

Review

Not peer-reviewed version

---

# Laboratory Diagnosis of COVID-19 in Timor-Leste: Needs and Challenges

---

[Gregorio Rangel](#)\*

Posted Date: 1 September 2025

doi: 10.20944/preprints202509.0072.v1

Keywords: COVID-19; diagnosis; molecular; Timor-Leste; challenges



Preprints.org is a free multidisciplinary platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This open access article is published under a Creative Commons CC BY 4.0 license, which permit the free download, distribution, and reuse, provided that the author and preprint are cited in any reuse.

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Review

# Laboratory Diagnosis of COVID-19 in Timor-Leste: Needs and Challenges

Gregorio Rangel <sup>1,2,3</sup>

<sup>1</sup> Ossomali Research and Development, Timor-Leste

<sup>2</sup> National Health Laboratory, Timor-Leste, Ministry of Health

<sup>3</sup> National Training Directorate of National Institute of Public Health, Timor-Leste

\* Correspondence: gregoriorangel20@gmail.com

## Abstract

Timor-Leste rapidly scaled molecular testing for SARS-CoV-2 from minimal pre-pandemic capacity to a nation-wide network reaching all referral hospital. The National Health Laboratory (NHL) in Dili—supported by the Ministry of Health (MoH), WHO, and partnership development stood up RT-PCR on existing and newly procured platforms, extended testing via GeneXpert in referral and municipal laboratories, and implemented data systems and workforce surge strategies. Despite achievements, over 200,000 molecular tests during COVID-19 periods; peak national capacity around 500-700 tests/day, constraints in human resources, procurement, logistics, and quality management were persistent. Consolidating gains now offers opportunities to institutionalize multiplex respiratory testing, integrate middleware/LIMS for connectivity, and extend molecular diagnostics to other priority pathogens.

**Keywords:** COVID-19; diagnosis; molecular; Timor-Leste; challenges

---

## Introduction

Timor-Leste, one of the youngest nations in Southeast Asia, is situated on the eastern half of Timor Island. As of 2022, the country had a total population of 1,340,434. Administratively, Timor-Leste is divided into one special autonomous region (Oecussi), 13 municipalities, 65 administrative posts, 442 villages, and 2,225 hamlets (Rangel, G., et al., 2023).

Early in 2020, Timor-Leste faced the global imperative to establish accurate, scalable laboratory diagnosis for SARS-CoV-2 to guide public-health measures (WHO, 2023). Pre-pandemic, the National Health Laboratory (NHL's) molecular capacity comprised a small facility using a single ABI 7500 for limited influenza work and a handful of GeneXpert instruments primarily for Tuberculosis. A coordinated, partner-supported scale-up added platforms, staff, infrastructure (a new PC2 molecular laboratory), and connectivity, enabling timely diagnosis and response. These efforts contributed to >200,000 molecular tests by February 2021 and decentralized access across municipalities (Hengel, B., et al., 2021). The objective of this review to describe the current opportunities and ongoing challenges for sustainable diagnostics

## The Overview of COVID-19 Diagnosis in Timor-Leste

The National Health Laboratory (NHL) in Dili rapidly established and expanded its RT-PCR capacity during the early phase of the COVID-19 pandemic. A new PCR laboratory was commissioned in December 2020, providing enhanced infrastructure for molecular testing. Validation conducted in collaboration with the Australian reference laboratory in Darwin demonstrated 100% concordance in early external quality assurance panels, confirming the reliability of the NHL's testing capacity.

As a result of these developments, the World Health Organization (WHO) formally recognized Timor-Leste's national capacity for COVID-19 molecular diagnosis, particularly at the NHL. This milestone marked a significant achievement for the country, enabling Timor-Leste to perform SARS-CoV-2 testing independently and reducing reliance on international laboratories. The strengthened capacity not only supported timely case detection and outbreak response but also laid the foundation for sustainable molecular diagnostic services in the future.

## Decentralized Testing

To strengthen access to COVID-19 diagnostics beyond the capital, Timor-Leste expanded molecular testing to municipal sites through the deployment of existing and newly procured GeneXpert instruments. These platforms were strategically placed at the Hospital Nacional Guido Valadares (HNGV) in Dili, one regional hospital and four referral hospitals, and selected municipal health centers. The decentralization of testing enabled same-day local diagnosis, significantly reducing turnaround time and improving patient management, especially in remote areas where specimen transport to Dili was previously required. This approach also relieved pressure on the National Health Laboratory (NHL) by distributing testing demand across multiple sites (Sarmiento N, et al., 2023)

The introduction of GeneXpert systems at municipal level not only increased diagnostic coverage but also enhanced outbreak surveillance capacity, allowing more rapid detection of community transmission. In addition, the training of local laboratory technicians in GeneXpert operation and biosafety practices contributed to building sustainable diagnostic expertise within the municipal health system.

This decentralization represented a critical step toward equitable access to molecular diagnostics, ensuring that timely COVID-19 testing was not limited to the central laboratory but was available closer to the communities most in need.

Throughput milestones. From 100 PCR/day in early 2020 to 700 tests/day nationwide at peak June 2021.

Testing strategy alignment. WHO SEARO supported algorithm optimization (wider Ag-RDT use during surges), expanded GeneXpert at point-of-care, and strengthened biosafety/logistics and quality systems. Types of Molecular Diagnosis in Use: (Goel, V., et al., 2023):

1) Standard RT-PCR (National Health Laboratory)

Platforms: Applied Biosystems (ABI 7000/7500) with manual (Qiagen spin columns) then automated extraction (Thermo Fisher KingFisher). Strengths: high throughput, flexible assays; Limitations: batching, skilled staffing, supply dependence. In Timor-Leste, ABI platforms underpinned central surge capacity, with estimated ~940 tests/day per high-throughput ABI system (10-hour run assumption).

2) GeneXpert (Cepheid)

Assays: Xpert® Xpress SARS-CoV-2 and multiplex CoV-2/Flu/RSV plus; cartridge-based RT-PCR with 30–45-min TAT. Strengths: simplicity, decentralization; Limitations: cartridge supply, per-test cost. Deployed widely across municipalities to extend access; estimated daily capacity ~53 tests on GX-IV and ~213 on GX-XVI (at 10-hour operation).

3) AusDiagnostics (AusDx)

System: Multiplex, automated PCR workflows with integrated extraction/amplification; used at NHL to diversify platforms and reduce single-supplier risk; estimated ~240 tests/day per unit (10-hour run). Strengths: multiplexing, throughput; Limitations: proprietary reagents, training.

4) BioFire FilmArray (BioFire Diagnostics)

Assay: Respiratory Panel 2.1 (RP2.1), FDA-authorized multiplex PCR detecting SARS-CoV-2 plus common respiratory pathogens with ~45-min TAT. Strengths: syndromic diagnosis; Limitations: cartridge cost/availability. (Note: a widely used global platform; applicability in TL should be based on site readiness/procurement.)

## Human Resources

Rapid workforce growth. Molecular staff increased from 5 to 28 (2019→2022), with targeted training for scientists (methods, interpretation, reporting) and technicians (extraction, master mix, instrument). Municipal enablement. NHL teams mentored municipal technicians on GeneXpert operation/maintenance and data reporting (Sarmiento, N., et al., 2023). Surge and governance. WHO recommended activating localized surge capacity (including trainees/students) and establishing quality management and biosafety cells for continuous oversight (Carenzo, L., et al., 2020 and WHO., 2020).

## Molecular Logistics & Supply

Procurement realities. Border closures and global demand complicated reagent/consumable access; diversification of platforms reduced risk. Government, NHL, and central procurement supported by partners prioritized inventory management to avert stockouts (Sanchez-Graells, A. (2020). Sample transport & data. NHL built a specimen transport model; introduced LIMS (SchuyLab CGM) and moved from GxAlert to Cepheid C360 middleware integration for GeneXpert result flow to patient records. WHO guidance. Forecasting for PCR and Ag-RDTs, logistics mapping (including hard-to-reach areas), and variant monitoring/sequencing are integral to resilient supply chains (Manjate, N. J., et al., 2023).

## Current Opportunities

Institutionalize multiplex respiratory testing (e.g., CoV-2/Flu/RSV and broader panels where justified) to manage co-circulating pathogens efficiently.

Strengthen connectivity by fully interfacing C360 middleware with LIMS for near-real-time municipal-to-central reporting (also benefits TB/HIV programs).

Leverage the PC2 lab & trained workforce to expand molecular diagnostics beyond COVID-19 (e.g., influenza, dengue adjunct assays, AMR surveillance), as recommended in national “lessons learnt.” (Francis JR, et al., 2023).

Embed agile testing strategies (smart use of Ag-RDTs + targeted PCR) in routine ILI/SARI surveillance and surge response.

## Challenges Encountered (and Persisting Risks)

Infrastructure: Need for expanded, safer molecular laboratory facilities. Supply Chain: Heavy reliance on imported reagents and cartridges; requires multi-vendor supply and better forecasting. Human Resources: Ongoing challenges in staff retention, continuous training, and sustaining quality management beyond emergency funding. Quality & Biosafety: Importance of maintaining external quality assurance, regular supervision, and incident management outside surge periods. Data Systems: Transition from outdated platforms (e.g., GxAlert) to integrated middleware/LIMS without disrupting reporting. Cost & Equity: High costs of cartridges and multiplex panels; ensuring equitable testing access across municipalities.

## References

1. Rangel, G., Saldanha, P., & Viegas, E. (2023). Academic Accreditation and Assessment in Medical Laboratory Science Education in Timor-Leste. *Journal of Clinical Images & Reports. SRC/JCIR-123. J Clin Image & Rep, 2(3), 2-4.*
2. World Health Organization. (2023). *Global report on neglected tropical diseases 2023.* World Health Organization.

3. Hengel, B., Causer, L., Matthews, S., Smith, K., Andrewartha, K., Badman, S., ... & Guy, R. (2021). A decentralised point-of-care testing model to address inequities in the COVID-19 response. *The Lancet Infectious Diseases*, 21(7), e183-e190.
4. Goel, V., Mathew, S., Gudi, N., Jacob, A., & John, O. (2023). A scoping review on laboratory surveillance in the WHO Southeast Asia Region: Past, present and the future. *Journal of Global Health*, 13, 04028.
5. Sarmento N, Soares da Silva E, Barreto I, et al. The COVID-19 laboratory response in Timor-Leste: a story of collaboration. *Lancet Regional Health – Southeast Asia*. 2023; 11:100150. (Open-access summary of platforms, throughput, HR scale-up, decentralization, LIMS/middleware.)
6. WHO SEARO. Adjusting national COVID-19 testing strategy and scaling up testing capacity in Timor-Leste. (Testing algorithm, GeneXpert expansion, Ag-RDT use, logistics and quality recommendations.)
7. Carezzo, L., Costantini, E., Greco, M., Barra, F. L., Rendiniello, V., Mainetti, M., ... & Cecconi, M. (2020). Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. *Anaesthesia*, 75(7), 928-934.
8. Sanchez-Graells, A. (2020). Procurement in the time of COVID-19. *N. Ir. Legal Q.*, 71, 81.
9. Manjate, N. J., Siteo, N., Sambo, J., Guimarães, E., Canana, N., Chilaúle, J., ... & Russo, G. (2023). Testing for SARS-CoV-2 in resource-limited settings: A cost analysis study of diagnostic tests using different Ag-RDTs and RT-PCR technologies in Mozambique. *PLOS Global Public Health*, 3(6), e0001999.
10. Francis JR, de Araujo RM, Viegas ODS, et al. The response to COVID-19 in Timor-Leste: lessons learnt. *BMJ Global Health*. 2023;8(10):e013573. (Systems-level lessons and future directions.)
11. Cepheid. Xpert® Xpress CoV-2/Flu/RSV plus (assay overview, typical TAT). cepheid.com
12. BioFire Diagnostics. BioFire® Respiratory 2.1 Panel (multiplex syndromic PCR capability including SARS-CoV-2). BioFire Diagnostics
13. Rhoads DD, et al. Evaluating the newly developed BioFire COVID-19 test (performance/targets). *J Clin Virol*. 2020. PMC
14. AusDiagnostics. COVID-19 solutions (platform overview and product line; used locally to diversify supply). AusDiagnostics

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.