

Background & Objectives

Over the past five years, the laboratory has experienced an average annual specimen volume growth of 15%, driven by higher patient admissions, increasingly complex infectious disease cases, and rising diagnostic needs. This growth has intensified the demand for scalable, high-efficiency diagnostics. Despite a committed and highly skilled workforce, the laboratory faced mounting challenges, including increasing specimen volumes, workflow inefficiencies, biosafety risks, and variability in manual laboratory workflow. Traditional manual methods, such as culture plating, streaking, and smear preparation, are time-consuming and prone to operator-dependent variability, necessitating additional time on verification and rework, reducing workflow efficiency and extending turnaround times. These systemic inefficiencies threatened to limit the laboratory's capacity to meet the demands of modern patient care, particularly in an era of growing infectious disease threats. Recognising these challenges, SMC's Microbiology Laboratory embarked on a transformational automation journey in 2018.

What began as targeted automation of identification and antimicrobial susceptibility testing evolved into a comprehensive strategy to modernise the entire microbiological workflow through progressive automation.

Methods

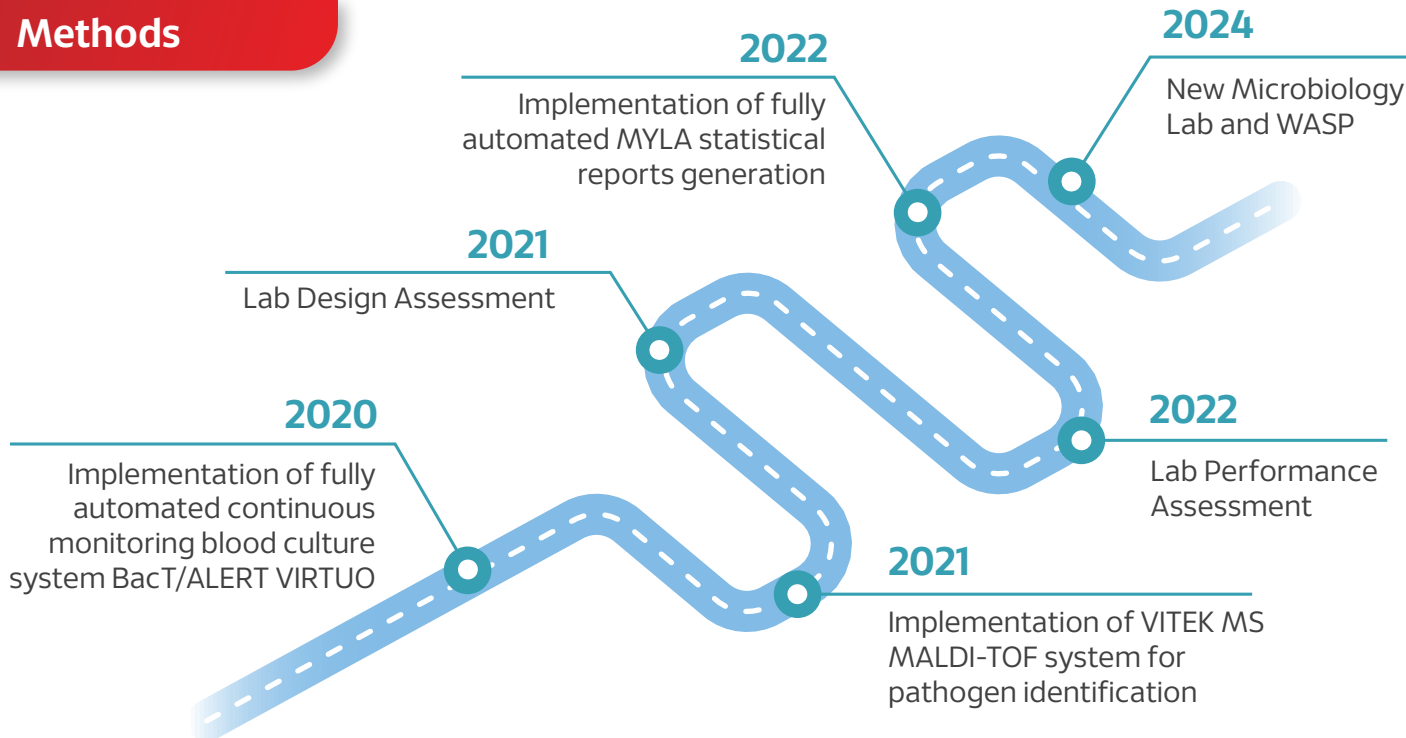


Figure 1: Key Milestones in Laboratory Transformation

The automation journey at Sunway Medical Centre's Microbiology Laboratory was carefully phased (Figure 1) over several years to ensure a smooth transition, effective system integration, and sustainable improvements.

A dedicated team comprising laboratory, technical, and support personnel implemented a phased automation programme from 2018 to 2024 in a high-throughput clinical microbiology laboratory. Systems introduced included automated identification and antimicrobial susceptibility testing, blood culture monitoring, mass spectrometry for rapid organism identification, and middleware for real-time data integration. This culminated in full specimen processing automation with the WASP system. Throughout this journey, each implementation phase included rigorous validation, standard operating procedures updates, staff training, and feedback loops. Interdisciplinary collaboration and robust staff engagement ensured smooth adoption while maintaining patient safety and reinforcing a culture of continuous improvement.

Results

Improving Turnaround Time for Clinical Decisions

Switching from VITEK® 2 to VITEK® MS reduced average identification time by 9 hours 33 minutes, with over 90% of significant pathogens identified within 24 hours of inoculation. VIRTUO® reduced median blood culture reporting from 69.6 to 67.2 hours, and when integrated with VITEK® 2 and VITEK® MS, this decreased further to 57.6 hours, significantly enhancing clinical responsiveness (Table 1).

Table 1: Time to reporting of positive blood culture during the progressive implementation of BACT/ALERT VIRTUO with VITEK Mass Spectroscopy (MS)

Time frame and automation introduced	Median time to reporting
2019 Semi-automated BACT/ALERT 3D + VITEK2 ID/AST	2.90 days (69.6 hours)
2020 Fully automated BACT/ALERT VIRTUO + VITEK2 ID/AST	2.80 days (67.2 hours)
2022 Fully automated BACT/ALERT VIRTUO + VITEK2 ID/AST + VITEK MS	2.40 days (57.6 hours)

Standardising Processes for Consistency and Reproducibility

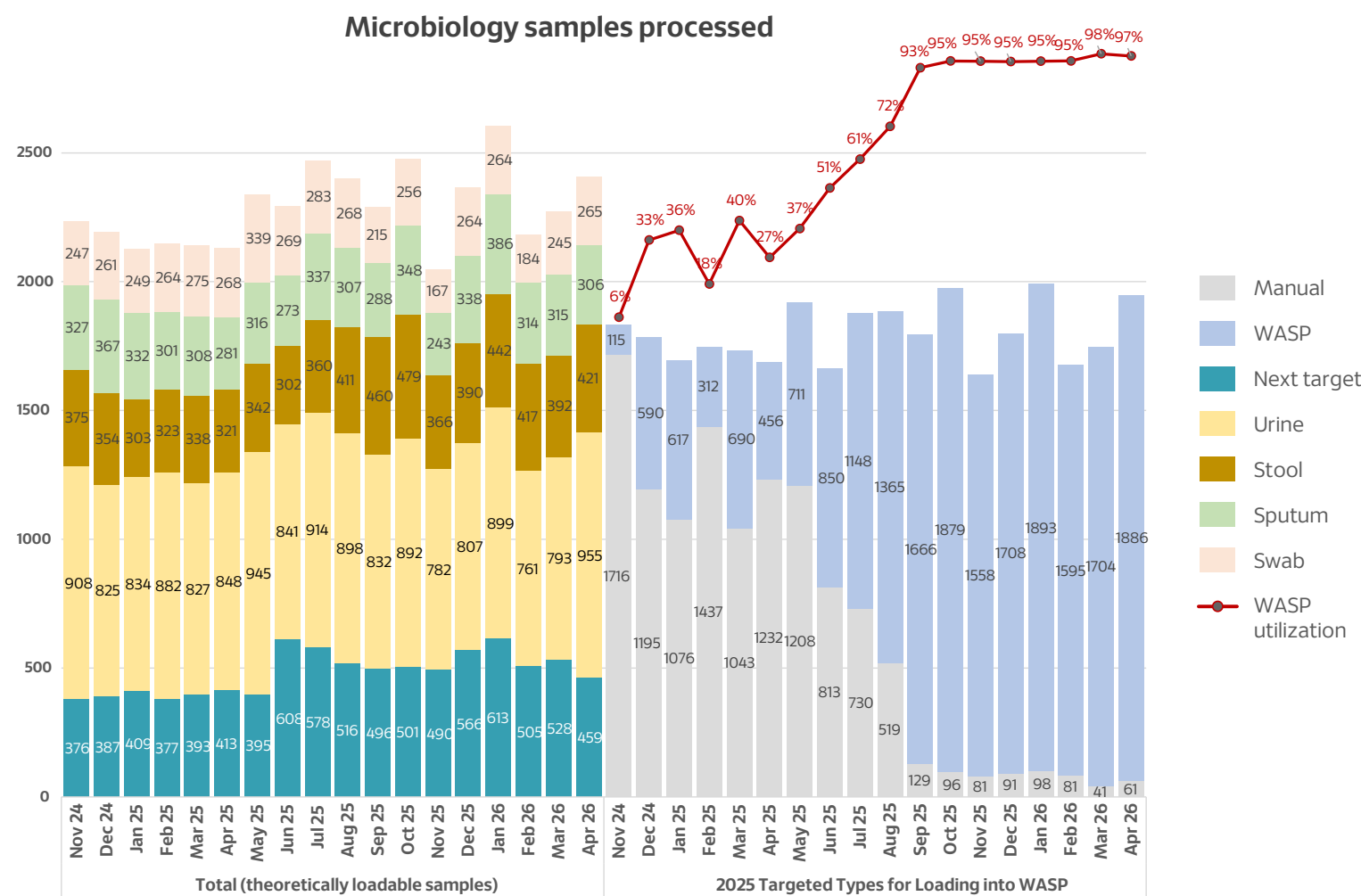


Figure 2: Sustained Improvement in the Adoption of Automated Specimen Processing

The 2024 introduction of the Walk-Away Specimen Processor (WASP) automated specimen processing eliminated shift-to-shift variability by streamlining workflows and reducing delays. Its sustained adoption (Figure 2) enabled faster, reproducible results without compromising diagnostic accuracy. WASP reduced manual plating time by 14.8% and increased specimen throughput by 15%, all without increasing staff headcount, demonstrating a scalable, consistent performance.

WASP introduced full automation in specimen processing with high-throughput precision and traceability, supporting quality assurance, biosafety, and audit readiness. These outcomes are sustainable through ongoing staff training, robust SOPs, and strategic partnerships, including third-party validation by bioMérieux. The modular design also allows for future upgrades, including integration with digital microbiology systems such as WASPLab, ensuring long-term scalability. Beyond technology, this initiative fostered a culture of innovation. Staff are now freed to engage in higher-order tasks like infection prevention stewardship, while clinicians benefit from faster, more reliable diagnostic information, translating into earlier interventions and better patient outcomes.

Optimising Human Capital for Higher-Value Work

Automation relieved skilled staff from manual plating and data transcription, enabling more time for culture interpretation and infection control. MYLA® middleware provided real-time connectivity across all platforms (Figure 3), and its analytics module reduced antimicrobial surveillance report generation time from 8 hours to 2 hours, thereby unlocking expert time for more strategic functions.

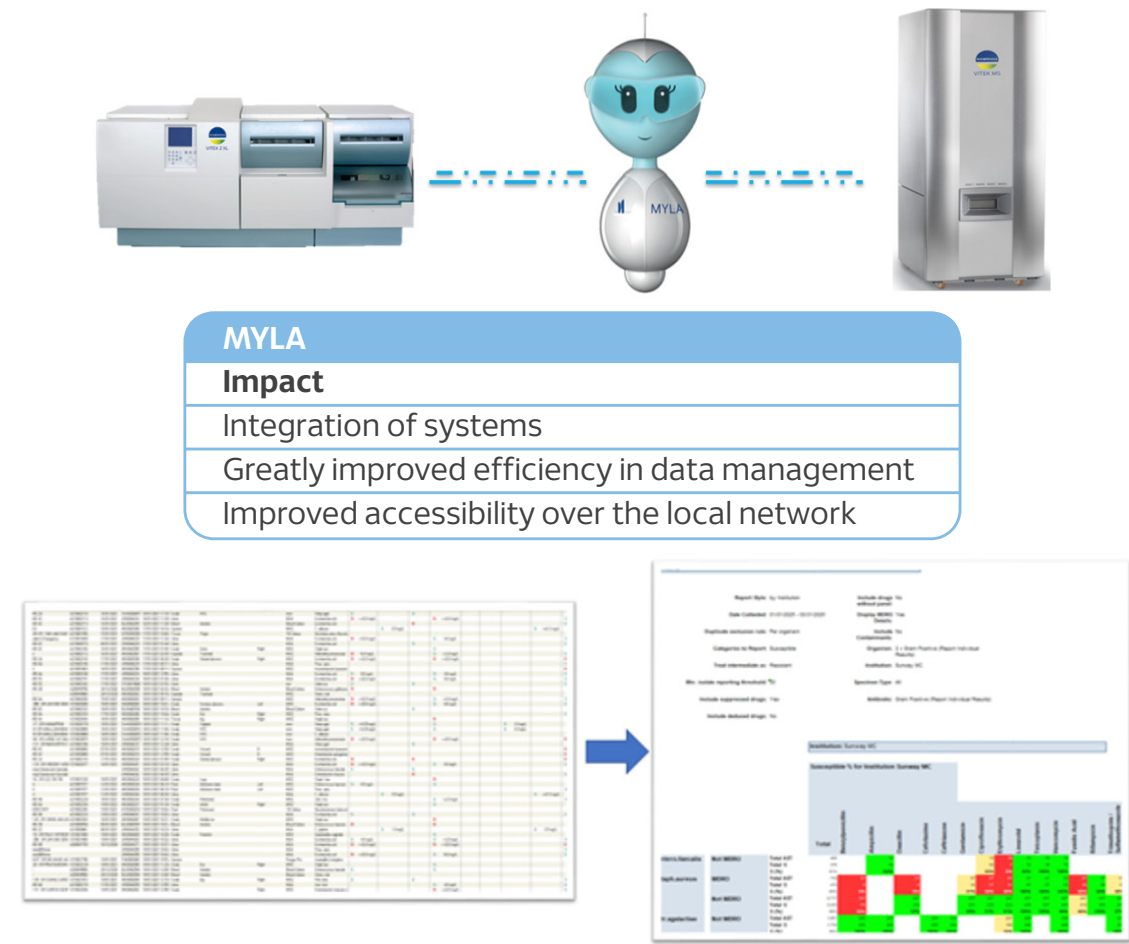


Figure 3: A Platform that Supports Connectivity, Accessibility, and Surveillance

Conclusion

As one of Malaysia's first laboratories to implement full-spectrum microbiology automation, Sunway Medical Centre has established a structured, phased transformation culminating in the WASP system in 2024. Each phase has strengthened diagnostic capability, improved efficiency, and enhanced workforce capacity.

Beyond operational gains, the impact is reflected in patient care. Improved standardisation and faster turnaround times support earlier clinical decision-making and more timely, targeted treatment, particularly in time-sensitive infectious diseases.

This initiative demonstrates how microbiology automation can enhance both laboratory performance and the broader clinical ecosystem. It provides a scalable model for sustainable smart hospital development, improving efficiency and diagnostic quality without proportional increases in manpower.

