Liquid-based microbiology and automation: a new frontier in the management of bacteriology laboratory

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Abstract

Objective: Bacteriology specimens have been historically inoculated and streaked manually onto agar media. Some systems to perform these tasks automatically are now available on the market. These automations can process only liquid specimens. Copan Italia (Copan) has developed a range of collection and transport devices that provide the lab (and automation) with a liquid specimen - a new approach called Liquid Based Microbiology (LBM). An automation called "Walk Away Specimen Processor" (WASP, Copan) performs the inoculation and streaking from a variety of bacteriology specimens (swabs, urine, feces, etc.), fully managing the opening/recapping of containers and plates-labelling. Our laboratory is beta-testing site for the WASP and the LBM range. We evaluated the quality of the culture results, when processed by the WASP and manually; we report our experience in using the machine.

Methods: Six months prior the implementation of WASP we adopted in our routine ESwab and Uriswab (both from Copan), replacing the traditional collection and transport systems for vaginal swabs (Transystem with gel) and urine (vacuum tubes with preservative). ESwab comprises a flocked swab and liquid Amies medium, while Uriswab is a sponge bonded with preservatives; both devices allow manual as well as automatic processing from just one specimen collected.

WASP was installed on 29/10/2008 and used to process vaginal swabs and urine. For one month clinical specimens were processed manually and automatically, and results compared, for 832 ESwabs and 1.378 Uriswabs. WASP was evaluated in terms of throughput, reliability, reproducibility; consistency with the results from manual processing was analysed.

Results: The quality of the plates processed automatically is equivalent or superior to those obtained manually. For vaginal swabs a significant improvement of isolation rate was found on the samples processed by WASP: its quality of streaking is highly consistent and facilitates plate-reading and subsequent tasks. The machine did not show failures and is very easy to use. WASP full management of the process is faster than operators and guarantees full traceability.

Conclusions: WASP fully processes bacteriology specimens with minimal intervention from operators. The quality and consistency of results using the automation is valuable. Lab technicians have more time to perform other important tasks, generating significant savings.

Introduction and Purpose

Centro Diagnostico Italiano is a private healthcare center based in Milano, Italy. We offer a wide range of medical services, including preventive, diagnostic and therapeutic medicine, serving 2.000 patients every day. During 2008 we agreed to collaborate with Copan Italia and become a beta testing site of a recently developed automation for the bacteriology lab, called Walk Away Specimen Processor, WASP.

Bacteriology specimens have been historically inoculated and streaked manually onto agar media. Some systems to perform these tasks automatically are now available on the market. These automations can process only liquid specimens. Copan Italia (Copan) has developed a range of collection and transport devices that provide the lab (and automation) with a liquid specimen - a new approach called "Liquid Based Microbiology" (LBM).

WASP performs the inoculation and streaking from a variety of bacteriology specimens (swabs, urine, feces, etc.), fully managing also the opening/recapping of containers and plates-labelling. Our goal is to validate the instrument for the microbiological as well as practical aspects: we compared the quality of the culture results, when processed by the WASP and manually and the level of reproducibility provided by the machine; we report our practical experience in using the machine and compare the traditional bacteriology laboratory operations with the new workflow based on the implementation of WASP.

Methods

WASP was installed in our lab on 29th October 2008 and we started to use it for routine as well as validation work with clinical samples.

Six months prior the implementation of WASP we adopted in our routine ESwab and Uriswab (both from Copan), replacing the traditional collection and transport systems for vaginal swabs (Transystem with gel) and urine (vacuum tubes with preservative). ESwab comprises a flocked swab and liquid Amies medium, while Uriswab is a sponge bonded with preservatives; both devices allow manual as well as automatic processing from just one specimen collected.

WASP has been used to process vaginal swabs and urine. The system was evaluated in terms of throughput, reliability and reproducibility; consistency with the results from manual processing was analysed.

A total of 1378 Uriswab and 832 ESwab (vaginal) specimens were processed both manually and by WASP, following the laboratory protocols. Urine samples were plated on chromogenic medium with a 10µl loop and plates read after 24 hours incubation at 35°C. Vaginal samples were plated with a 30µl loop with a 4 Quadrants streaking pattern on 3 or 5 plates depending on the age of the patients; plates were read after 24-48 hour incubation at 36°C and appropriate atmosphere (CO_2) when required.

Culture results were considered positive or negative based on our standard criteria: positivity for urine specimens at ≥10.000 CFU/ml and for vaginal specimens in presence of isolated pathogenic micro-organisms. The number of discrepancies between results obtained by manual and automatic processing was evaluated.

Reproducibility: For a week, each day we selected randomly 5 urine specimens. Each Uriswab was processed by WASP 5 times, and culture results compared between the 5 plates.

Additional comments are reported and were collected by interviewing the laboratory personnel about their experience using the WASP.

Vaginal Swab (ESwab) processed by WASP, 4 Quadrants pattern, 30 µl Loop

WASP 30 µl Loop Triquetra

Results

Throughput: The number of plates processed by the machine is 150/hour, corresponding to a hourly productivity of 50 ESwabs (3 plates per specimen) or 150 Uriswabs (1 plate per specimen).

Reliability: During our trial the machine did not show major failures. Minor issues were promptly solved by the technical assistance team from the manufacturer.

Reproducibility: A complete overlapping between the results on the 5 plates obtained from each specimen was found.

Consistency: Very good correspondence was found between the results from manually and automatically processed plates. In some cases we got clearer isolation and better plate-readability with WASP; also the following steps (pick up of colonies) are easier for the operator with automatically-processed plates.

User-friendliness: The use of the automation is simplified by the intuitive software and the touch-screen monitor.

Full Traceability: Barcode labels on the specimens and the LIS integration guarantee fully automated operations, with limited intervention from the operator. An advanced barcode reading system is able to read container labels, also those not too well positioned. The barcode on each specimen provides the Patient/Specimen ID and, through data retrieved from the LIS, the additional data to be printed onto each streaked plate; this allows the system to apply the right protocol for each specimen type, without the need for the operator to select it manually. After each plate is streaked and labelled a final barcode reader controls readability of the plate label barcode and verifies it matches with the correspondent specimen container label, guaranteeing 100% traceability on all processes.

Containers Standardisation and Miniaturisation: This advantage is perceived at multiple levels (stock, collection point, transport, disposal, archiving). For example, the space occupied by a standard urine container is equivalent to 7 Uriswab tubes. ESwab tubes are shorter (50%) than traditional swabs with tube & gel medium, thus facilitating refrigerated transport.

In addition, compared to the use of old-style Transystems (swabs with transport medium), with the introduction of ESwab it was possible to reduce the number of vaginal samples collected from each patient from 3 to 1. This is clear advantage for all the key persons involved in the workflow: patient, nurses, laboratory technicians.

In addition the sample, both with ESwab and Uriswab, can be kept as a back up for later testing and without need to re-collect the specimen from the patient.

Safety for the operator and reduced risk of cross-contamination: WASP incorporates a HEPA filtration system, introducing further safety for the operators and minimising risk of cross-contamination between specimens; when processing also fecal specimens with the WASP, we will experience a reduction of smell from such samples in the lab, thanks to the double-carbon filter, which comes with the HEPA filter. The use of metal loops, sterilised at 800ºC, avoids the risk of cross-contamination between samples.

Automatic plate sorting system: WASP features a Plate Sorter that unloads processed (labelled) plates already sorted by homogeneous type of incubation (36 ºC and CO_2). The operator can pick up piles of processed plates and place them directly into the appropriate incubation conditions.

Walk-Away: WASP proved to be a real walk-away system. Working with the LIS integration, the interaction between the technician and the instrument is minimised: loading / unloading of samples and plates and start of the procedure.

Cost-Benefit analysis: The current saving in terms of labour costs, for the management of vaginal swabs and urines is 1 Full Time Equivalent. The machine will be used soon to process also other specimens (feces, other swabs, other fluids): with the coming increase of workload, the machine will be able to provide further processing capacity without increased labour costs.

Considering the saving in labour costs and disposables, the investment is paid back in 3 Years.

Conclusions

WASP fully processes bacteriology specimens with minimal intervention from operators. The quality and consistency of results using the automation is valuable. Lab technicians have more time to perform other important tasks, generating significant savings.

The adoption of Liquid Based Microbiology and the WASP automation in our laboratory represents a practical and cost-effective solution for the automation of the bacteriology laboratory.