Enhancing Core Laboratory Excellence through GLP System Track Automation at Sunway Medical Centre

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Abstract

This study presents a transformative initiative undertaken by Sunway Medical Centre to enhance diagnostic laboratory operations through the implementation of the GLP System Track Automation. Faced with increasing test volumes and stringent regulatory requirements, the laboratory aimed to modernize its Immunoassay and Clinical Chemistry (IACC) workflows by integrating a modular automation platform with its Laboratory Information System (LIS) and middleware. The project, executed from September 2023 to October 2024, focused on achieving end-to-end sample traceability, reducing manual handling, improving turnaround times, and promoting sustainability. Key outcomes included an 81% reduction in manual touchpoints, a 36% decrease in pre-analytical processing time, and significant improvements in Laboratory Turnaround Time (L-TAT) despite a surge in test volumes. Staff satisfaction rose markedly, and digital transformation efforts led to substantial environmental savings. This initiative not only reinforced compliance with MS ISO 15189, ACHS, JCI, and MSQH standards but also positioned the laboratory as a regional benchmark for innovation, efficiency, and sustainable healthcare delivery.

Keywords: Laboratory Automation, GLP System Track, Digital Transformation, Sample Traceability, Operational Efficiency, Sustainability, Clinical Chemistry, Immunoassay

Introduction

Sunway Medical Centre (SMC), Sunway City laboratory serves as the central hub within the Sunway Healthcare Group (SHG) hospital network laboratories. Diagnostic tests that are not processed at individual SHG Medical Diagnostic Laboratories are routed to the centralized laboratory at SMC in Sunway City. With increasing diagnostic demands and evolving regulatory requirements, SMC Laboratory recognized the need to establish an integrated, standardized, and traceable workflow within its pathology operations.

Today, the SMC Laboratory processes over 3.8 million immunoassay and chemistry tests annually, covering inpatient, outpatient, and SHG-wide testing needs. To advance clinical excellence and long-term sustainability, the Medical Diagnostic Laboratory at SMC partnered with a laboratory solutions provider to implement a comprehensive transformation initiative.

This project focused on Total Laboratory Automation (TLA), digital integration, and workflow reengineering to enhance efficiency, scalability, and diagnostic accuracy.
Previously, the laboratory faced challenges due to manual processes across the sample lifecycle including labelling, tracking, pre-analytical handling, and documentation which posed risks to sample integrity, turnaround time, and audit readiness. Fragmented specimen tracking, human error, and inefficient documentation further threatened compliance with accreditation standards and service excellence, ultimately impacting patient safety and institutional credibility.

To address these challenges, the GLP System Track Automation Project was launched in 2023, specifically targeting the Immunoassay and Clinical Chemistry (IACC) Laboratory. This initiative was designed to modernize sample journey management, emphasizing traceability, real-time visibility, and quality assurance. The goal was to align laboratory operations with both regulatory standards and internal quality benchmarks by implementing a fully traceable system integrated with the Laboratory Information System (LIS) and automation platforms.

At the heart of this transformation is the GLP System Track automation a modular platform comprising key components such as the Bulk Loader Module, Input/output Module, Tube Assessment Centre, Centrifuge, Decapper, Buffer, Recapper, Storage, and Remover Modules. This comprehensive infrastructure seamlessly integrates with the LIS and middleware (Analyzer Management System or AMS) to enable end-to-end traceability through sample handling, middleware coordination, and real-time dashboards.

Materials and Methods

The GLP System Track Automation at Laboratory, Sunway Medical Centre, Sunway City
The system automates data capture at every stage of sample handling, transfer, processing, archiving, and disposal ensuring a secure and auditable trail in compliance with Good Laboratory Practice (GLP) and accreditation requirements. Its validated architecture not only enhances compliance and reduces manual errors but also increases operational transparency, positioning it as a cornerstone of SMC's laboratory workflow transformation.

GOALS

The primary goal of the project was to automate and digitalize the complete sample tracking process from initial loading of samples to archiving and eventual disposal of those samples to improve accuracy, regulatory compliance, and operational efficiency. The key objectives were to:
1. Establish comprehensive, end-to-end traceability for all specimens to ensure regulatory compliance through automated audit trails and documentation.
2. Reduce manual handling by laboratory staff and minimize associated errors through automation.
3. Improve turnaround times and enhance sample visibility in clinical chemistry and immunoassay testing.
4. Enhance staff confidence, productivity, and job satisfaction by streamlining workflows.
5. Implement digital solutions that promote long-term sustainability in laboratory operations.

To support this transformation, a structured change management roadmap was adopted, consisting of three phases: Awareness, Training, and Go Live and Support. This approach targeted key stakeholders across a multidisciplinary team, including hospital leadership, department managers, medical technology director, laboratory scientists (as champion users), pathologists, IT specialists, quality assurance personnel, and vendor partners from both the LIS and GLP System Track automation. Together, these stakeholders collaborated to define workflows, conduct risk assessments, and implement a phased automation strategy. Key components of this implementation included the integration of IACC analyzers Alinity ci, middleware (Analyzer Management System or AMS) and track management solutions (TWM - Track Workflow Manager, TSM - Track Sample Manager), LIS and real-time performance dashboards.

Method

The project was executed in well-defined phases to ensure smooth implementation and minimal disruption to daily operations:

Phase 1 – Awareness: This phase centered on building understanding and engagement around the GLP System Track Automation. Communication of the overarching vision was carried out through presentations, site visits, and interactive system demonstrations.

Phase 2 – Training: Focused on role-specific education through cross-functional workshops, basic and advanced training modules, and detailed orientation for key users.

Phase 3 – Go Live and Support: Support mechanisms were established to ensure a successful transition, including access to job aids, checklists, help hotlines, on-demand support, and self-service guides.

Results

The project delivered substantial, quantifiable improvements:

1. Establish comprehensive end-to-end traceability for all specimens

The implementation of a fully integrated track management solutions (TWM - Track Workflow Manager, TSM - Track Sample Manager), and Analyzer Management System (AMS) enables 100% digital traceability of all specimens through precise, time-stamped events. This end-to-end visibility not only ensures accurate sample tracking but also strengthens regulatory compliance by generating automated audit trails and comprehensive documentation. These digital records enhance audit readiness and align with key accreditation requirements such as MS ISO 15189 and the College of American Pathologists (CAP) standards.

2. Reduce manual handling by laboratory staff and minimize associated errors through automation.

Previously, the laboratory's testing workflow required extensive manual intervention from sample reception to final unloading. With the implementation of the GLP System Track Automation, manual touchpoints were reduced by 81%, significantly lowering the risk of human error and enhancing the lab's capacity to accommodate growing test volumes. Automation also streamlined multiple stages of the process most notably, reducing pre-analytical processing time by 36%. Additionally, it eliminated inefficiencies in recursive

workflows and unnecessary sample aliquoting, achieving a 51% and 50% reduction. Recursive workflow refers to the repeated process of locating, identifying, and retrieving a sample tube to perform re-tests or additional tests using the same specimen.

3. Enhance turnaround times and sample visibility in clinical chemistry and immunoassay testing

Laboratory Turnaround Time (L-TAT), defined as the duration between sample registration and the release of test results, was used to assess the impact of automation on operational efficiency. A comparative analysis was conducted using time-stamped data from the Laboratory Information System (LIS) for the periods of January to March 2024 and January to March 2025.

For **Clinical Chemistry**, the average L-TAT **improved by 16.6%,** despite a **65.9% increase in test volume over the year**. Currently, **95% of Clinical Chemistry test reports are released within 133 minutes.**

For **Immunoassay**, an average **13% improvement** in L-TAT was recorded, even as test **volumes grew by 53.4%**. At present, **95% of Immunoassay reports are released within 156 minutes.**

These improvements demonstrate the effectiveness of digital sample tracking and automation in accelerating result delivery while managing increased workload.

4. **Enhance staff confidence, productivity, and job satisfaction** through streamlined workflows

Recognizing the importance of a positive work environment, the laboratory invested in a solution that fosters employee engagement, empowerment, and satisfaction. Following the implementation of the GLP System Track Automation, 80% of surveyed staff reported a 76% improvement in pre-analytical satisfaction, a 124% increase in post-analytical satisfaction, and a 90% overall rise in job satisfaction within just six months. These cultural shifts have strengthened staff confidence in sample handling, enhanced workload management, and contributed to higher productivity and retention of skilled personnel.

5. Drive long-term sustainability through digital transformation

As energy-intensive institutions, healthcare organizations are increasingly focused on reducing their environmental footprint. The laboratory embraced digital transformation as part of its commitment to sustainability. The implementation of the GLP System Track automation solution integrated with the Analyzer Management System (AMS) and the Laboratory Information System (LIS) enabled seamless data exchange across IACC instruments. This integration significantly reduced manual result verification and paper use, enabling faster, more accurate result validation and improving both patient care and operational efficiency.

The shift to digital workflows led to 81% results auto-verified, improving post-analytical turnaround time and reducing human error. Additionally, the reduction in paper usage estimated at 340,000 sheets annually which translated into substantial environmental savings: the equivalent of 171 trees, 3.59 million liters of water, 17,990 kWh of energy, and 1,799 kilograms of CO_2 emissions saved each year. These outcomes underscore the lab's commitment to sustainable and responsible healthcare delivery.

The system significantly improved operational visibility and control, enabling proactive quality management and reinforcing a culture of excellence within the pathology department.

Discussion

The GLP System Track Automation initiative marks a transformative milestone in Laboratory Sunway Medical Centre's digital journey, reinforcing its commitment to innovation, sustainability, and clinical excellence. Anchored by standardized SOPs, continuous staff development, and a validated, audit-ready infrastructure, the project ensures long-term viability and regulatory compliance.

With strong endorsements from Department of Standards Malaysia on the recent transition audit of MS ISO 15189: 2022 held in April 2025, the initiative showcases best practices in diagnostic safety, traceability, and operational efficiency. By fully automating the sample lifecycle and integrating real-time data management, Laboratory Sunway Medical Centre has not only enhanced its current capabilities but also built a scalable and resilient framework for future growth.

Conclusion

This transformation sets a new benchmark for laboratories regionally and globally demonstrating how thoughtful integration of technology and collaborative change management can lead to sustained improvements in diagnostic accuracy, turnaround time, environmental impact, and patient outcomes.

Ultimately, this initiative affirms Laboratory Sunway Medical Centre's position as a forward-thinking healthcare leader, delivering measurable results while advancing the vision of sustainable, digitally enabled, high-quality care.

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References

1. The Australian Council on Healthcare Standards (ACHS) The Australian Council on Healthcare Standards (ACHS) International, The ACHS EQuIP7 Guide for Hospitals, Sydney, Australia 2021

2. Joint Commission International Accreditation Standards for Hospital, 7th Edition 2021

3. Malaysian Society for Quality in Health (MSQH) Malaysia Hospital Accreditation Standards, 6th Edition 2021

4. Department of Standards Malaysia Medical Laboratories - Requirements for quality and Competence MS ISO15189:2022

5. References available upon request or as per institutional documentation on Policies and Procedures.