Benchmarking Thailand's Laboratory System: From Quality Infrastructure to Digital Transformation and AI-Enabled Performance

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To the Editor,

The *Clinical Chemistry Laboratory Benchmarking Survey 2025 (Thailand vs APAC)* provides an important and timely perspective on the current state of laboratory medicine in Thailand and its position within the Asia-Pacific region. This initiative is particularly significant in light of the recent memorandum of understanding (MOU) between the Medical Technology Council of Thailand and Roche Diagnostics (Thailand) Ltd., representing one of the first formal public-private collaborations to promote systematic benchmarking at a national level. Such efforts reflect an increasing recognition of data-driven approaches as a foundation for quality improvement and strategic development in laboratory systems.

The findings highlight several key strengths of the Thai laboratory system. Foremost is the presence of a well-established, multi-layered accreditation ecosystem integrating international and national standards. While approximately 36.5% of laboratories have adopted ISO 15189, a substantially larger proportion operate under local frameworks, including Laboratory Accreditation (LA) (67.9%) and the Ministry of Public Health (MOPH) standards. These local accreditation systems should be recognized not merely as alternatives to international standards, but as foundational pillars of Thailand's laboratory ecosystem, enabling broad participation across diverse laboratory settings, including smaller community-based laboratories operating under resource constraints.

By helping laboratories maintain quality and governance while managing operational costs, these frameworks also support the continued development of community-based medical technology laboratory clinics, which play an important role in improving access to laboratory services within the Thai healthcare system. In this context, the "Lab Anywhere" initiative may further expand the role and service capabilities of these decentralized laboratory models. However, the success of such an initiative depends on robust quality standards, standardized clinical governance, and digital technologies that support secure connectivity, interoperability, and reliable laboratory reporting across diverse healthcare settings.

Operationally, Thai laboratories demonstrate strong discipline in quality control and turnaround time (TAT). Approximately 24.1% of laboratories perform quality control at every shift, compared with only 7.7% in other APAC countries. More than 60% of laboratories target ≤ 60 minutes for routine chemistry tests, and nearly all maintain ≤ 60 minutes targets for STAT testing, reflecting high operational reliability.

Thailand also shows high maturity in process improvement and workforce management, with 72.3% adoption of Six Sigma metrics and over 90% implementation of HR and safety programs. Similarly, risk management and sustainability practices exceed 80-90% adoption, alongside strong patient-centered programs.

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Received date: May 11, 2026 **Revised date:** June 10, 2026 **Accepted date:** June 11, 2026

An important insight from the survey is the heterogeneity across laboratory sectors. University hospitals demonstrate higher international alignment, with up to 76.2% ISO 15189 adoption, and greater engagement in advanced practices such as real-time QC and TAT monitoring. In contrast, government and private laboratories rely more on LA and MOPH frameworks, reflecting a stratified system with varying levels of digital and operational maturity.

To synthesize these findings, the key differences between Thailand and the broader APAC region are summarized below:

Table 1 Comparative profile of Thailand vs APAC laboratory systems.

Domain	Thailand	APAC (excluding Thailand)	Interpretation
Local accreditation (LA/MOPH)	High (67.9%/19.0%)	Limited	Strong national system
ISO 15189 adoption	36.50%	>50%	Gap in international alignment
QC rigor (shift-based QC)	24.10%	7.70%	Strong operational discipline
Routine TAT ≤60 min	>60% labs	Lower	Faster service performance
Six Sigma adoption	72.30%	Lower	Strong process improvement
Training frequency	Annual (60.4%)	Monthly/quarterly	Workforce development gap
Automation (e.g., aliquoting)	<15%	Higher	Technology gap
Cloud middleware	~5.1%	~24%	Digital infrastructure gap
AI adoption	<15%	Emerging	Major opportunity

To further illustrate the contrasting strengths and transformation opportunities within the Thai laboratory system compared with the broader APAC region, a summary overview is presented in Fig. 1.

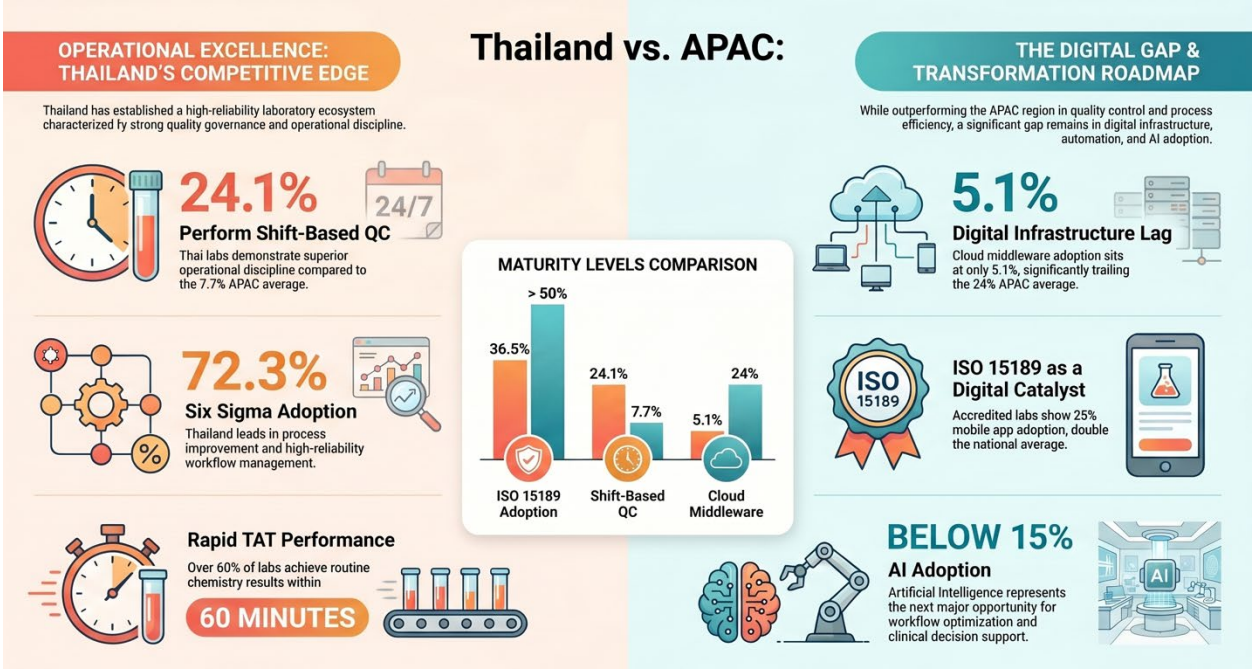

Fig. 1 Comparative overview of operational strengths, digital maturity gaps, and AI transformation opportunities in Thailand's laboratory system compared with the APAC region.

Despite its strengths, several gaps remain. Digital maturity remains limited, with low adoption of cloud systems (~5.1%) and mobile health technologies. Survey data indicate that the adoption of smartphone applications for patient result reporting in Thailand has shown a gradual but consistent increase, rising from 8.0% in 2019 to 15.3% in 2025. Although this remains below the APAC average of 34.8%, certain sectors demonstrate stronger digital readiness, with government hospitals (16.0%) currently surpassing the private sector in this specific capability. Furthermore, laboratories accredited under ISO 15189 demonstrate substantially higher adoption rates (25.0%), suggesting that international quality alignment may also serve as a catalyst for digital health integration and patient-centered laboratory services. Automation also remains incomplete, particularly in pre-analytical processes such as sample aliquoting (<15%). Additionally, training frequency is lower, with 60.4% conducted annually, and AI adoption remains below 15%, indicating early-stage development in digital transformation and AI-enabled laboratory operations.

Taken together, these findings suggest that Thailand has achieved maturity in rule-based, high-reliability laboratory systems, supported by strong accreditation (LA, MOPH, ISO), structured workflows, and quality control. While these operational strengths may provide a useful foundation for future digital development, substantial gaps in automation, interoperability, cloud infrastructure, and AI adoption remain important challenges for broader transformation.

In this context, the current state of Thai laboratory services may be viewed as an important transitional phase rather than immediate readiness for widespread AI integration. Although the standardization and operational consistency of many laboratories provide a useful foundation for future digital development, current adoption rates of automation, cloud-based systems, and AI technologies remain relatively limited. These findings suggest that the transition toward AI-enabled laboratory practice will likely occur gradually and require continued development of digital infrastructure, workforce competencies, data integration, and governance frameworks.

Nevertheless, broader healthcare trends—including workforce shortages, aging populations, increasing service demands, and decentralization of care—continue to create pressure for more efficient and data-driven healthcare systems. In this setting, AI and intelligent automation may gradually support selected areas of laboratory practice, such as workflow optimization, test utilization, quality management, and clinical decision support, particularly as organizational readiness, workforce capability, and technological maturity continue to evolve.

Importantly, automation and AI should be viewed not merely as technological upgrades, but as fundamental workforce enablers. By reducing repetitive manual review and operational burden, these technologies may help free medical technologists to assume higher-value roles in interprofessional consultation, data-driven quality improvement, laboratory stewardship, and community-based healthcare services. Rather than being viewed as a disruption, AI should be considered an extension of Thailand's established strengths in standardization, quality governance, and operational reliability.

To advance further, strategic priorities may include: (1) expanding ISO 15189 alongside LA and MOPH systems; (2) accelerating digital infrastructure and interoperable laboratory connectivity; (3) strengthening automation and workforce-enabling technologies; (4) enhancing training models and digital competencies; and (5) integrating AI into laboratory workflows and stewardship practices.

In conclusion, Thailand represents a high-reliability, locally optimized laboratory ecosystem supported by strong accreditation frameworks, operational discipline, and a deeply embedded culture of quality governance. Although important gaps in digital infrastructure and AI adoption remain, the continued development of interoperability, workforce competencies, and data-driven laboratory systems may support future progress toward more distributed, patient-centered, and digitally enabled healthcare services.

Transparency Statement

The stakeholder survey referenced in this letter was conducted as a collaborative professional initiative involving participating medical laboratories in Thailand. Roche Diagnostics (Thailand) Ltd. provided the survey platform and data processing support for participating laboratories. The Medical Technology Council of Thailand supported promotion of participation and academic dissemination of the survey findings. No direct funding was provided to the Medical Technology Council of Thailand for this work. The interpretation, conceptual framework, and opinions presented in this article are those of the author and academic contributors and were developed independently of the supporting organization. The author participated in the survey initiative during a previous term as Secretary General of the Medical Technology Council of Thailand.