Automating Urine Culture Plate Reading to Create a More Efficient Workflow

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Learning Objectives

- Examine the impact of AI based automation on laboratory time.

- Describe how automation categorizes the difference between significant and non-significant growth from urine cultures.

- Discuss how standalone automation can be installed and integrated into a labs lean workflow.

11/22/2023

Disclosures

No disclosures

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Albany Medical Center

766 bed tertiary care urban hospital including a children's hospital

Level 1 adult trauma center
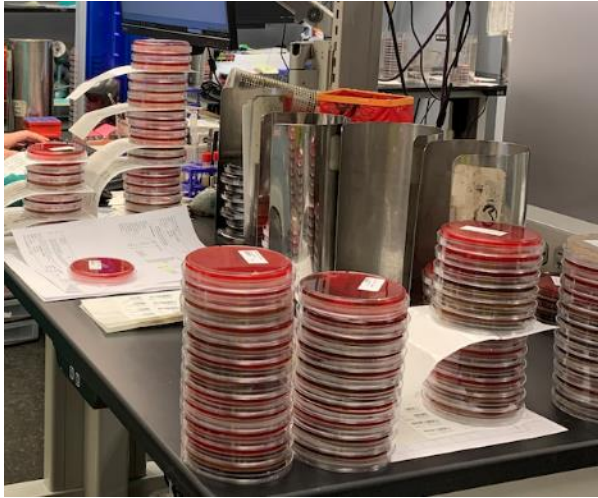Level 1 pediatric trauma center

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Numerous outpatient practice sites

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Microbiology Laboratory

➢ 25,000 urine cultures/year

➢ Urine culture assessments performed on 1st and 2nd shifts on weekdays. 1st shift only on weekends and holidays

➢ 1 FTEE each shift

➢ 10,000 more urine cultures a year are expected from an affiliate hospital
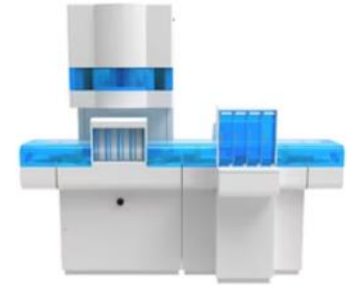
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How will we manage?

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Is automation the answer?

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Where would we put automation?

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APAS footprint
78.74 inches X 31.5 inches

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What is the APAS® Independence?

The Automated Plate Assessment System (APAS) Independence (Clever Culture Systems, Switzerland) is a stand alone in-vitro diagnostic instrument that fully automates culture plate imaging and interpretation.

The APAS reads and interprets microbial cultures using proprietary algorithms for enumeration and classification of growth.

Brenton, L et. al. 2020   Clinical evaluation of the APAS Independence: Automated imaging and interpretation of urine cultures using artificial intelligence with composite reference standard discrepant resolution. Journal of Microbiological Methods
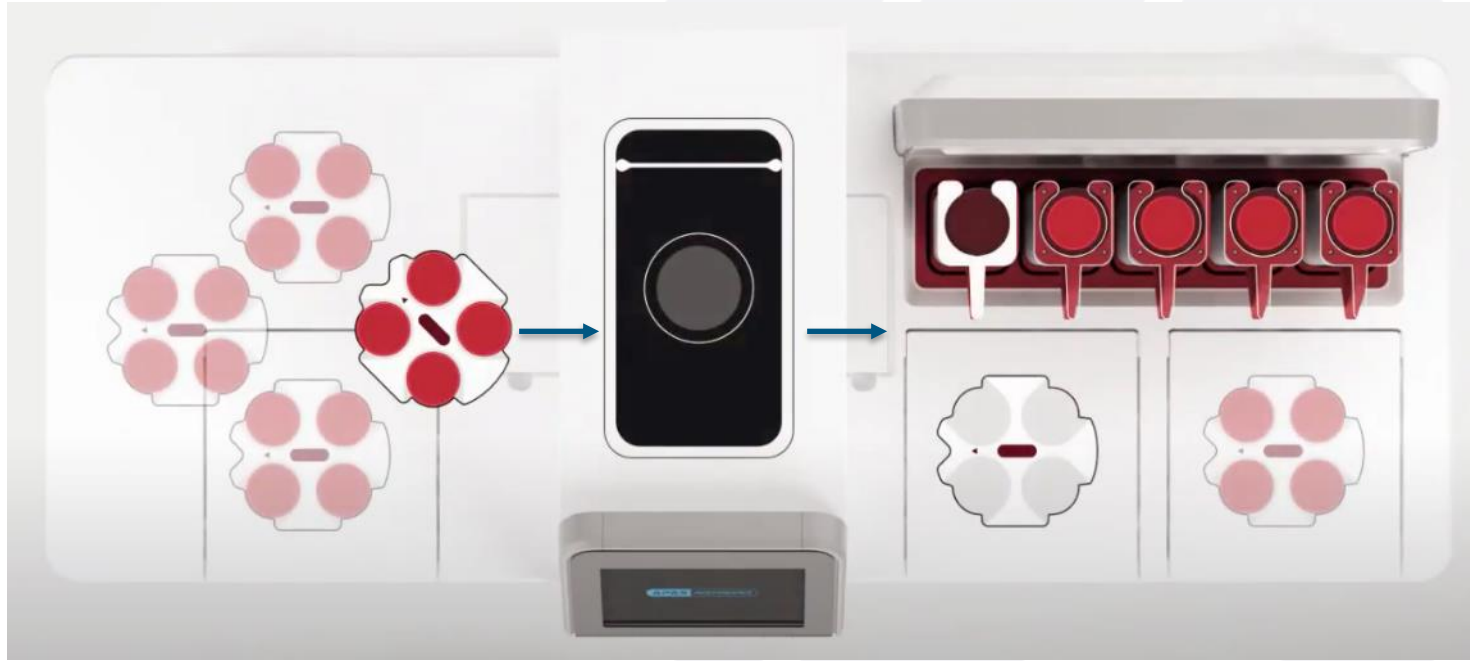
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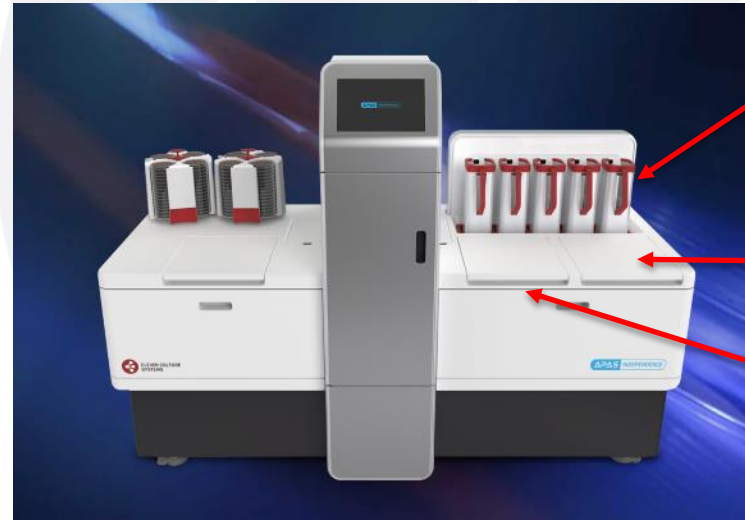
How does it work?

Image courtesy Clever Culture Systems

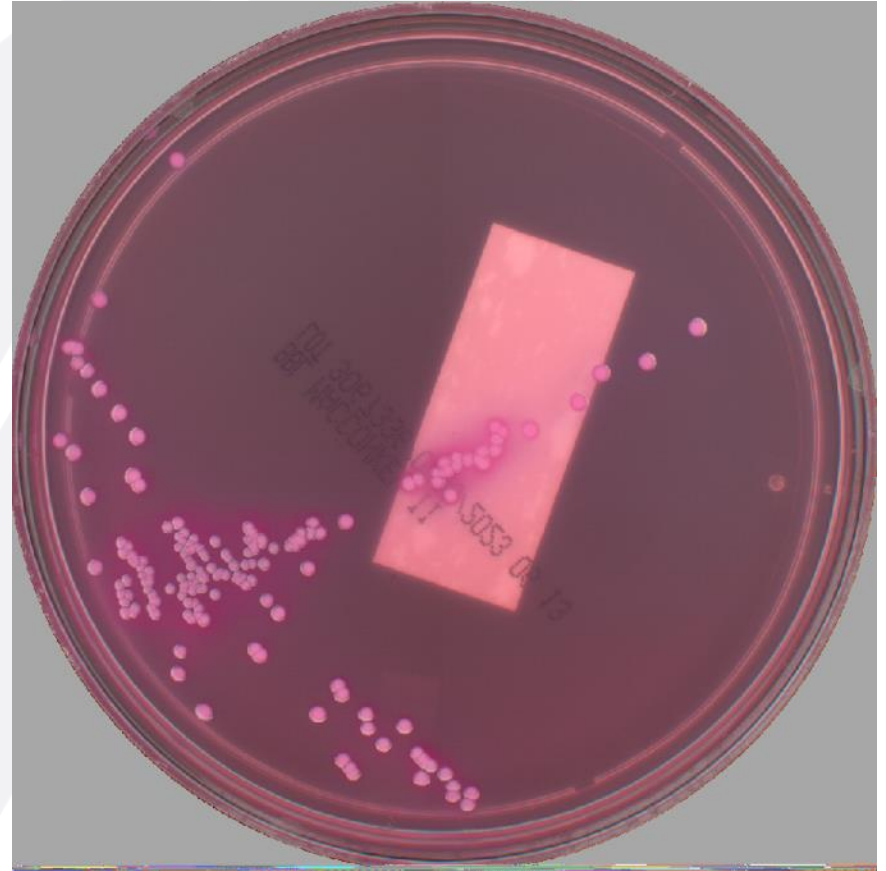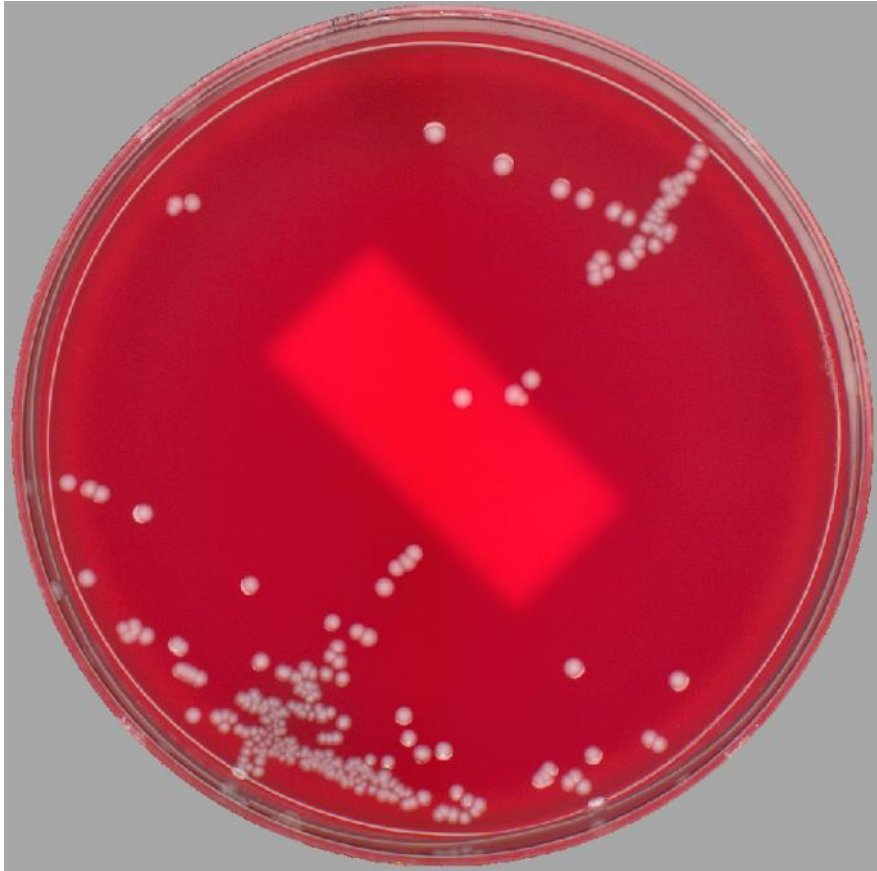ALBANY MED Health System

Plate classification and sorting

The instrument classifies and sorts urine culture plates into 4 designation categories based on the likely significance of the culture.

Probable $(\geq 10^4$ cfu/mL)
Review
Doubtful $(10^3$ cfu/mL)
No Growth

Probable
Review

Doubtful
No growth

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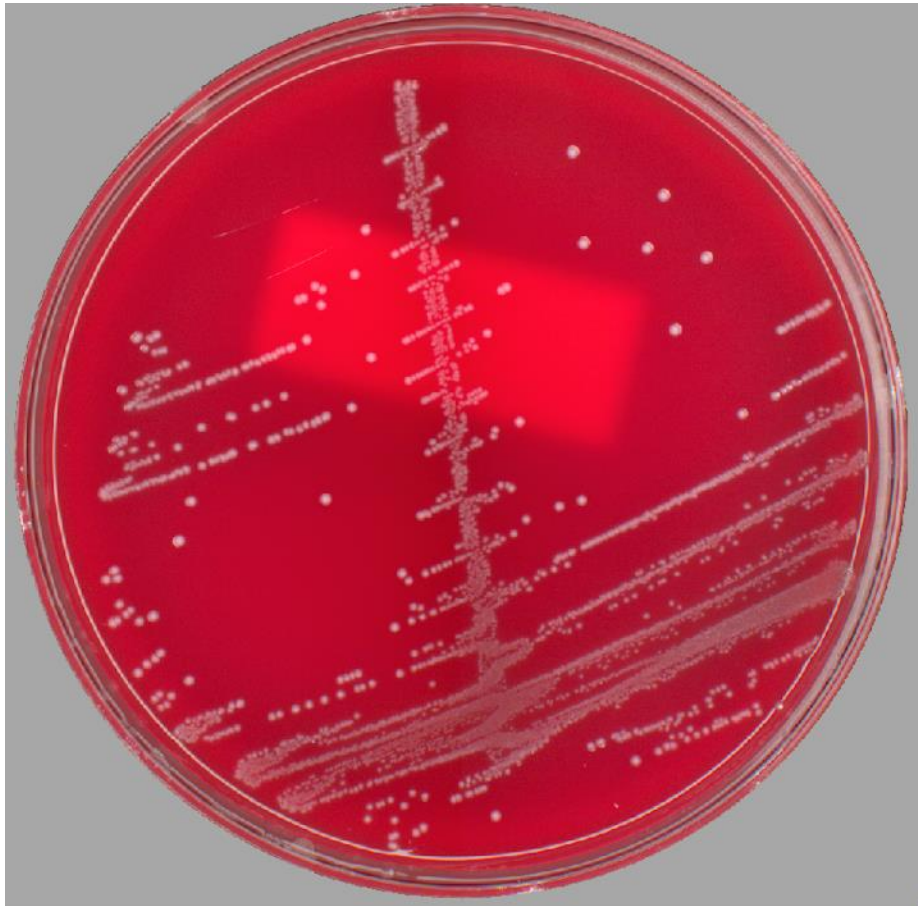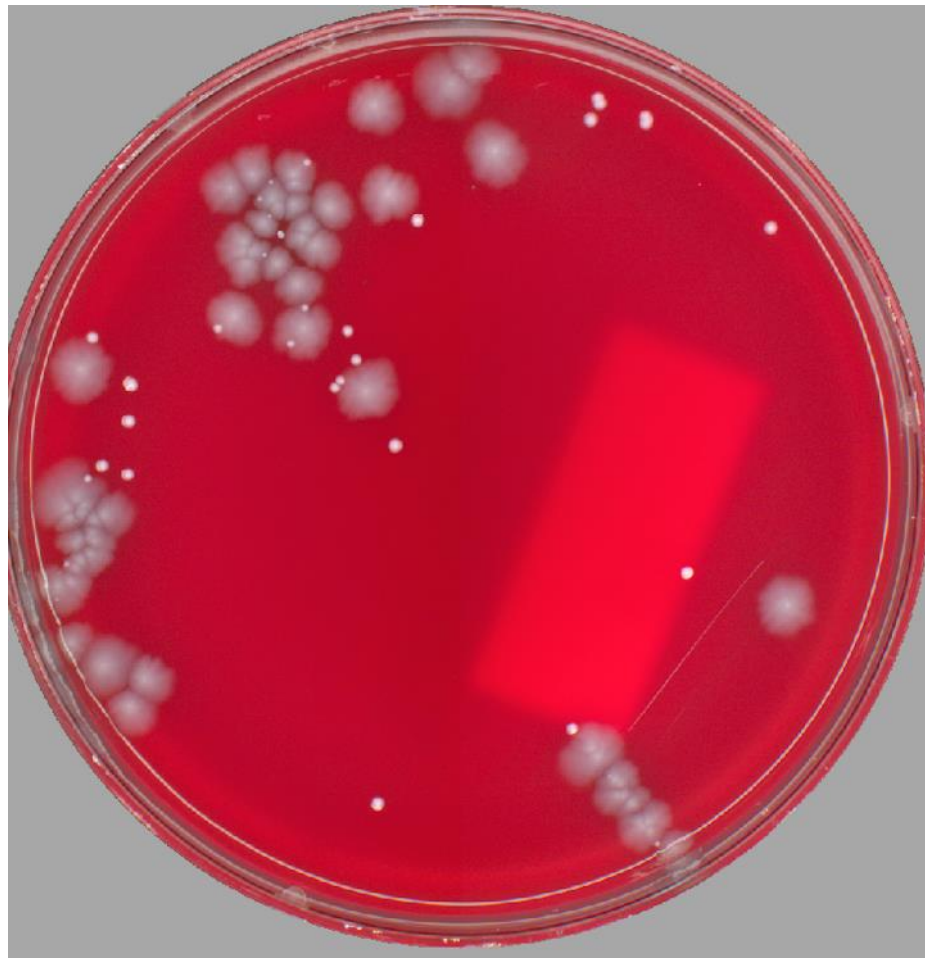
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Blood and MacConkey agar plates were manually inoculated with 1μL of urine then incubated in APAS carriers.

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At designated time intervals, plates that had incubated at least 18 hours were loaded into the APAS where they were sorted.

Plating and reading workflow

Plate: 0700 - 1000 Read: 0700 (RED)
Plate: 1001 - 1800 Read: 1200 (GREEN)
Plate: 1801 - 2100 Read: 1500 (BLUE)
Plate: 2101 - 2400 Read: 1800 (PURPLE)

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Technologists blinded to the APAS results then evaluated and reported the cultures using established laboratory procedures.

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APAS classifications

N= 1028 Urine cultures

N= 871 (Growth)

N= 157 No growth

$\geq 10^5$ cfu/mL
N= 427

10^4 cfu/mL
N= 238

Unable to enumerate
Swarming Proteus
N= 13

10^3 cfu/mL
N= 193

George, M and S. Giglio 2023 Can an automated plate reading system for urine cultures
create a more efficient laboratory workflow? Presented ASM Microbe 2023

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APAS versus manual plate assessment and reporting

APAS	Manual			
	No growth	10^3 cfu/mL	10^4 cfu/mL	$\geq 10^5$ cfu/mL
No growth	152	1	2	2
10^3 cfu/mL	110	77	4	2
10^4 cfu/mL	44	96	90	8
$\geq 10^5$ cfu/mL	4	13	156	254

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The APAS accurately identified 98.1% of the negative cultures when No growth and Doubtful plate designations were considered a negative test and Review and Probable classifications were considered a positive test. There were 10 cultures that were read as a negative test by the APAS but were resulted as a positive test by laboratory staff.

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Description of test discrepancies	
APAS No growth	1 culture with 10^4 presumptive *Gardnerella vaginalis* * 1 culture with 10^4 mixed urogenital flora * 1 culture with $\geq 10^5$ *Candida glabrata* along with 10^3 mixed urogenital flora * 1 culture with $\geq 10^5$ *Gardnerella vaginalis* *
APAS Doubtful (10^3)	2 cultures with 10^4 *Candida glabrata* 2 cultures with 10^4 mixed urogenital flora * 2 cultures with $\geq 10^5$ *Gardnerella vaginalis* along with 10^3 mixed urogenital flora *

* 8 of the discrepant APAS negative cultures were compared against manually read plates incubated for additional time because of observed fine growth on Day 1. The recovery of *G. vaginalis* and *Candida* species from clean catch or indwelling catheter samples has questionable significance. In cases of complicated UTI, where more invasive collection methods are used, these organisms are more likely to represent a significant finding. The APAS can be configured to send these types of cultures for technologist review on Day 1 if they are classified as a negative test so that they can be manually assessed and reincubated.
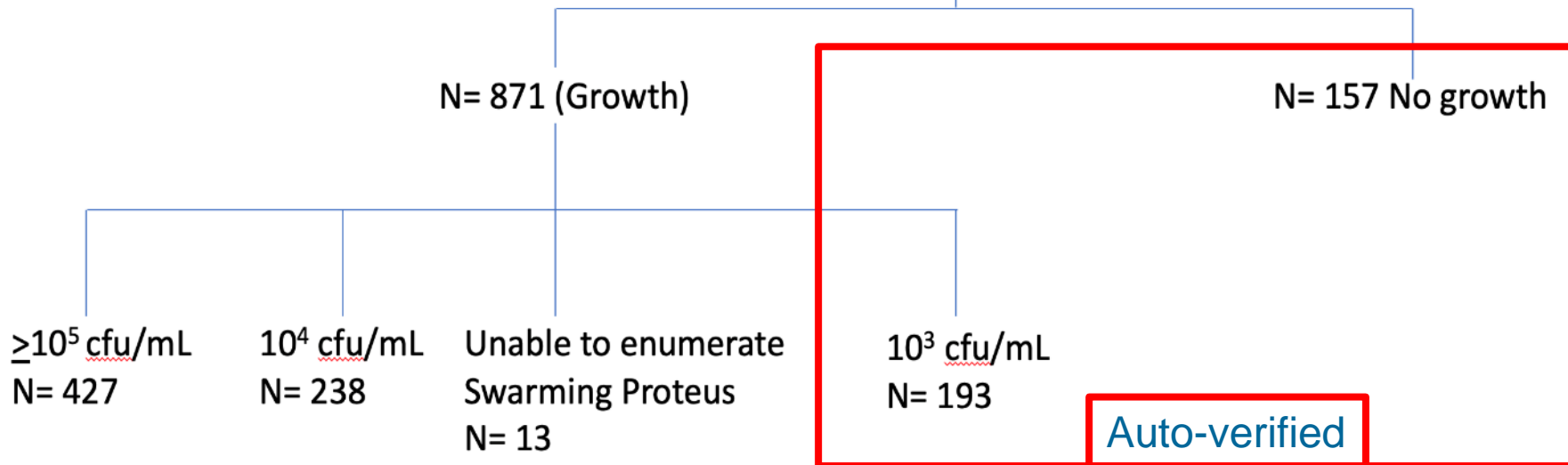
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Albany Medical Center APAS culture reporting

	Reporting criteria	Impact on reporting workflow	Percentage of cultures
Positive culture	$\geq 10^4$ cfu/mL ($\geq$ 10 colonies on plate)	These cultures require technologist review	67%
Negative culture	$< 10^4$ cfu/mL ($<$ 10 colonies on plate)	Removed from workflow and reported using auto-verification	33%

✓ Straight catheter urines are flagged by the interface to be reviewed and re-incubated if negative on Day 1.

✓ Urine samples that are plated with 10 μL of urine (e.g. obtained by cystoscopy or suprapubic aspirate) are incubated separately from APAS samples. However, if accidentally loaded on the APAS, these specimen types are flagged by the interface to be diverted for review.

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Auto-verified

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Did the APAS save time?

➢ APAS average processing time for a negative test BAP was 17 seconds while manual negative test BAP reading time ranged from 13 – 26 seconds.

➢ The average negative test report turn around time was decreased by 2 hours during the first phase of auto-verification implementation.

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Conclusions

➢ The APAS can accurately identify cultures with nonsignificant growth and clear them from the manual reading and reporting workflow allowing technical staff to focus their time on significant cultures.

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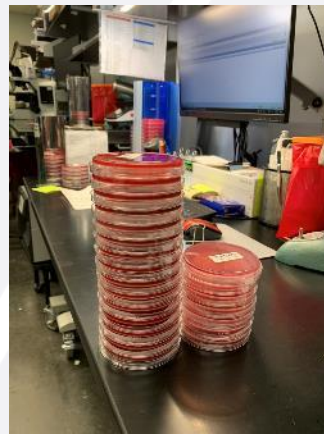
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Conclusions

➢ Because the APAS system does not include the robotics to inoculate the specimen or an integrated incubator, the cost of the instrumentation was substantially lower than other automation systems making it more budget friendly for our facility.

➢ The APAS, with length and depth dimensions similar to a standard laboratory work table, was easy to install in the limited space within our laboratory.

➢ Training was easy and will allow for support from non-technical staff with loading and removal of sorted plates.

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Conclusions

- ➢ The APAS was adaptable to already established lean laboratory workflows which allowed for better staff acceptance.
- ➢ LIS interfacing allows for auto-verification of negative cultures which reduces turnaround time for these reports.

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Thank you!

Questions?

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