing reliable diagnostic information near the patient. Their compact design, ease of use, and adaptability to decentralized environments facilitate their integration into diverse healthcare settings; however, safe implementation requires appropriate operator training, competency assessment, and quality management oversight [13].
The widespread implementation of POCT has been particularly evident following the COVID-19 pandemic, when decentralized diagnostic testing became essential for maintaining healthcare services while reducing pressure on centralized laboratories. Today, POCT is recognized as a fundamental compo-



Figure 1. *Schematic comparison of the conventional laboratory testing process and the POCT workflow. Decentralized testing enables faster turnaround times by reducing pre analytical and analytical delays, thereby supporting timely diagnosis and therapeutic decision-making.*

2. The Expanding Role of Point-of-Care Testing in Modern Healthcare

The growing diffusion of POCT represents a major organizational innovation in laboratory medicine. By decentralizing diagnostic services, POCT has enabled a shift from laboratory-centred workflows toward more immediate, patient-oriented models of care, making it an integral component of healthcare delivery across diverse environments ranging from self-testing, primary care, outpatient services, and hospital settings, where it supports screening, diagnosis, patient monitoring, and triage. This decentralization is particularly relevant in healthcare systems aiming to improve equity of access, reduce geographical barriers, and support timely diagnosis in settings where conventional laboratory infrastructure may be limited [7,9].
POCT encompasses a broad and heterogenous range of technologies, including lateral flow assays, microfluidic systems, lab-on-a-chip platforms, biosensor-based devices, and portable analysers capable of performing increasingly complex biochemical and immunological measurements [10–12]. These platforms vary considerably in analytical complexity, ranging from qualitative rapid tests and unit-use quantitative systems to more advanced systems designed for decentralized laboratory-like analyses.
nent of integrated laboratory networks and personalized medicine, with growing applications supported by digital health technologies and artificial intelligence [4].

3. Challenges in POCT Implementation: Sources of Diagnostic Error and Quality Assurance

Despite its advantages, the decentralized nature of POCT introduces specific vulnerabilities that may affect diagnostic accuracy, particularly when testing is performed outside traditional laboratory environments. Unlike conventional laboratory testing, POCT is often performed by healthcare professionals whose primary role is not laboratory medicine and whose levels of training and competency may vary. Consequently, errors may occur throughout the pre-analytical, analytical, and post-analytical phases of testing [14].
These errors may lead to false-positive or false-negative results, potentially compromising patient safety and undermining confidence in POCT when quality management systems are inadequate. Maintaining high analytical quality is therefore essential not only to protect patients but also to preserve the clinical credibility of decentralized diagnostic services [15,16].
Additional challenges include technological limitations affecting sensitivity and specificity, variability

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in operator competency, economic considerations related to device costs, and heterogeneous regulatory frameworks across different healthcare systems [17].

To ensure reliable implementation, POCT must therefore operate within structured governance and quality assurance systems that include standardized operating procedures, regular calibration and maintenance, internal and external quality assessment, continuous monitoring of analytical performance, operator training and active laboratory oversight. In this context, biomedical laboratory professionals play a central role not only in supervising POCT programs, but also in developing training pathways, assessing operator competency, and supporting clinical departments [18].

4. Strengthening Healthcare Professional Education for Safe POCT Practice

Among all factors influencing POCT quality, operator competence is arguably the most critical. Technology alone cannot guarantee reliable results without adequately trained operators capable of performing, interpreting, and managing POCT according to established quality standards [19].

Comprehensive education should begin during undergraduate healthcare programs and continue throughout professional careers. Biomedical laboratory scientists, nurses, physicians, and other authorized operators all require specific competencies to perform POCT safely [1,8]. Core educational content should include the correct use and maintenance of POCT devices, pre- and post-analytical procedures, quality control principles, interpretation of results and reference intervals, recognition of critical values, sample traceability, and adherence to standardized operating procedures. Education should integrate theoretical instruction with practical experience through laboratory courses, simulation-based training, supervised clinical practice, e-learning resources, and periodic competency assessment [18].

Laboratory professionals should actively participate in both the design and delivery of training programs, ensuring that operators remain updated as technologies evolve. Particular attention should also be devoted to curricular innovation within Nursing and Biomedical Laboratory Science degree programs by incorporating dedicated POCT modules. At the postgraduate level, master's degrees, certification programs, refresher courses, and continuing professional development initiatives can further strengthen professional competencies. Additionally, because of POTC technologies and clinical applications continuous evolution, competency should be viewed as a dynamic process requiring regular reassessment rather than a one-time achievement [1,8].

Well-designed educational programs produce multiple benefits, including improved technical competence, greater patient safety, higher diagnostic quality, more efficient utilisation of POTC systems and increased confidence during emergencies, as clearly demonstrated during the COVID-19 pandemic [20,21]. Comprehensive training also enhances healthcare professionals' resilience and preparedness during public health emergencies by enabling them to manage POCT devices confidently, rapidly recognize analytical problems, and implement corrective actions when necessary [21]. Moreover, the increasing complexity of decentralized diagnostic networks is also creating new professional roles, such as POCT coordinators responsible for supervising decentralized testing programs and specialists supporting immediate clinical decision-making [1].

5. Future Perspectives for POCT Education and Clinical Practice

Although POCT is now an established component of modern healthcare, its continued evolution is being driven by rapid technological innovation. Advances in biosensors, microfluidics, miniaturization, digital connectivity, artificial intelligence, and telemedicine are expected to further expand the role of decentralized diagnostics within personalized and community-based healthcare [22].

Future improvements should focus on improving analytical performance, expanding multiplex capabilities, enhancing digital interoperability, and reducing costs. These advances will enhance the clinical reliability and economic sustainability of POCT, particularly in resource-limited settings. However, technological innovation alone cannot guarantee highquality diagnostic performance. The competence of healthcare professionals will remain a fundamental determinant of the reliability, safety, and clinical effectiveness of POCT, making continuous education an essential component of future healthcare systems [19].

Emerging applications are expected in chronic disease monitoring, emergency
medicine, perioperative care, infectious diseases, and potentially early cancer detection. Rather than replacing centralized laboratories, POCT will increasingly complement conventional laboratory testing by providing rapid diagnostic support where immediate clinical decisions are required [23].

The educational landscape must evolve in parallel with these technological
developments. Interactive digital learning platforms, simulation-based education, competency tracking systems, and multidisciplinary continuing education programs will become increasingly important to ensure that healthcare professionals maintain the skills necessary for safe POCT practice [24].

Conclusions

Point-of-Care Testing has become an essential component of contemporary laboratory
medicine and healthcare delivery. Its widespread adoption illustrates how laboratory medicine has evolved to meet the growing demand for timely, ac-

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cessible, and patient-centred diagnostic services.
Although POCT offers significant advantages in terms of accessibility, turnaround time,
and clinical decision-making, these benefits can only be realized through rigorous quality assurance and competent healthcare professionals. Diagnostic accuracy depends not only on analytical performance, but also on proper device management, adherence to standardized procedures, and appropriate interpretation of results.
For this reason, educational innovation should accompany technological progress. Integrating POCT into undergraduate curricula, expanding postgraduate training opportunities, and strengthening continuing professional education are essential strategies for ensuring the safe, effective, and sustainable integration of POCT into routine clinical practice.
As laboratory medicine continues to evolve, collaboration between laboratory professionals, clinicians, educators, and healthcare organizations will be essential to maximize the clinical value of POCT while maintaining high standards of diagnostic quality and patient safety. In this evolving scenario, the clinical laboratory should increasingly serve as a bridge between organizational innovation in community-based healthcare and translational research. By facilitating the implementation of novel biomarkers and advanced diagnostic technologies while ensuring that innovation is supported by rigorous quality assurance and appropriate professional training, laboratory medicine will remain central to the safe integration of POCT into future healthcare systems. Ultimately, the future success of POCT will depend less on
further technological advances than on the ability of healthcare systems to ensure appropriate governance, education, and quality management.

References

1. *F. Di Serio, T. Trenti, P. Carraro, Raccomandazioni per l'implementazione e la gestione del "point-of-care testing" (POCT), Biochim. Clin.* 35 (2011) 242–251.
2. *A.J. Hicks, Z.L. Carwardine, M.J. Hallworth, E.S. Kilpatrick, Using clinical guidelines to assess the potential value of laboratory medicine in clinical decision-making, Biochem. Med. (Zagreb).* 31 (2021) 74–84. *https://doi.org/*10.11613/*BM.*2021.010703.
3. *Y. Nam, H.-D. Park, Revolutionizing Laboratory Practices: Pioneering Trends in Total Laboratory Automation, Ann. Lab. Med.* 45 (2025) 472–483. *https://doi.org/*10.3343/*alm.*2024.0581.
4. *A. De Luca, L. Provvidenti, M. Muselli, G. Di Gianfilippo, M. Angelucci, M.C. Totaro, M. Pitorri, M. Marcelli, M. D'Innocenzo, M. Scatigna, R. Mastrantonio, S. Necozione, L. Fabiani, Implementation of community health care services to counter the SARS-CoV2 pandemic, BMC Health Serv. Res.* 24 (2024) 158. *https://doi.org/*10.1186/*s*12913-024-10607-*x*.
5. *X. Liu, X. Zhu, G.J. Kost, J. Liu, J. Huang, X. Liu, The Creation of Point-of-Careology, Point of Care: The Journal of Near-Patient Testing & Technology* 18 (2019) 77–84. *https://doi.org/*10.1097/*POC.*0000000000000191.
6. *I.H. Elrobaa, K. Khan, E. Mohamed, The Role of Point-of-Care Testing to Improve Acute Care and Health Care Services., Cureus* 16 (2024) *e*55315. *https://doi.org/*10.7759/*cureus.*55315.
7. *B. Srinivasan, S. Tung, Development and Applications of Portable Biosensors, SLAS Technol.* 20 (2015) 365–389. *https://doi.org/*10.1177/2211068215581349.
8. *E. Rampoldi, G. Patrucco, M. Casati, B. Morelli, P. Carraro, Principi per l'implementazione e la gestione del point-of-care-testing (POCT): indicazioni essenziali, Biochim. Clin.* 45 (2021). *https://doi.org/*10.19186/*BC_*2021.032.
9. *Naief Mohommad Ali Abdelaal, Jomanh Hudeeb Alamri, Turki Mohammed Sultan Hakami, Hakeem Mohammed Alomair, Montaha Radhi*
10. *Qussom Alanazi, Abdullah Omar Mohammed Omair, Zayed Mohammad Zayed Aldawsari, Ziyad Saad Juraybia Alraddadi, Faris Hamad Ayed Altait, YasirAhmed Mohammed Abduldaem, Point-of-Care Testing (POCT) in Emergency and Critical Care Settings: Clinical Outcomes and Laboratory Integration, International Journal of Computational and Experimental Science and Engineering* 10 (2024). *https://doi.org/*10.22399/*ijcesen.*4857.
11. *L.L. Levorato, D. Marra, L. Biondi, F. Garofalo, D.M. Kinyua, A. Acunzo, R. Velotta, V. Iannotti, B. Della Ventura, Rapid gluten quantification by aggregation-driven magnetophoretic transduction using core–satellite magnetic particles, Sens. Actuators B Chem.* 463 (2026) 140050.
12. *https://doi.org/*10.1016/*j.snb.*2026.140050.
13. *A. Scarsi, D. Pedone, P.P. Pompa, A dual-color plasmonic immunosensor for salivary cortisol measurement, Nanoscale Adv.* 5 (2023) 329–336. *https://doi.org/*10.1039/*D2NA*00563*H*.
14. *W. Jung, J. Han, J.-W. Choi, C.H. Ahn, Point-of-care testing (POCT) diagnostic systems using microfluidic lab-on-a-chip technologies, Microelectron. Eng.* 132 (2015) 46–57. *https://doi.org/*10.1016/*j.mee.*2014.09.024.
15. *P.B. Luppa, C. Müller, A. Schlichtiger, H. Schlebusch, Point-of-care testing (POCT): Current techniques and future perspectives, TrAC Trends in Analytical Chemistry* 30 (2011) 887–898. *https://doi.org/*10.1016/*j.trac.*2011.01.019.

16. *S.S. Satheesh, P.S. Mourya GV, Risk Evaluation of Point-of-Care Testing (POCT) Devices: Insights From a Tertiary Care Hospital, Cureus* (2025). *https://doi.org/*10.7759/*cureus*.80499.
17. *N. Nordin, S.N. Ab Rahim, W.F.A. Wan Omar, S. Zulkarnain, S. Sinha, S. Kumar, M. Haque, Preanalytical Errors in Clinical Laboratory Testing at a Glance: Source and Control Measures, Cureus* (2024). *https://doi.org/*10.7759/*cureus*.57243.
18. *F. Meier, B.A. Jones, Point-of-care testing error: Sources and amplifiers, taxonomy, prevention strategies, and detection monitors, Arch. Pathol. Lab. Med.* 129 (2005) 1262–1267.
19. *A.D. Quinn, D. Dixon, B.J. Meenan, Barriers to hospital-based clinical adoption of point-of-care testing (POCT): A systematic narrative review., Crit. Rev. Clin. Lab. Sci.* 53 (2016) 1–12. *https://doi.org/*10.3109/104083 63.2015.1054984.
20. *A.H. Khan, S. Shakeel, K. Hooda, K. Siddiqui, L. Jafri, Best Practices in the Implementation of a Point of Care Testing Program: Experience From a Tertiary Care Hospital in a Developing Country., EJIFCC* 30 (2019) 288–302.
21. *S. Yenice, Training and Competency Strategies for Point-of-Care Testing., EJIFCC* 32 (2021) 167–178.
22. *P. Boutros, N. Kassem, J. Nieder, C. Jaramillo, J. von Petersdorff, F.J. Walsh, T. Bärnighausen, S. Barteit, Education and Training Adaptations for Health Workers during the COVID-19 Pandemic: A Scoping Review of Lessons Learned and Innovations., Healthcare (Basel)* 11 (2023).
23. *https://doi.org/*10.3390/*healthcare*11212902.
24. *G.J. Kost, Public Health Education Should Include Point-of-Care Testing: Lessons Learned from the Covid-19 Pandemic., EJIFCC* 32 (2021) 311– 327.
25. *P. Kovur, K.M. Kovur, D.Y. Rayat, D.S. Wishart, POC Sensor Systems and Artificial Intelligence—Where We Are Now and Where We Are Going?, Biosensors (Basel).* 15 (2025) 589. *https://doi.org/*10.3390/*bios*15090589.
26. *A.R. Khan, W.L. Hussain, H.C. Shum, S.U. Hassan, Point-of-care testing: a critical analysis of the market and future trends, Frontiers in Lab on a Chip Technologies* 3 (2024). *https://doi.org/*10.3389/*frlct*.2024.1394752.
27. *S.Y. Guraya, J.M. Dias, Blending simulation and e-learning in medical education to enhance professional competence and skills acquisition, BMC Med. Educ.* 26 (2026) 318. *https://doi.org/*10.1186/*s*12909-026-08686-*x*.

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