

LETTER TO THE EDITOR

Implementation of an Advanced Automation System in the Laboratory Medicine Department

Tze-Kiong Er^{1,2}

¹ Division of Laboratory Medicine, Asia University Hospital, Asia University, Taichung, Taiwan

² Department of Medical Laboratory Science and Biotechnology, Asia University, Taichung, Taiwan

SUMMARY

Background: The implementation of advanced automation systems in the Laboratory Medicine Department at Asia University Hospital represents a significant shift from labor-intensive manual sample handling to a fully automated workflow. This study outlines the adoption of automation in both general and urine analysis systems and examines its impact on diagnostic throughput and patient care.

Methods: We implemented two automation systems: a sample classification workstation with six high-speed robotic arms for pre-analytical tasks, connected directly to the blood drawing counter, and a direct track system for urine analysis. These systems minimized manual handling and improved workflow efficiency. Effectiveness was evaluated by comparing pre- and post-implementation data on procedural steps and processing time.

Results: Automation reduced procedural steps in pre-analytical activities from eleven to eight and in urine analysis from twelve to eight. Processing time for pre-analytical activities decreased by 33% (from 2,370 to 1,590 seconds), while urine analysis time dropped by 36% (from 990 to 630 seconds), significantly enhancing laboratory efficiency and reducing turnaround time.

Conclusions: Automation significantly improved workflow efficiency and quality of care by minimizing errors and allowing lab technologists to focus on complex tasks. It also enhanced patient privacy during urine sample collection, underscoring the value of integrating advanced technologies into laboratory operations to meet the needs of modern healthcare.

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Correspondence:

Tze-Kiong Er, PhD
Division of Laboratory Medicine
Asia University Hospital
No. 222, Fuxin Rd.
Wufeng Dist., Taichung City 413
Taiwan
Phone: +886-4-37061668 ext. 1297
Email: tzekiong92@gmail.com
ORCID ID: <https://orcid.org/0000-0002-7068-1652>

Supplementary Data

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Before Blood Draw Counter Automation System Implementation

Work Description	Operation	Transportation	Examination	Delay	Storage	Time
A. Patients go to the laboratory department to take a number ticket and wait for the medical technologist to call them in sequence for processing.	○	→	□	D	△	360'
B. The medical technologist verifies the health insurance card and the examination form with the patient at the blood draw counter.	●	→	□	D	△	
C. The medical technologist processes the signing and receipt of the test order.	●	→	□	D	△	
D. The medical technologist prepares the blood collection tubes according to the test requirements and properly affixes the test labels.	●	→	□	D	△	
E. The medical technologist collects a blood sample from the patient	●	→	□	D	△	
F. The medical technologist collects the blood specimen and stores it temporarily on the specimen rack.	○	→	□	D	△	360'
G. The medical technologist sorts the blood specimens (collection tubes) in the temporary storage area according to the type of laboratory analyzer.	●	→	□	D	△	300'
H. The medical technologist performs centrifugation on the blood specimens that require it.	●	→	□	D	△	600'
I. The medical technologist takes the sorted/centrifuged specimens to different analyzers for automated analysis.	○	→	■	D	△	120'
J. The medical technologist conducts a preliminary review of the analyzer's returned reports using the middleware, and then uploads the reports to the LIS system.	○	→	□	D	▲	600'
K. The medical technologist issues the report through the LIS system for clinical interpretation.	○	→	□	D	▲	30'

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After Blood Draw Counter Automation System Implementation

Work Description	Operation	Transportation	Examination	Delay	Storage	Time
A. Patients go to the laboratory department to take a number ticket and wait for the medical technologist to call them in sequence for processing.	○	→	□	D	△	360'
B. The medical technologist verifies the health insurance card and the examination form with the patient at the blood draw counter.	●	→	□	D	△	
C. The medical technologist processes the signing and receipt of the test order.	●	→	□	D	△	
D. The medical technologist prepares the blood collection tubes according to the test requirements and properly affixes the test labels.	●	→	□	D	△	
E. After collecting the blood specimen from the patient, the medical technologist directly deposits the specimen into the specimen submission slot at the blood collection counter.	○	→	□	D	△	
F. The specimen enters the conveyor system, where the automated machine determines whether centrifugation is required and identifies the testing items. The specimen is then transported via the conveyor to the connected centrifuge or analyzer for further processing.	○	→	■	D	△	600'
G. The medical technologist conducts a preliminary review of the analyzer's returned reports using the middleware, and then uploads the reports to the LIS system.	○	→	□	D	▲	600'
H. The medical technologist issues the report through the LIS system for clinical interpretation.	○	→	□	D	▲	30'

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Before Urine Automation System Implementation

Work Description	Operation	Transportation	Examination	Delay	Storage	Time
A. Patients go to the laboratory department to take a number ticket and wait for the medical technologist to call them in sequence for processing.	○	→	□	D	▲	300'
B. The medical technologist verifies the health insurance card and the examination form with the patient at the blood draw counter.	●	→	□	D	▲	
C. The medical technologist issues urine sample collection tubes and urine cups (paper cups or plastic cups).	●	→	□	D	▲	
D. The medical technologist educates the patient on how to collect the urine sample and informs them of the location of the specimen collection window.	●	→	□	D	▲	
E. The patient goes to the restroom to collect the urine sample according to the instructions given by the medical technologist.	●	→	□	D	▲	
F. The patient places the collected urine sample at the specimen collection window of the laboratory department.	○	→	□	D	▲	180'
G. The patient cleans their hands again using handwashing or hand sanitizer before leaving.	●	→	□	D	▲	60'
H. The medical technologist retrieves the patient's urine sample from the laboratory's specimen collection window.	○	→	□	D	▲	180'
I. The medical technologist performs the sample receipt procedure in the urine microscopic examination area.	●	→	□	D	▲	30'
J. The medical technologist places the signed-off urine sample into the machine for automated analysis.	○	→	■	D	▲	30'
K. The medical technologist preliminarily reviews the instrument-generated report in the laboratory middleware and then uploads the report to the LIS system.	○	→	□	D	▲	180'
L. The medical technologist issues the report through the LIS system for clinical interpretation.	○	→	□	D	▲	30'

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After Urine Automation System Implementation

Work Description	Operation	Transportation	Examination	Delay	Storage	Time
A. Patients go to the laboratory department to take a number ticket and wait for the medical technologist to call them in sequence for processing.	○	→	□	D	▲	300'
B. The medical technologist verifies the health insurance card and the examination form with the patient at the blood draw counter.	●	→	□	D	▲	
C. The medical technologist issues urine sample collection tubes and urine cups (paper cups or plastic cups).	●	→	□	D	▲	
D. The medical technologist educates the patient on how to collect a urine sample and explains how to use the automated urine analysis machine.	●	→	□	D	▲	
E. The patient goes to the restroom to collect a urine sample according to the medical technologist's instructions, places it in the automated machine inside the restroom, then cleans their hands before leaving.	○	→	□	D	▲	60'
F. The urine sample enters the automated machine track, is automatically signed in, and then proceeds for analysis.	○	→	■	D	▲	60'
G. The medical technologist performs an initial review of the instrument-generated report in the laboratory middleware before uploading the report to the LIS system.	○	→	□	D	▲	180'
H. The medical technologist issues the report through the LIS system for clinical interpretation.	○	→	□	D	▲	30'

Figure S1. The supplementary data contains four sections: 1) Before and 2) After Blood Draw Counter Automation, and 3) Before and 4) After Urine Automation System Implementation, illustrating workflows and changes in efficiency.