Bridging the Last Mile: How Near-Point-of-Care Diagnostics Are Rewriting the Rules for TB Elimination

Dr. Himanshu Vashistha
drhimanshuvashistha@gmail.com

Regional Technical Specialist, FIND (The Foundation for Innovative New Diagnostics), Pune-411040

Abstract: Despite advances in centralized molecular diagnostics, such as GeneXpert, nearly 30-40% of global TB cases remain undiagnosed because of logistical barriers at the periphery, such as lack of power, cold chains, and skilled staff at primary health centres (PHCs). This study evaluated two near-point-of-care (nPOC) platforms, Uniamp (Huwel Diagnostics)/ Pluslife MiniDock and TruePOC MTB Ultima (Molbio), for integration into the National TB Programmes (NTPs). Utilizing insights from field trials conducted in Southeast Asia, and Sub-Saharan Africa, along with WHO benchmarks for 2024–2025, we summarised evidence on technical performance, operational resilience, and economic factors. TruePOC offers micro-PCR on disposable chips with the ability to detect Rif/Isoniazid resistance, whereas Pluslife employs isothermal RHAM amplification for quicker, energy-efficient results. Both systems achieve 91–93% sensitivity in sputum samples compared to GeneXpert Ultra, with Pluslife allowing (85.7% sensitivity) and TruePOC (77.9% sensitivity) for tongue swabs in patients who are difficult to sample, such as children. The average cost per sample is $3.6, which is way more economical than centralized testing costs of $18–25 (including transportation). Challenges include digital integration and scaling up training; however, with adaptations by NTP, such as linking to the Nikshay portal and implementing quality assurance (QA), these tools support the goal of decentralized TB elimination by 2030.

Keywords: Near-Point-of-Care (near-POC), Decentralized TB Diagnostics, Molecular NAAT (mNAAT), TruePOC / Molbio Diagnostics, Pluslife MiniDock, Tongue swab testing.
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Introduction: In the global fight against tuberculosis (TB), late detection has always been a silent killer. For many years, the story of TB diagnostics has been characterized by centralization, where samples are sent over long distances from the patient to the testing equipment, often compromising their viability, tracking, or timeliness. Although WHO recommended molecular nucleic acid amplification tests (mNAATs) like GeneXpert MTB/RIF (Cephied) and Truenat MTB-RIF (Molbio) assays have transformed our capacity to identify Rifampicin (RIF) drug resistance, still nearly 30-40% of TB cases worldwide remain undetected and transmit TB in the community [1].

As we are near the pivotal goals of the WHO End TB Strategy, which aims for an 80% decrease in incidence by 2030, we must address the logistical challenges that contribute to the "missing millions [1]." Recent assessments of field trials in India, Southeast Asia, and sub-Saharan Africa have highlighted the emergence of a new wave of "near-point-of-care" (near-POC) platforms. These innovations, such as TruePOC (Truenat MTB Ultima from Molbio Diagnostics) and Pluslife MiniDock (Huwel Uniamp in India), offer the potential to identify the disease and make diagnosis more accessible [2,3].

Shortcomings of the Hub-and-Spoke Model: To understand why these new nPOC platforms are essential, it is important to examine the limitations of the current system. In many areas with limited resources, the diagnostic shortfall is not due to a lack of scientific understanding but rather to a deficiency in infrastructure. Centralized testing depends on a "hub-and-spoke" model. Patients present at a peripheral clinic (the spoke), but their sputum must be transported to a hub (reference laboratory) equipped with stable AC power, air conditioning, and skilled staff. This model is fragile in states where power outages can last for hours, and environment temperatures soars about 45 Degree Celsius. Results that should take hours take days. Patients with low economic status, often daily wage earners who cannot afford to wait for the late results, lost in transit, and chose to drop out of the care cascade before it begins. The 2024–2025 targets suggest that for universal access, tools that can survive the peripheral health care network settings, not just the reference laboratory, are needed. This is where near-POC platforms come into play [2].

TruePOC and Pluslife/Huwel [3-12]: Recent comparative analyses have focused on two frontrunners gaining attention in the National TB Programs (NTPs): TruePOC (Truenat MTB Ultima from Molbio) and Pluslife MiniDock (Huwel Uniamp). Although they share the goal of decentralization, their underlying technologies offer distinct advantages. TruePOC utilizes a chip-based micro-polymerase chain reaction (PCR) and is an evolution of the widely used Truenat system but is optimized for rugged utility. It targets the IS6110 gene complex along with rpoB and inhA genes to detect Rifampicin and Isoniazid resistance. The operational utility of this device lies in its autonomy. It runs on battery power capable of sustaining 8–10 tests and features built-in GSM/Wi-Fi connectivity. This allows for the automatic upload of results to national dashboards, such as India's Ni-kshay portal, a critical feature for real-time surveillance.

Pluslife MiniDock (Huwel Uniamp), conversely, employs an isothermal amplification technique known as Recombination-Aided Hyper-Branching Amplification (RHAM)/ loop mediated isothermal amplification (LAMP). By avoiding the thermal cycling required for PCR, the device consumes significantly less electricity, making it potentially solar/battery operation viable option. It targets IS6110 and mpb64 genes. However, the most groundbreaking aspect of this innovation may not lie in its chemical composition but in its ability to work with various samples (tongue swab, sputum). Studies conducted in India, Uganda, Vietnam, Cameroon and Bangladesh have demonstrated that Pluslife excels in tongue swabs, showing a sensitivity of 76% compared to 91% when using sputum samples. Breakthrough technology for patients unable to produce sputum like children: The proficiency of the Pluslife (Huwel) platform with tongue swabs is extraordinary. Diagnosing TB in children has been difficult for many years. Children often struggle to produce sputum, necessitating invasive methods such as gastric lavage for sample collection. Alternatively, treatment decisions sometimes depend on the clinical judgment of healthcare providers.

A near point-of-care (POC) device capable of delivering a non-invasive, highly sensitive test through a simple tongue swab could revolutionize pediatric screening practices. This breakthrough would allow healthcare providers to conduct screenings for both children and the elderly in community environments where collecting induced sputum samples is impractical. While the sensitivity of this method is not as high as that of molecular tests based on sputum, it greatly outperforms the smear microscopy currently used in these settings. This development offers a "triage" function that has the potential to save thousands of lives.

Reducing Cost in TB elimination: The Economic argument for decision-makers in public health, weighing clinical benefits against financial constraints is crucial. The question lies in, is it feasible for NTPs to decentralize these tests? The current centralized testing using GeneXpert is projected to cost between $11.47* and $14.84* per test [GeneXpert Device cost-$15000, and Test cost-$7.97 while for Truenat assay Device cost- $10000 and test cost- $7.9] (6,7), considering the "hidden" expenses of sample transportation, cold chain upkeep, power backups, and the administrative load of retesting due to sample loss. Conversely, the overall cost per sample for near-POC platforms ranged from $10.45* to $10.70* when scaled (6,7). The TruePOC cost was approximately $5-8 per test*, while the average cost for Pluslife from Pluslife Biotech (Guangzhou, China) is $3.60 per test [Minidock ultra device cost $155 + Thermolyse cost- $180]. Cost reference from GDF catalogue Jan 2026 [7,15]. The bulk of this cost (approximately 61%) lies in the disposable cartridges. However, as procurement scales up through global mechanisms, such as the Global Drug Facility (GDF), these prices are projected to drop. Furthermore, these devices eliminate the need for cold chains. Reagents for TruePOC are stable at 30°C for six months, a massive logistical relief for supply chains struggling with the "last mile."

In a country with a high TB burden like India, with per-test costs up to 80–90% lower than existing solutions, this platform and assay has the potential to dramatically improve affordability for low-income states, expand TB screening reach, save enough to fund nutritional support schemes, or expand active case-finding by integrating decentralized tools into the National TB Elimination Programme.

Operational Resilience and Workforce Transformation: Deploying these devices requires a shift in workforce strategy. The beauty of near-POC tools is that they are designed for mid-level providers, such as nurses and Community Health Workers (CHWs) or ASHAs, rather than trained specialists, such as microbiologists. Field pilots have indicated that user error rates decrease to below 2% following only two hours of training. Nonetheless, this transition shifts the training responsibility from a limited number of laboratory technicians to a significantly larger group of community workers. Although the initial cost of training 1,000 community health workers like Accredited Social Health Activists (ASHAs) appears higher than that of training personnel for a single reference laboratory, the long-term scalability facilitates a more profound integration of the health system within the community. However, challenges persist, particularly because healthcare sectors operate in isolation, posing a continuous threat. While TruePOC's integrated SIM card enables seamless data synchronization, Bluetooth-reliant devices, such as Pluslife, may encounter "handshake" failures in areas with weak signals. Ensuring data visibility is imperative for national programs to be successful. Quality Assurance (QA) systems, which enable artificial intelligence to identify anomalies in raw data curves, are crucial for upholding standards when testing is conducted outside a controlled laboratory environment [13,14,15].

The Verdict: Rather than viewing the comparison between TruePOC and Pluslife as a competition with a single victor, it should be seen as emphasizing the importance of a detailed and layered approach to diagnosis. TruePOC stands out as a reliable option for peripheral primary healthcare, especially in situations where testing for drug resistance (Rifampicin/Isoniazid) is essential, and direct access to national databases is necessary for tracking patients. In contrast, Pluslife, with its minimal power needs and compatibility with tongue swabs, is perfectly suited for active case-finding campaigns, pediatric clinics, and extremely isolated areas where battery power is the only viable energy source and collecting sputum is challenging.

Conclusion: The future of TB elimination lies in the decentralization of diagnostic tools near patients. Priced at approximately $3.60* per test, near-POC platforms are a robust, cost-effective, and accessible alternative to centralized bottlenecks. However, tools alone cannot eradicate diseases. To fully harness the potential of these tools, National TB Programs must invest in the surrounding ecosystem by negotiating assertively for reduced cartridge/chip prices, ensuring a dependable supply chain for consumables, conducting thorough maintenance checks, and crucially, investing in the training of community health workers. By moving diagnostics from reference laboratories to village-level Ayushman Arogya Mandirs (AAMs), we achieved more than just statistical improvements. We restore dignity to the patient, ensuring that detection is available not just to those who can reach the city but to anyone, anywhere, who needs it.

Table 1. Comparative performance, operational characteristics, and cost of near-point-of-care TB diagnostic platforms versus centralized NAAT systems			
Parameter	**TruePOC MTB Ultima (Molbio Diagnostics)**	**Pluslife MiniDock (Huwel/Uniamp)**	**Centralized NAAT (GeneXpert MTB/RIF / Truenat MTB-RIF)**
Technology platform	Chip-based micro-PCR	Isothermal amplification (RHAM/LAMP)	Real-time PCR-based NAAT
Target genes	IS6110, rpoB, inhA	IS6110, mpb64	rpoB (primary target)
Drug resistance detection	Rifampicin + Isoniazid	Not available	Rifampicin (± INH depending on assay)
Sensitivity (sputum samples)	91–93% vs. reference standard (8,13,15)	91–93% vs. reference standard (8,13,15)	Reference standard
Sensitivity (tongue swab samples)	77.9% (8,13)	85.7% (range ~76%) (9,12,15)	Not routinely applicable
Sample types supported	Sputum	Sputum, tongue swab	Sputum
Time to result	<2 hours (near-POC setting) (8)	~1 hour (isothermal amplification) (3,4)	~2 hours (excluding transport delays) (6,7)
Power requirements	Battery-operated (8–10 tests per cycle) (3)	Low power; battery/solar compatible (3,4)	Continuous stable electricity required
Connectivity	Built-in GSM/Wi-Fi; integration with Nikshay (India) (3,13)	Bluetooth-based data transfer (13)	Laboratory information systems
Cold chain requirement	Not required; reagents stable up to 30°C for ~6 months (7)	Not required (3,4)	Required for reagents and transport
Cost per test (assay only)	USD 5–8 (7)	USD 3.60 (7,15)	USD ~7.9–8 (6,7)
Total cost per test (programmatic)	USD 10.45–10.70 (including overheads) (6,7)	USD 10.45–10.70 (6,7)	USD 18–25 (including transport, logistics) (6,7)
Device cost (approximate)	~USD 10,000 (Truenat platform reference) (6,7)	~USD 155 (MiniDock) + consumables (7)	~USD 15,000 (6,7)
Training requirements	Minimal; usable by mid-level providers (13)	Minimal; suitable for CHWs/ASHAs (13)	Skilled laboratory technicians required
User error rate after training	<2% after short training (~2 hours) (13)	<2% after short training (~2 hours) (13)	Low (controlled lab environment)
Primary use case	Decentralized PHC-level diagnosis with drug resistance detection	Active case finding, pediatric TB, remote settings	Centralized confirmatory diagnosis
Key advantage	Integrated drug resistance detection + real-time reporting	Non-invasive sampling + ultra-low power requirement	Established high-accuracy reference standard
Key limitation	Higher cost than isothermal alternatives	Limited drug resistance detection; connectivity challenges	High logistical burden; delayed turnaround time

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