Total Lab Automation: Experience of a Roman Teaching Hospital

NOVEMBER 11, 2021

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Disclosures

A research grant by Angelini.

A grant as Advisory Board by Pfizer

No grant has been received for the **present presentation**

Let me introduce my Hospital & my Lab

A brief history just to introduce our….

Our Hospital was born in 2000 and today is 500 beds (Teaching Hospital -Tor Vergata University in Rome)

Our Microbiology lab…

Starts in 2000 processing just a few samples/day

Today we run about 400,000 exams (in bacteriology) per year

About 3,500,000 combined exams Microbiology&Virology per year

The aim of microbiological diagnosis

To search & identify for the causative pathogens of an infectious process, and when it is possible, to perform antimicrobial susceptibility testing (AST)

in the shortest time possible

Clinical Infectious Diseases

IDSA GUIDELINE

A Guide to Utilization of the Microbiology Laboratory for Diagnosis of Infectious Diseases: 2018 Update by the Infectious Diseases Society of America and the American Society for Microbiology[a]

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Some main issues on Clinical Microbiology

Unlike other areas of the diagnostic laboratory, clinical microbiology is a science of interpretive judgment that is **becoming more complex, not less**.

Even with the advent **of laboratory automation**….. in microbiology, interpretation of **results still depends on the quality of the specimens received**

Clearly, microbes grow, multiply, and die very quickly. If any of those events occur during the preanalytical specimen management processes, **the results of analysis will be compromised and interpretation could be misleading**

Microbes tend to be uniquely suited to **adapt to environments** where antibiotics and host responses apply pressures that encourage their survival: therefore culture methods remain the gold standard

If we agree that «Culture methods» still represent the referenced methods in a Microbiology lab

we cannot fail to consider the importance and the role played by molecular methods in the diagnosis of infections…

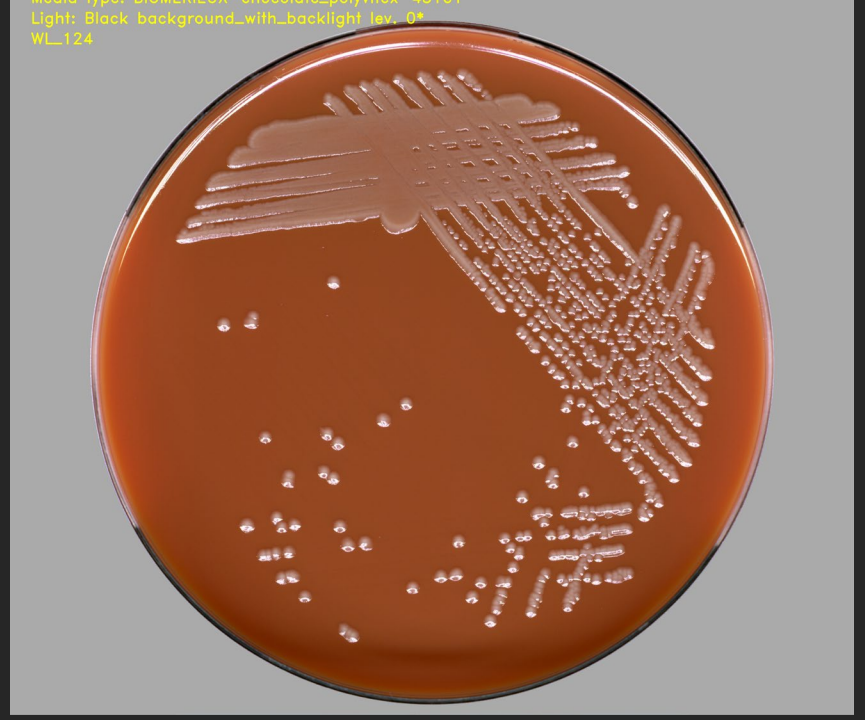
but as mentioned, bacteria evolve and sometimes molecular methods chase the microbial mutations,

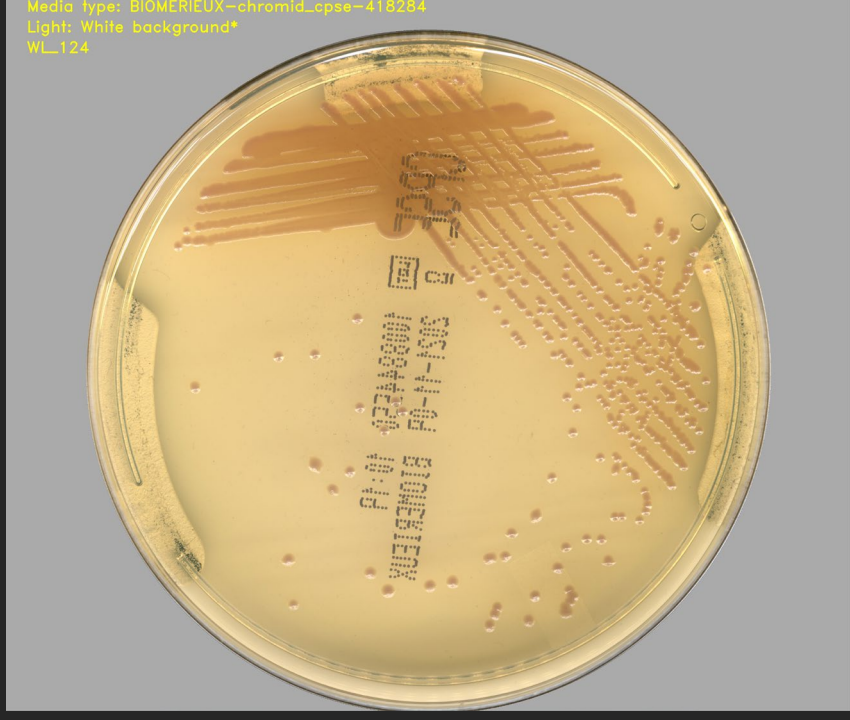
While, on the contrary, cultures give us living organisms ready to be studied

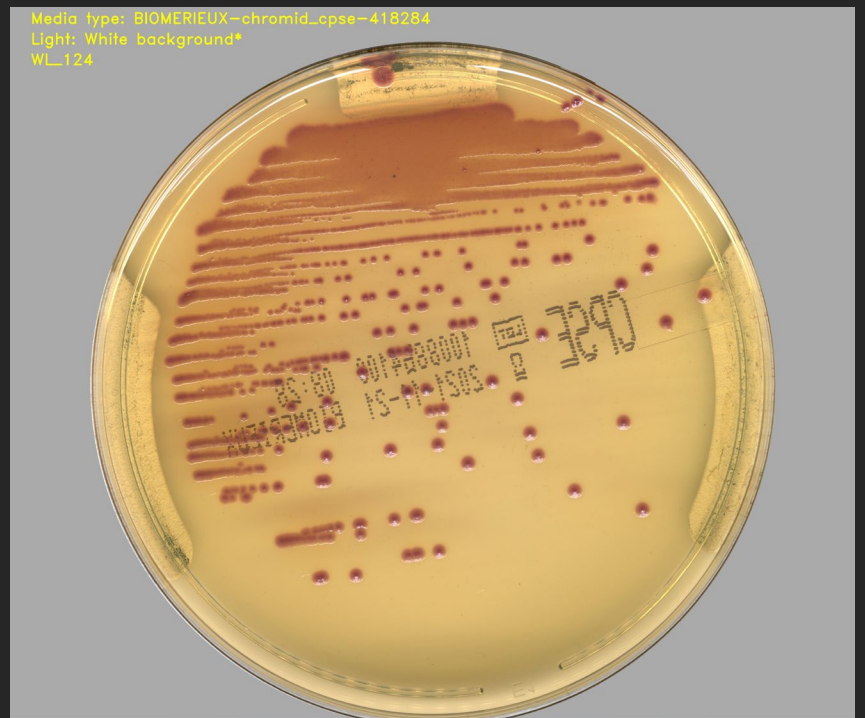
But to have living microorganisms

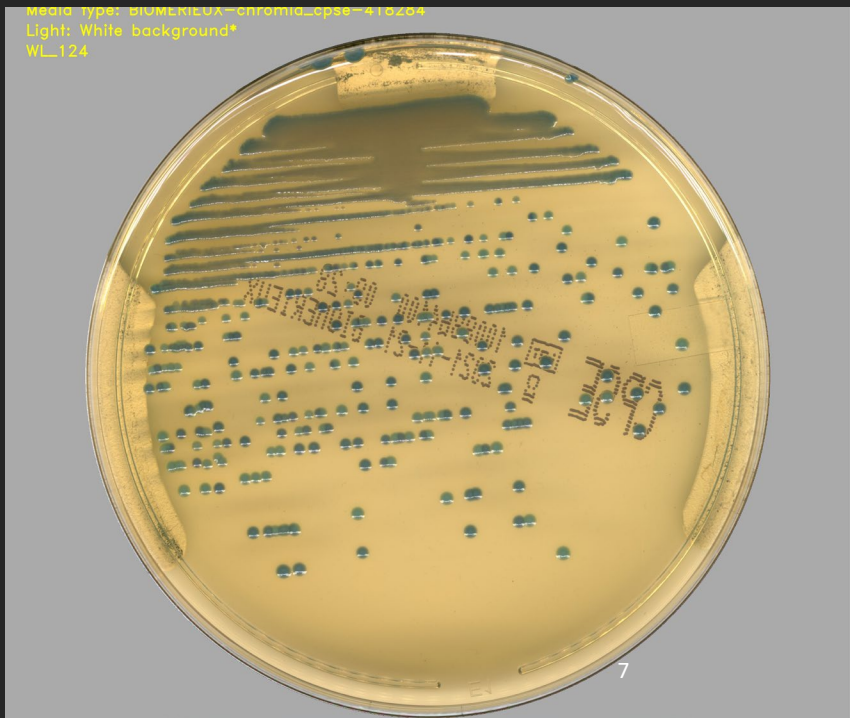
we have to satisfy a basic condition:

- do everything that is within our means so that the culture methods could to be effective!









Not only

fast-track DIAGNOSTICS

We have to invest in «fast microbiology» for many reason but the most important is …

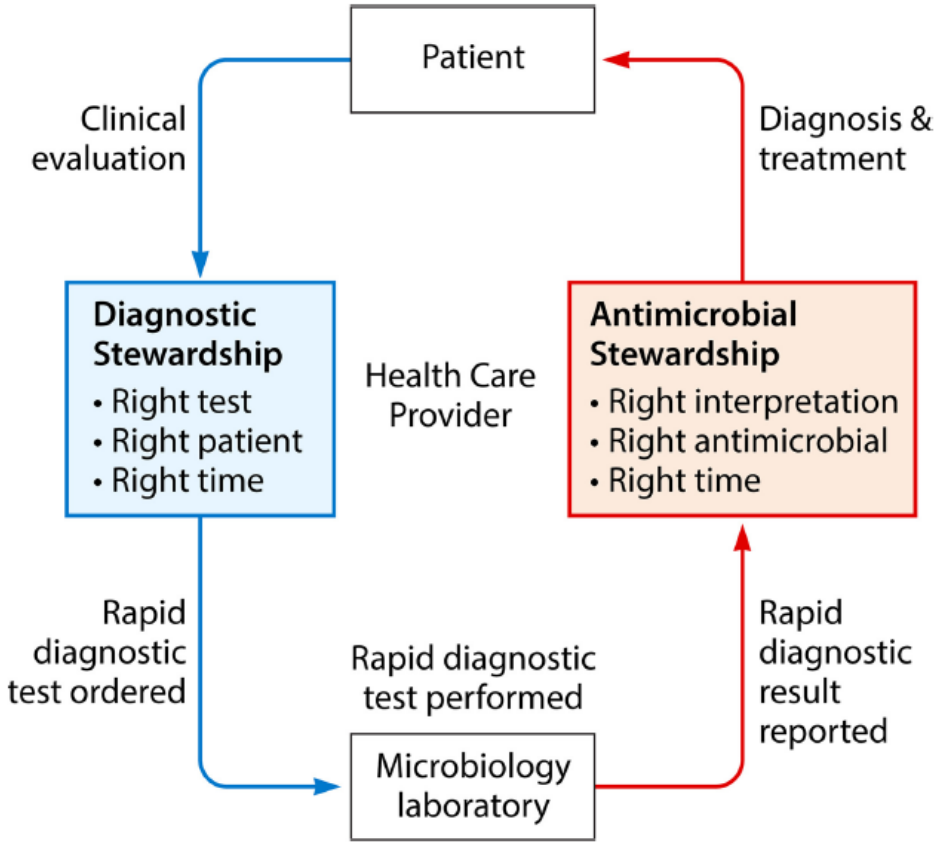


FIG 1 Roles of diagnostic and antimicrobial stewardship in the implementation of rapid molecular infectious disease diagnostics in the clinical setting.

- J Clin Microbiol. 2017 Mar;55(3):715-723. doi: 10.1128/JCM.02264-16. Epub 2016 Dec 28.
- **Implementation of Rapid Molecular Infectious Disease Diagnostics: the Role of Diagnostic and Antimicrobial Stewardship.**
- Messacar K, Parker SK, Todd JK, Dominguez SR

In processing microbiological samples

It is paramaount to satisfy 3 criteria:

- accuracy
- traceability
- speed

For accuracy…

LBM is the answer

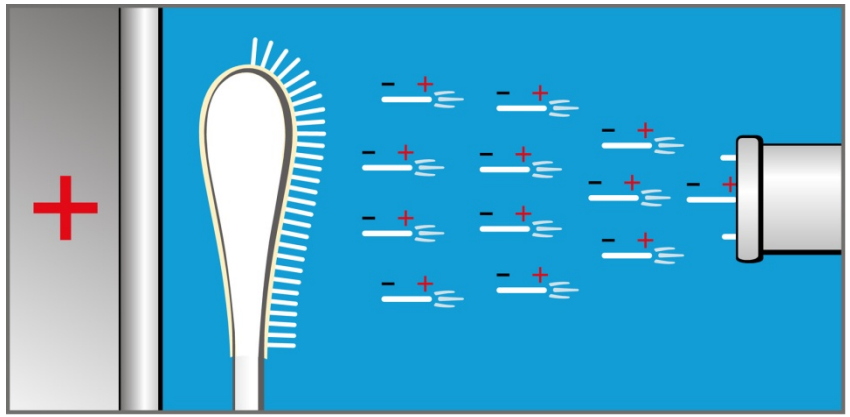
Liquid Based Microbiology: what we know well

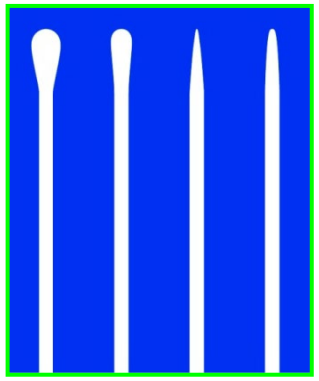
Copan: Company's name is an acronym from the expression "**Collection and Preservation for Analysis**"

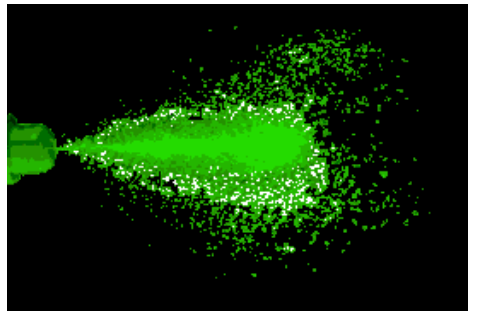
invention of Flocked Swabs, FLOQSwabs™ *by Copan*

soft brush, that allows improved specimen collection **and release**

FLOQSwabs™ have no inside: the sample is instantly and entirely released.







Advantages

1. High efficiency (increased culture sensitivity due to the total sample release)
2. High efficiency in the conservation and maintenance of the vitality of microorganisms
3. a single system for collection and transportation = simplification (the same sample is suitable for multiple methods: from culture to molecular methods)
4. Standardization (a single sample, a single liquid medium which is homogeneous)

Anc

We started in 2(ience with Walk Away Specimen

the end of a
etively

Advances in Microbiology, 2013, 3, 504-510
http://dx.doi.org/10.4236/aim.2013.36067 Published Online October 2013 (http://www.scirp.org/journal/aim)

Scientific Research

How Liquid Based Microbiology Can Change the Workflow in the Microbiology Laboratories

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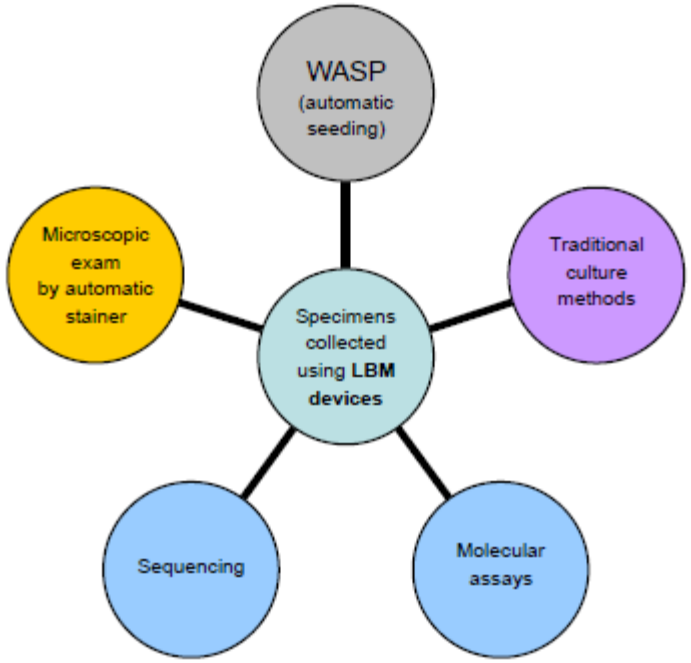


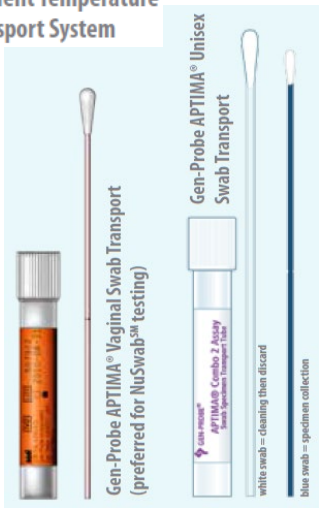
Figure 1. Central role of LBM devices in a multidirectional and multi-tasking laboratory.

Before LBM

Swab or Double Swab in Amies Agar Gel

Soft Aluminum Wire Dry Minitip Swab

BD Affirm™ VPIII
Ambient Temperature
Transport System



Double Polyester Dry Swab

Vacutainer™ Plus No Additive Transport Tube
Sterile Body Fluid Culture

Sterile Container

Bordetella Culture Transport

Vaginitis/Vaginosis by DNA Probe

Swab in Liquid Stuart's Medium

Port-A-Cul™ Anaerobic
Transport Tube

Stool Transport Without Preservative

After

i.e. simplification-standardization and homogeneous sample

Red Cupped Tube (instrumentation)

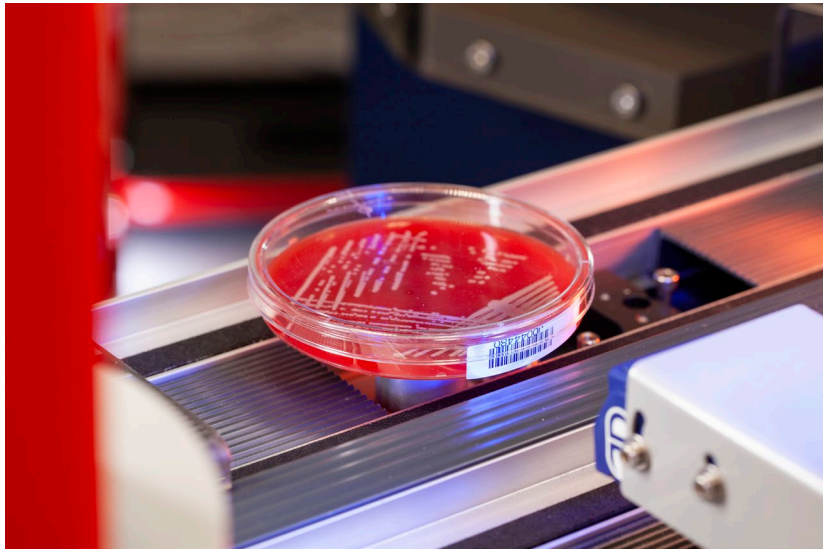
To collect every type of fluid samples (Positive Blood cultures included)

And this was the face of our staff after the introduction of the WASP system

In processing microbiological samples

It is paramaount to satisfy 3 criteria:

- accuracy
- traceability
- speed



Traceability & Speed

We immediately think:

- about lab automation (which for its own nature is based on pathways that have to be traced)
- and AI (which could help us in setting up shortcuts of our processes)

Why do we need full lab automation?

Do we really think that lab automation is useful just to …..?

1. Reduce the workload
2. Improve standardization
3. Show the rest of the world how cool our laboratory is

Or are there more concrete and visionary reasons?

In my mind

Automation is essential for measuring & improving our processes

Measuring and monitoring is the basis for improvement

Continuous improvement is the basis of efficiency

Efficiency is not a political slogan or simply compliance with mandatory standards, but it consists of a continuous (daily!) commitment and a long-term planning effort **to make:**

microbiology useful for patient care, useful for clinicians

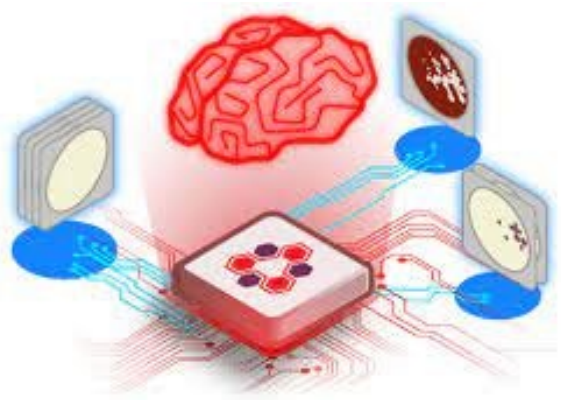
microbiology central in the screening and prevention programs

In my mind *AI*

AI is important to reduce unuseful pathways

when you start teaching ***Artificial Intelligence*** (that is the case of Phenomatrix software) you **understand** that many steps can be s**implified** and improved,

that is to say you **have to be open minded** and ready to review your historical behaviors



So our third step

WASPLAB

BEFORE

ON-GOING INSTALLATION


COPAN
WASPLab
COPAN
WASPLab
WASPLab
WASPLab
NOW

We start with WASPLAB

On November 2020 we started with our experience (in the middle of the second wave of COVID in Italy)

After one year of experience

What can we say?

First of all : these are our faces

…Jokes aside

Taking a look of our TAT just to respond to the last issues: traceabilty and speed

I have chosen two samples:

1) blood cultures

2) culture of BAL/BAS and steril fuid samples

Some clarifications

- We worked 7/7, 12h/day ,from 8am to 8pm in preCOVID time

- In COVID time we went to a **24/7** service, **but unfortunately** we didn’t/don’t have enough staff to work on BC also in the night shift . So if a BC turns positive during the night, it likely had/has to wait until morning to be cultured

TAT of BCs

Continuous incubation systems have the undoubted advantage of never interrupting bacterial growth curves and therefore of reducing growth times

That is true for **continuous monitoring blood culture system**, and it also true for **lab automation system**

Blood Culture System

Blood culture systems have also been used to assess the sterility of platelets and cell therapy products (i.e., human cells and tissues processed in vitro and then administered for therapeutic purposes).

From: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases (Eighth Edition), 2015

Download as PDF Set alert

Laboratory Diagnosis of Infection Due to Bacteria, Fungi, Parasites, and Rickettsiae

John C. Christenson, ... Ryan F. Relich, in Principles and Practice of Pediatric Infectious Diseases (Fifth Edition), 2018

Media.

Advances in blood culture systems have increased the yield of blood cultures, reduced the time to organism recovery, and diminished the laboratory technologist's hands-on time. Some systems were developed to maximize recovery of fastidious organisms. These

Laboratory Di
Infectious Dis

John C. Christenson, E
Pediatric Infectious Di

Media

Advances in blood cult
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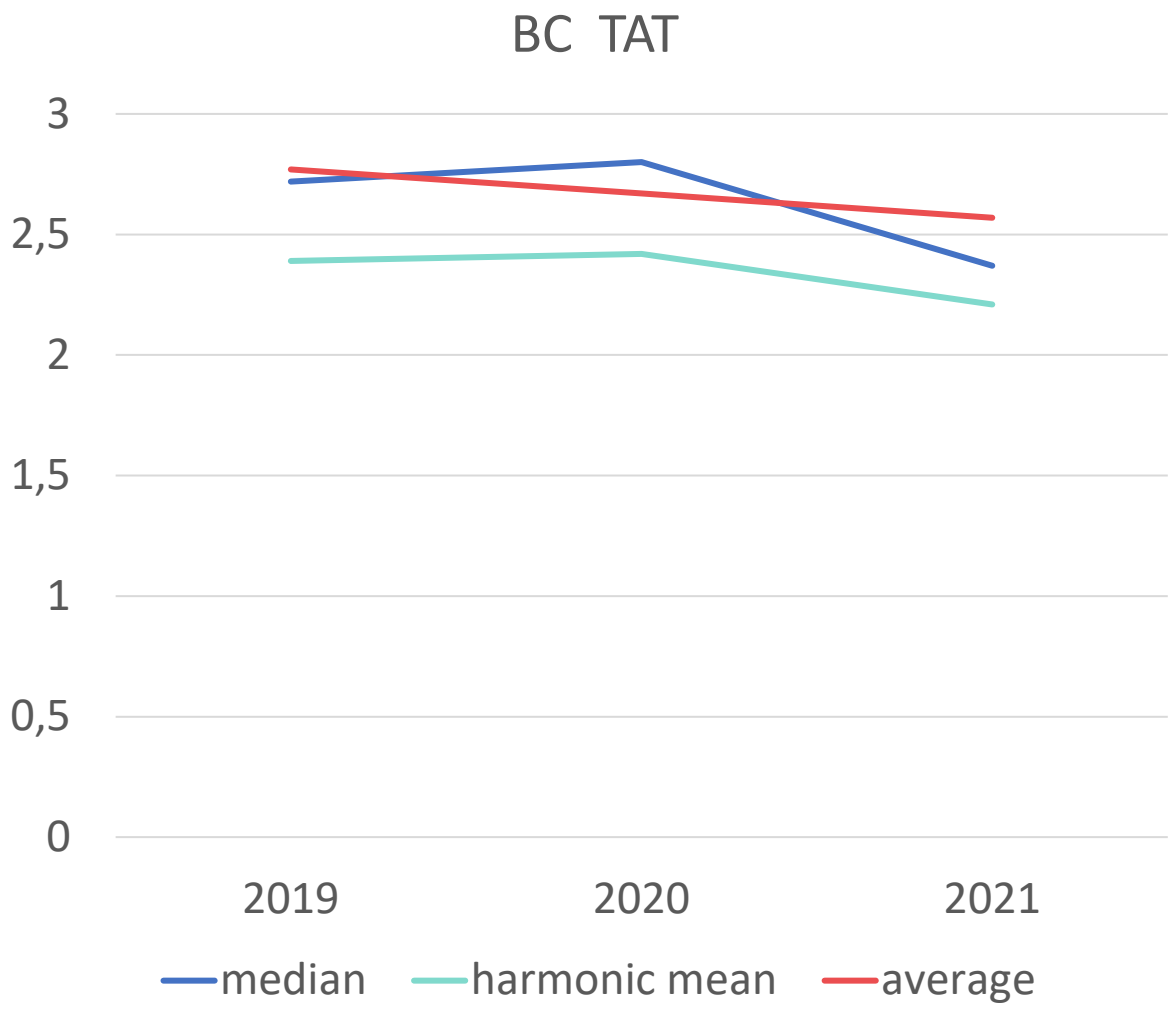
TAT pre and post WASPLAB (BCs)

Comparing TAT in 2019, 2020, and 2021

TAT from the arrival in the lab to the final report (availble for the clinicians)



Or if you prefer

	2019	2020	2021
median	2,72	2,8	2,37
Harmonic mean	2,39	2,42	2,21
average	2,77	2,67	2,57

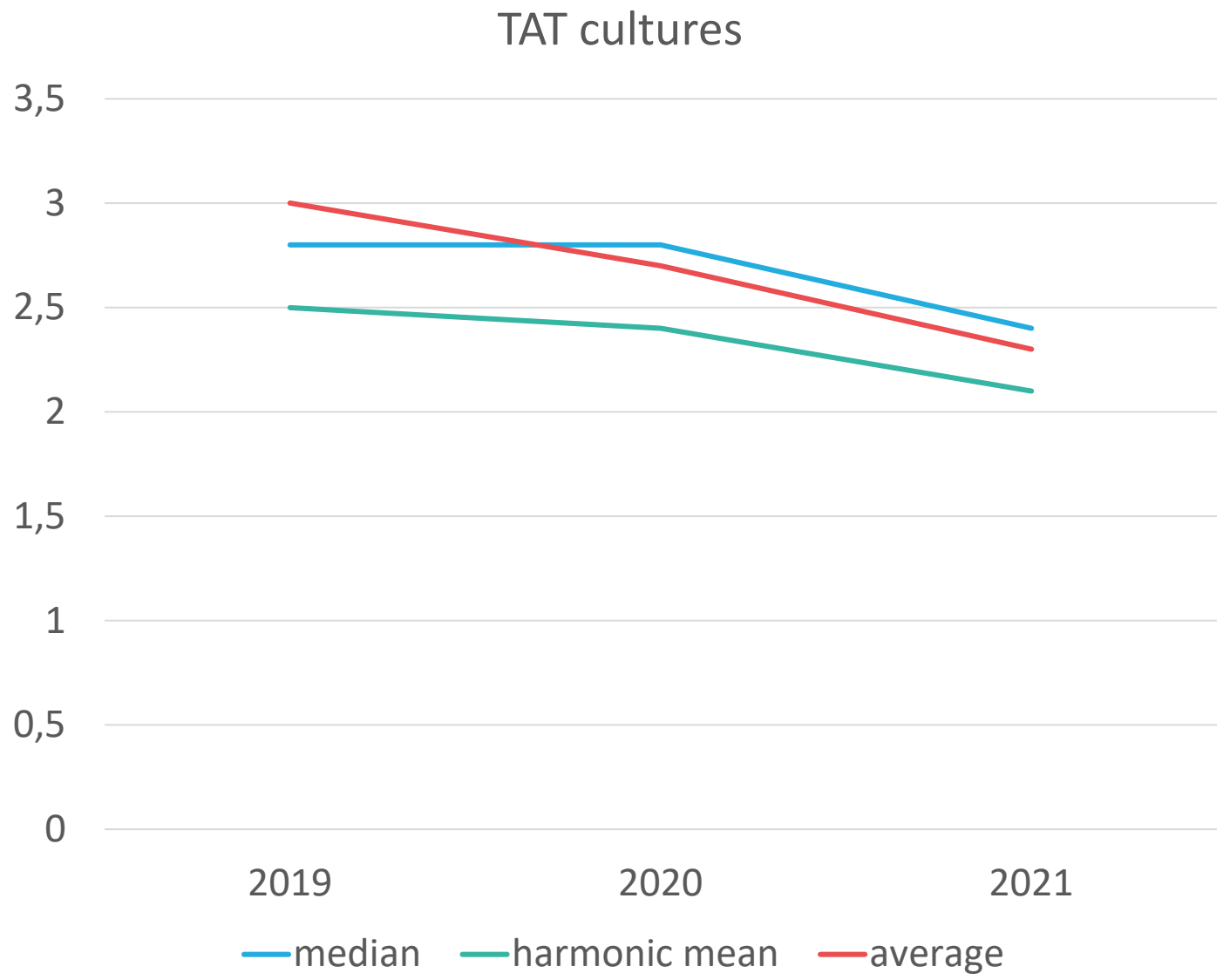
It shows an overall decrease in the reporting even if it's not statistically significant , **p value 0.06 (significant <= 0.05)**

TAT from the arrival in the lab to the final report (availble for the clinicians) expressed in days

TAT pre &post WASPLAB (cultures)

Comparing TAT in 2019, 2020, and 2021 (BAL/BAS and fluid specimens from sterile sites)

TAT from thearrival in the lab to the final report (availble for the clinicians)



3 means 72h
2,3 means 55h 20min that is about 17h just the incubation time of an AST performed by MICRODILUTION BROTH METHOD

Or if you prefer

	2019	2020	2021
median	2,8	2,8	2,4
harmonic mean	2,5	2,4	2,1
average	3	2,7	2,3

It shows an overall decrease in the reporting even if it's not statistically significant , **p value 0.057**

TAT from the arrival in the lab to the final report (availble for the clinicians) expressed in days

Automation in the night shift

the reporting Time (TAT) significantly decrease when we can «assure» also in the night shift the complete BC processing

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Just a real life example:

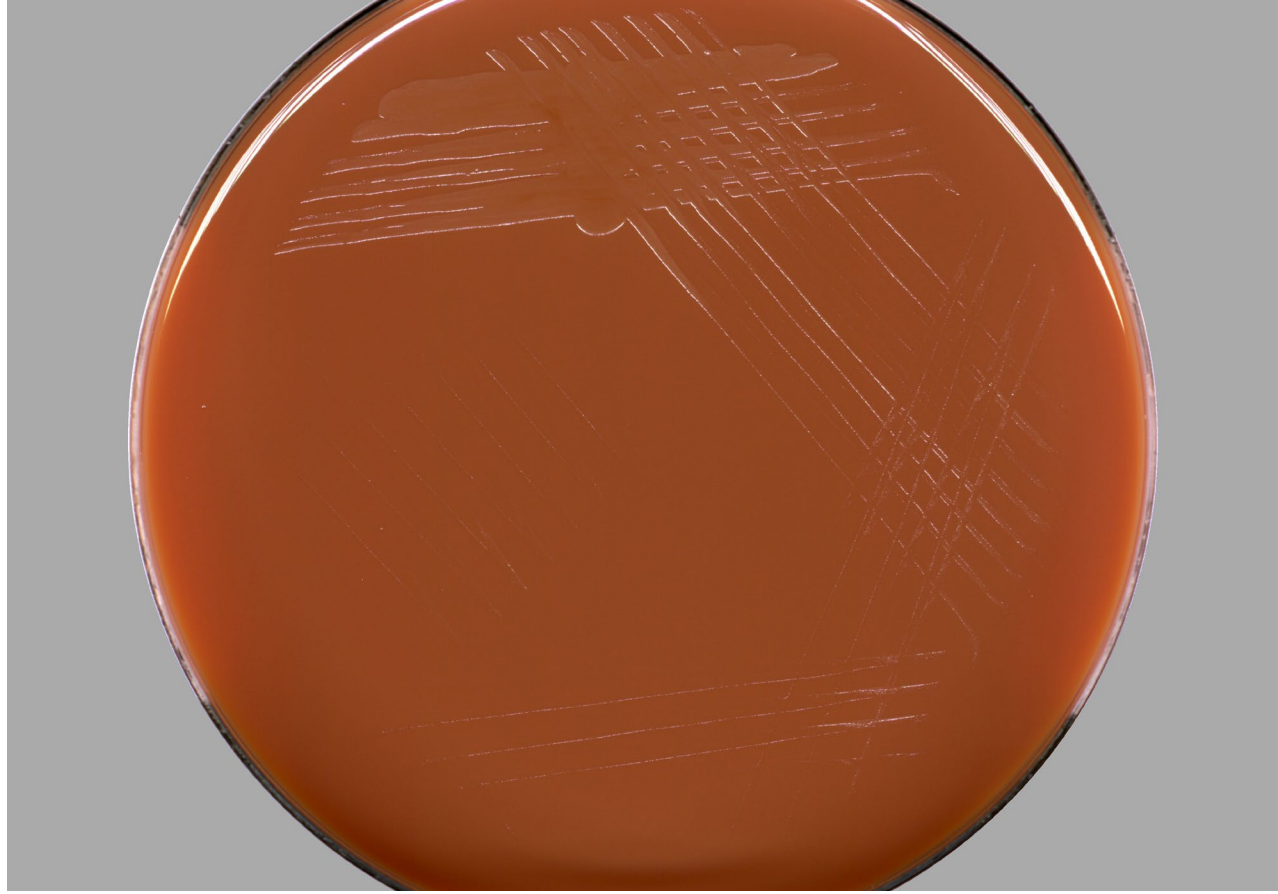
- BC Check in 13/09/21 at 6:55 pm;
- BC turns positive on 14/09/2021 at 3:57 am (night shift)

Automation in the night shift

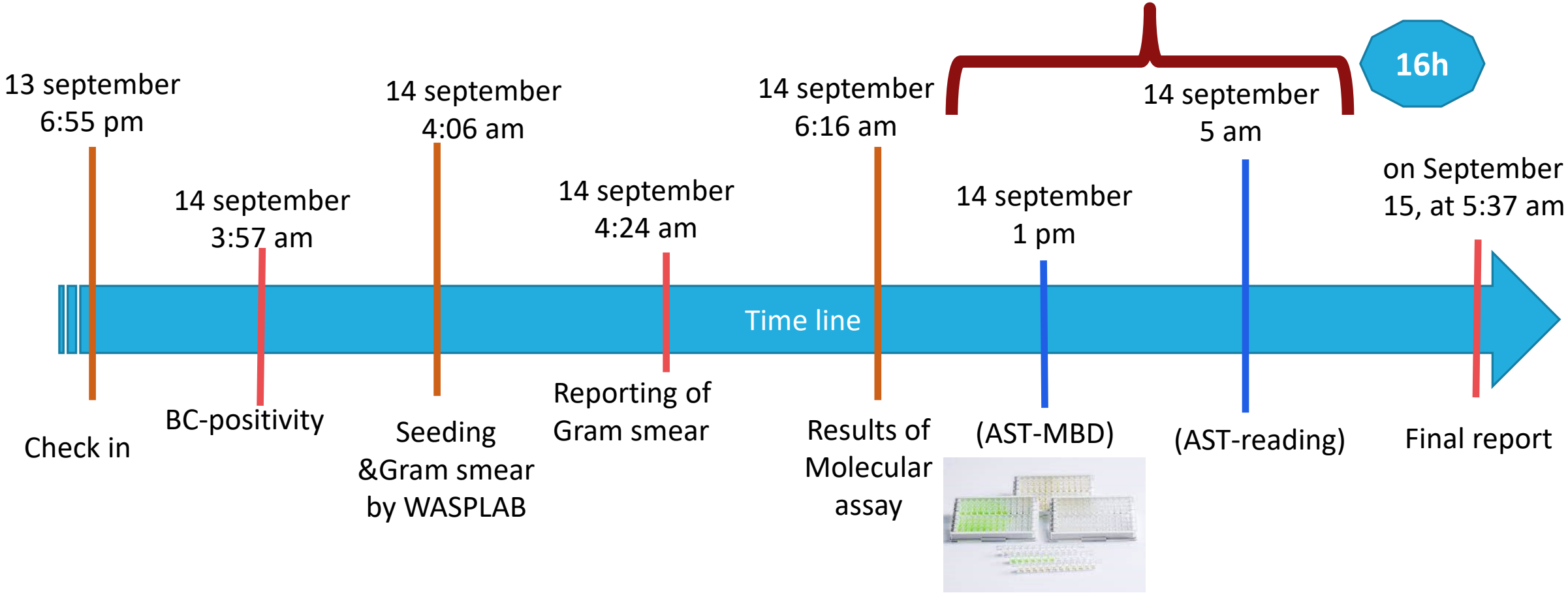
- BC was processed in WASPLAB, at 04:06:13
- gram-smear was prepared and it was ready to be coloured 4:06:23
- Result of Gram smear was reported to clinician 4:24 am

- At 6:16 was reported the result of molecular assay, **which was positive for *P.aeruginosa***
- **First** reading (on WASPLAB planet) at 9:14 (re-send in the incubator because of insufficient growth of microrganism)
- **Second** reading at 1 pm, when it was programmed an AST-work up on WASP LAB
- Final report on September 15, at 5:37 am

REQUIRES 1H AND 15 MIN



First reading (after 4 h of incubation)

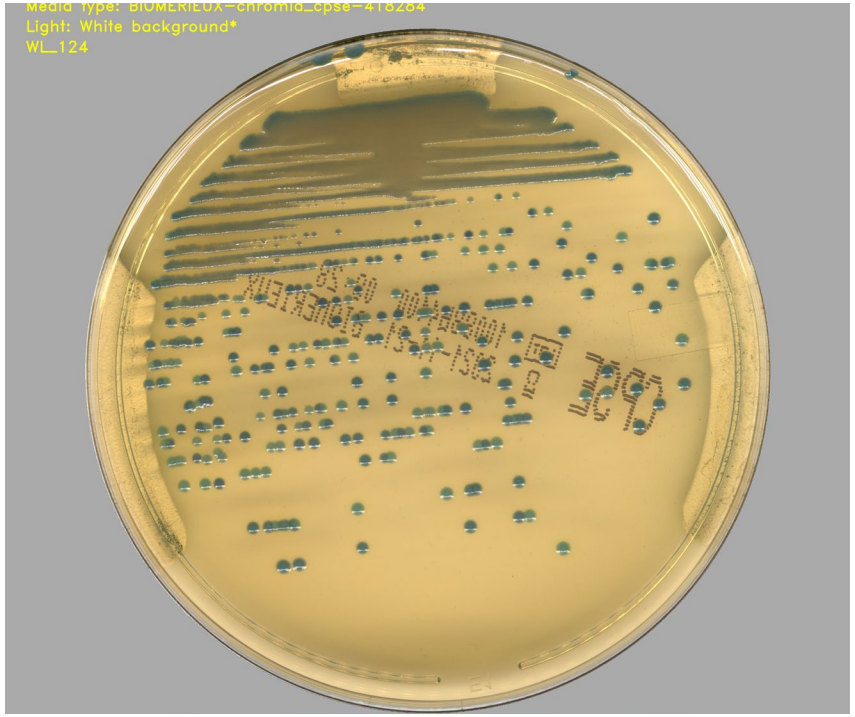


Full reporting pathway about 49 h

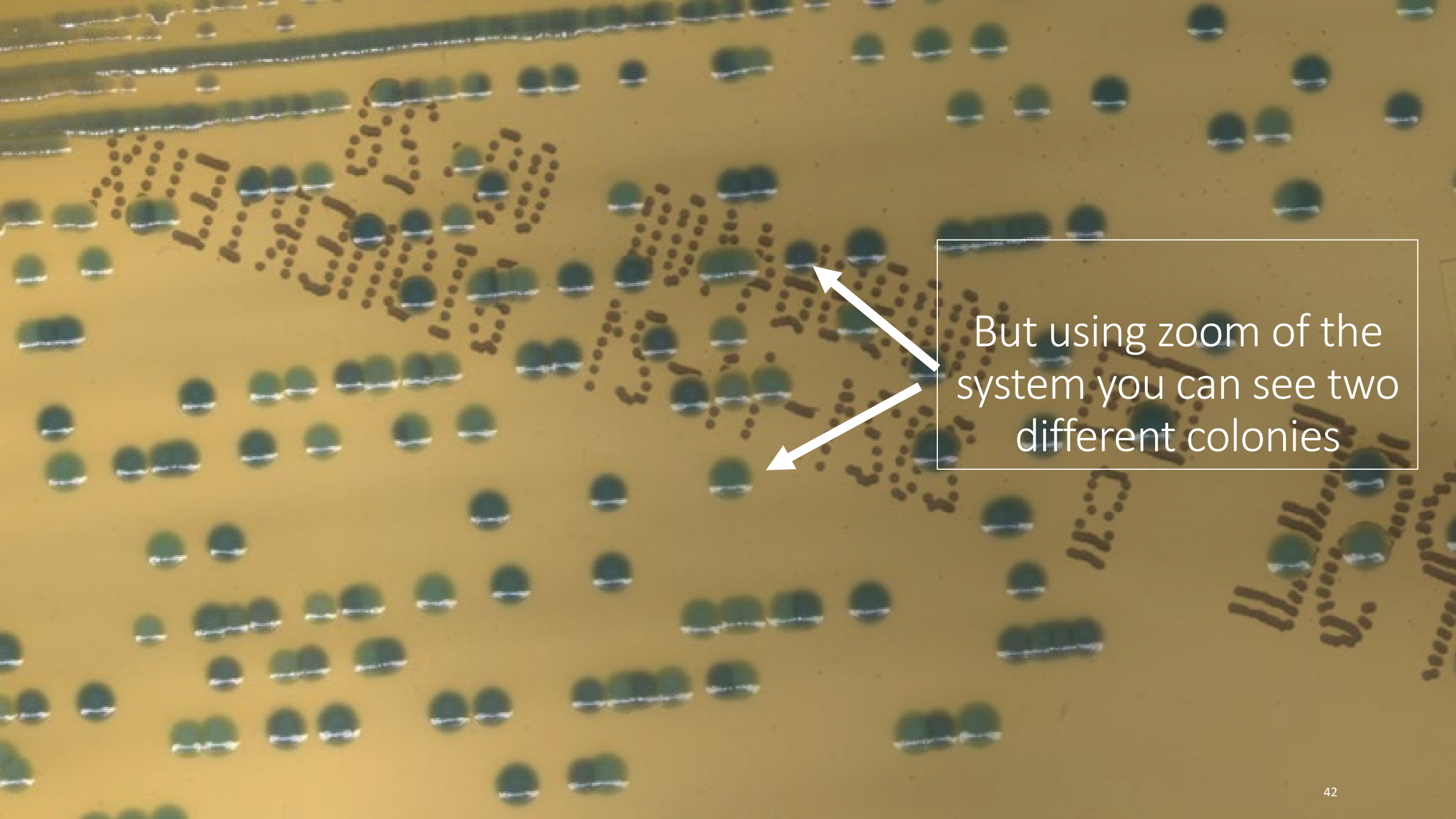
Reporting pathway from positivity of BC to EPLEX (ID and some molecular marker of resistance) results 2h 43min

And finally: Imaging – enhanced reality

Using imaging of WASPLAB, microbiologists **see what they cannot see before with eyes:**



It seems a pure culture of enterobacterales on Chrom orientation agar


But using zoom of the system you can see two different colonies

In conclusion

- Automation in microbiology lab is a **plus** for the microbiologist
- Automation **has** an important **impact** in **time of reporting** (thus, a benefit for the patient)
- We are now preparing PHENOMATRIX program depicting our shortcuts,
- on this regards I leave the virtual floor to my collegue Dr Simone Ambretti

Thank for your attention….

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or by linkedin