Automation
and IT

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Table

1. Why automation is needed ?

Why ?

- Reduced financial and human resources
- Increased activity

⇨ solution is automation

Additional benefits:

- increased quality

Mulatero et al Clin Microbiol Infect 2011, Matthews et al Clin Microbiol Infect 2011

1. What is Automation ?

Automation

Automation ≠ **Mecanisation**

⇩ ⇩

new method **robot replacing humans**

- **added value of the new process (patent)**
- **need validation and adaptation**

- **easier to implement**

1. What is IT ?

IT = information technology

- need of IT coupled to automation (to avoid semi-automation)

- IT needed to control automation
  - control = making something perform a task
  - automation without control: always same task is repeated

Table

1. Automation and IT
2. Automation in molecular biology : the easy part
3. Automation in bacteriology :
   - inoculation systems
   - automated colony picking
   - smart incubators
4. Conclusions

Molecular biology

- **Hamilton robot coupled to 96-wells Magnapure**
  = high throughput DNA extraction

- **Tecan robot + 384-wells real-time PCR**
  = high throughput PCR

⇨ **- increased reproducibility**
- less PCR contamination

Local experience in Lausanne:

Invalid runs : 264/3037

Apparent lack of sensitivity

	n	%
- stability of positive control	44	1.45
- master mix	56	1.84
- primer/probe	15	0.51
- procedural	56	1.84
- liquid handling system	70	1.30
Contaminations	21	0.69

Sahli R et al, ESCMID abstract

micro-automatisation: POCTs

Nespresso coffee machine

GeneXpert

⇩

micro-automation

Conclusions

1. Easy since

- **liquid based**
- **work in batch or with identical processes**

2. Improve

- **reproducibility**
- **throughput (number of tests/hour)**
- **quality (↘ contamination rate)**

but: need "home-made" test for flexibility

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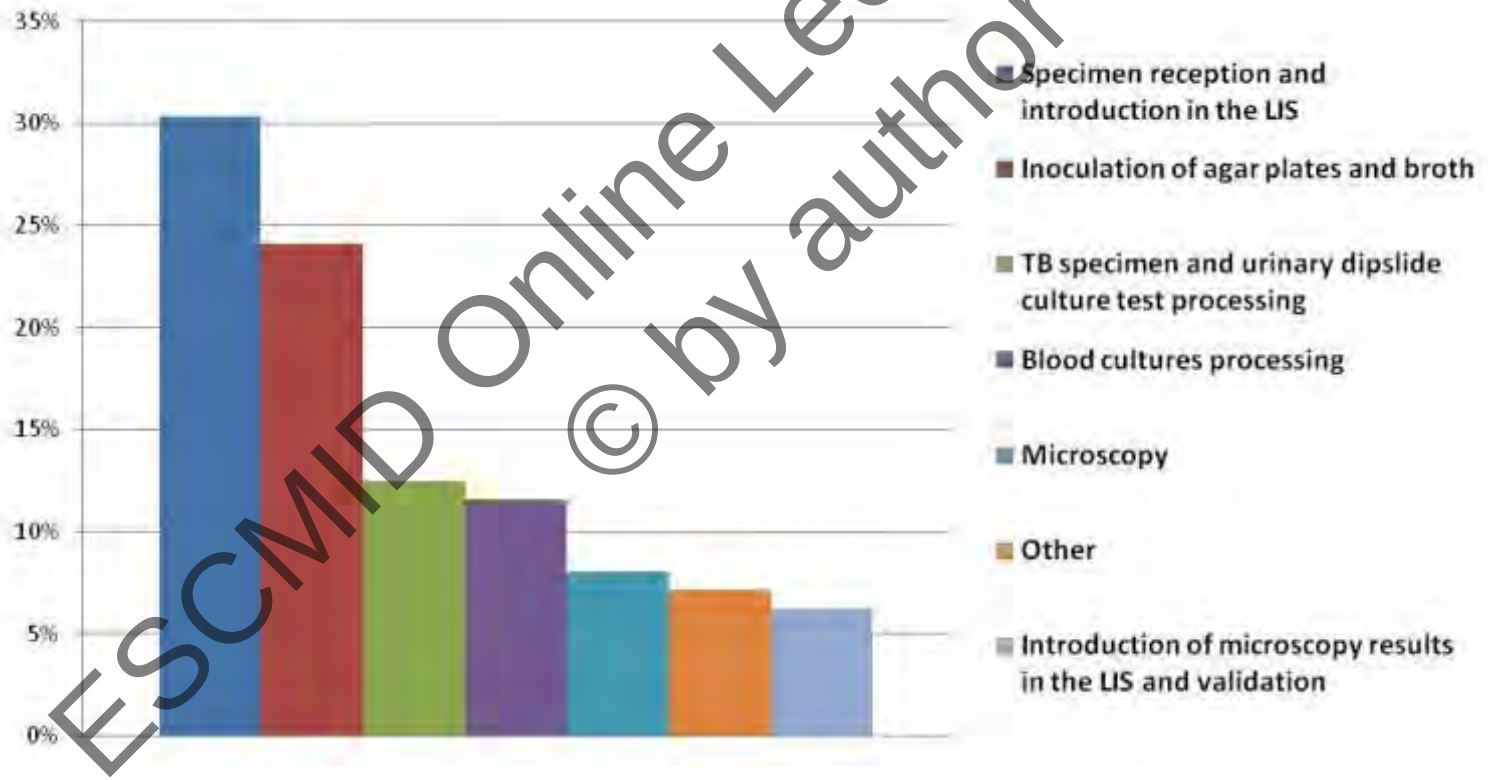
Inoculation steps

- avoid sample inoculation, which is a fastidious/ repetitive process
- represents 24% of preanalytical tasks in our lab



G. Greub & G. Prod'hom, Clin Microbiol Infect 2011; 17:655.

It is time for automation

1. Improved laboratory information systems (LIS)
2. Increased use of bar code to trace samples/ broth/ agar plates
3. Inoculab (Dynacan) already available since > 20 years

   <u>but</u>
   - low capacity (38 plates)
   - uni/bidirectional with LIS

   = 1st/2nd generations

Bourbeau et al. J Clin Microbiol 2009; Greub & Prodhom. Clin Microbiol Infect 2011

3. Automation in bacteriology

WASP (Copan)
PREVI Isola (BioMérieux)
Innova (Becton-Dickinson)
InoqulA (Kiestra)

= third generation

Allow high throughput accurate inoculation, including the following 4 steps :

1. **selecting the appropriate Petri dish**
2. **inoculating the sample efficiently**
3. **spreading the inoculum**
4. **labeling and sorting each inoculated plate**

What inoculation system to choose ?

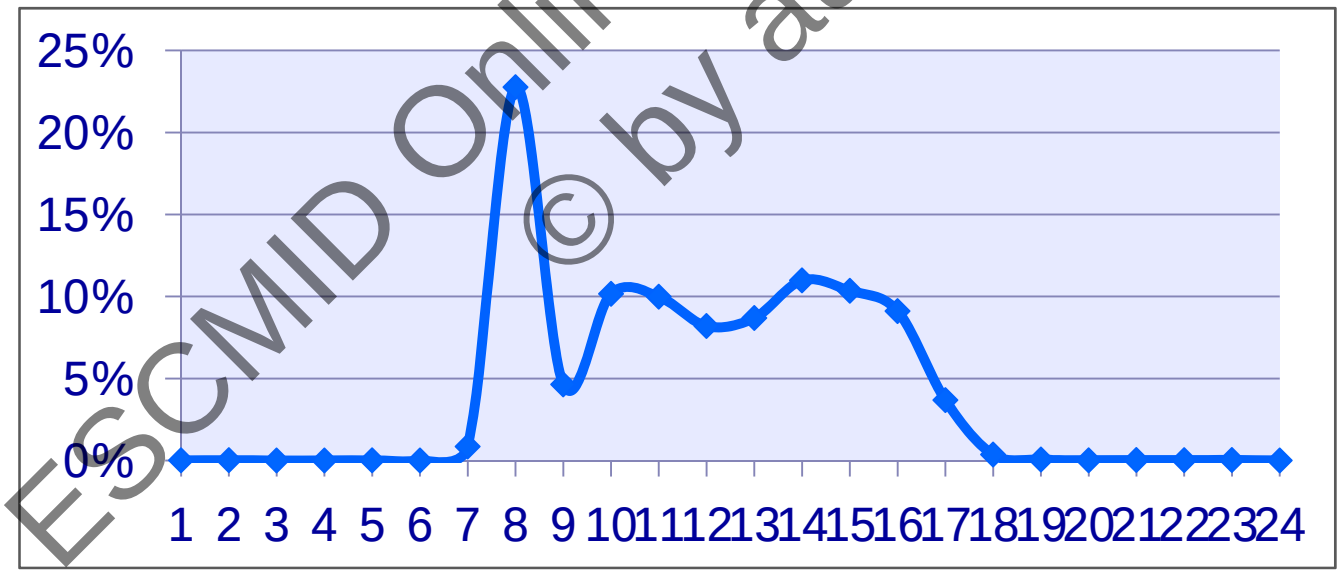
Characteristics of the instruments

- size/ weight/ noise/ …
- productivity (nb of agar/hour, …)
- inoculation
  - custom/ single streak/ circular
  - dispensable devices (captive or not)
  - type of device (bead/ calibrated loop/…)
- samples (various containers)
- capacity (loading/ sorting)
- maintenance/ costs/ …
- options: smears/ chain of automation

What inoculation system to choose ?

Characteristics of the lab

- **Number of samples processed**
  1000 plates/day
  - **over 24 h = 42 plates/h**
  - **over 9 h = 111 plates/h**



Greub & Prodhom. Clin Microbiol Infect 2011

What inoculation system to choose ?

Characteristics of the lab

- variety of inoculated media
- type of samples received
  - swabs 34%
  - liquid specimen 51%
  - stools 10%
  - tissue specimen 5%

Greub & Prodhom. Clin Microbiol Infect 2011

What inoculation system to choose ?

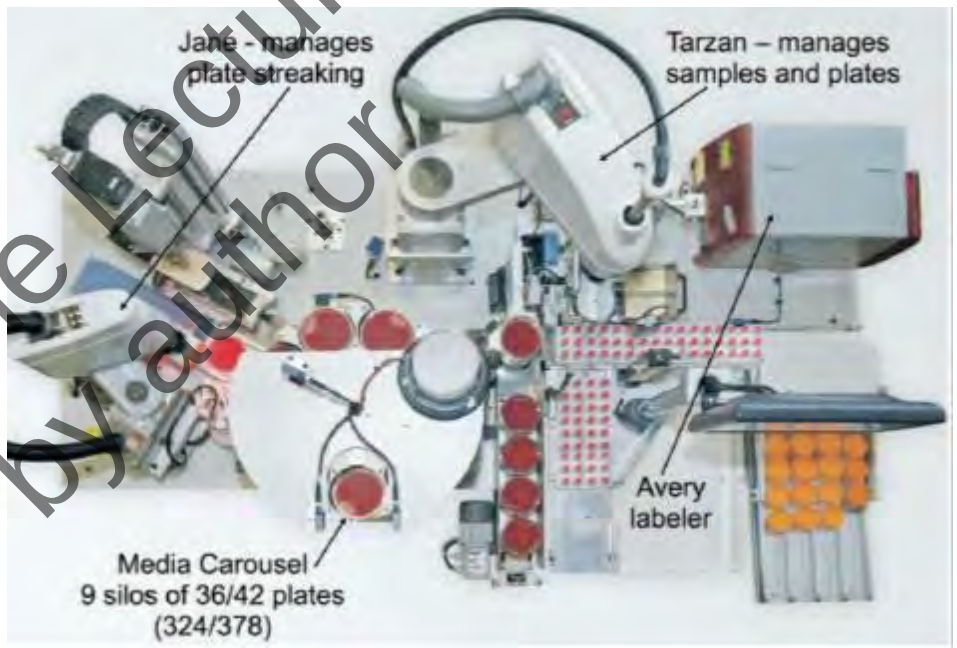
Characteristics of the lab

- variety of inoculated media
- type of samples received
- LIS
- budget
- space

3. Automation in bacteriology

What inoculation system to choose ?

The WASP



Bourbeau et al. J Clin Microbiol 2009

What inoculation system to choose ?

The WASP

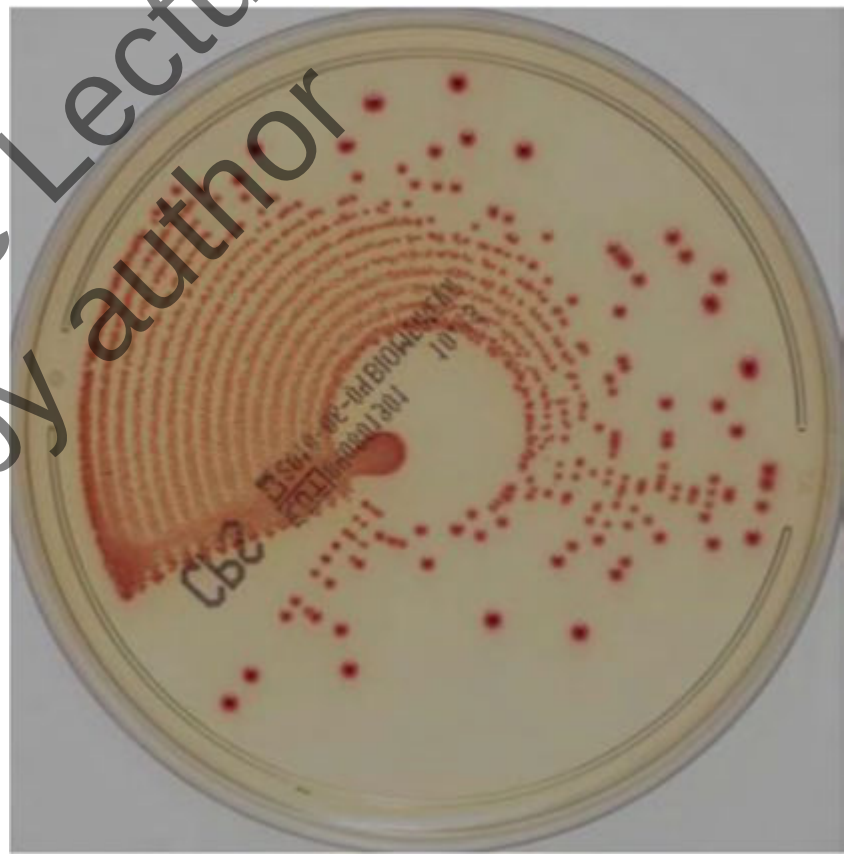
- **calibrated loop/re-usable**
- **mechanization → <u>any pattern</u>**
- **nine silos (≅ 350 agar plates)**
- **agitation/ centrifugation**
- **smear module**
- **biosecurity**
- **chain of automation**

Bourbeau et al. J Clin Microbiol 2009; Greub & Prodhom. Clin Microbiol Infect 2011

What inoculation system to choose ?

The Previ-Isola

- Disposable comb
- Circular pattern
- Manual decapping
- Five input silos



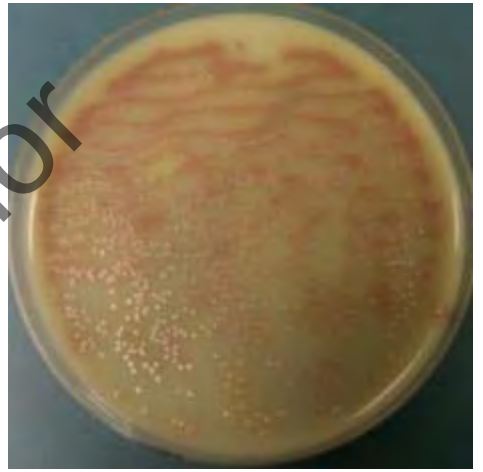
Mulatero et al. Clin Microbiol Infect 2011; Greub & Prodhom. Clin Microbiol Infect 2011

What inoculation system to choose ?

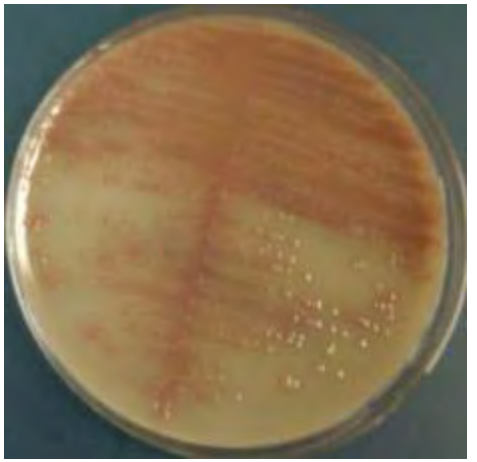
The Inoqula-FLA (Kiestra)

- Beads
- Any pattern
- 400 cm long spreading

- 400 plates/h
- Closed dish inoculation
- Six buffers (720 plates)



1 µl



10 µl

Matthews & Deutekom. Clin Microbiol Infect 2011
Greub & Prodhom. Clin Microbiol Infect 2011

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Smart incubators

Need to have a picture of the agar plate:

- **search the plate**
- **take a picture**
- **analyze the picture: growth? significant?**
- **sort the plate for downstream procedure or re-incubate**

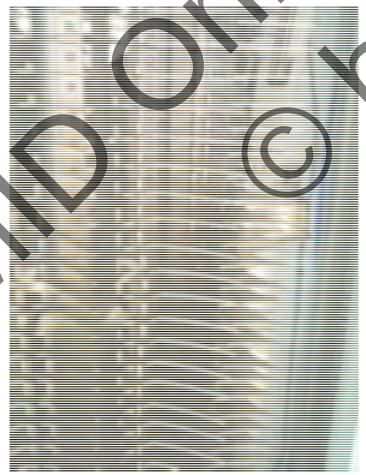
3. Automation in bacteriology

Smart incubators

Search the plate and take a picture





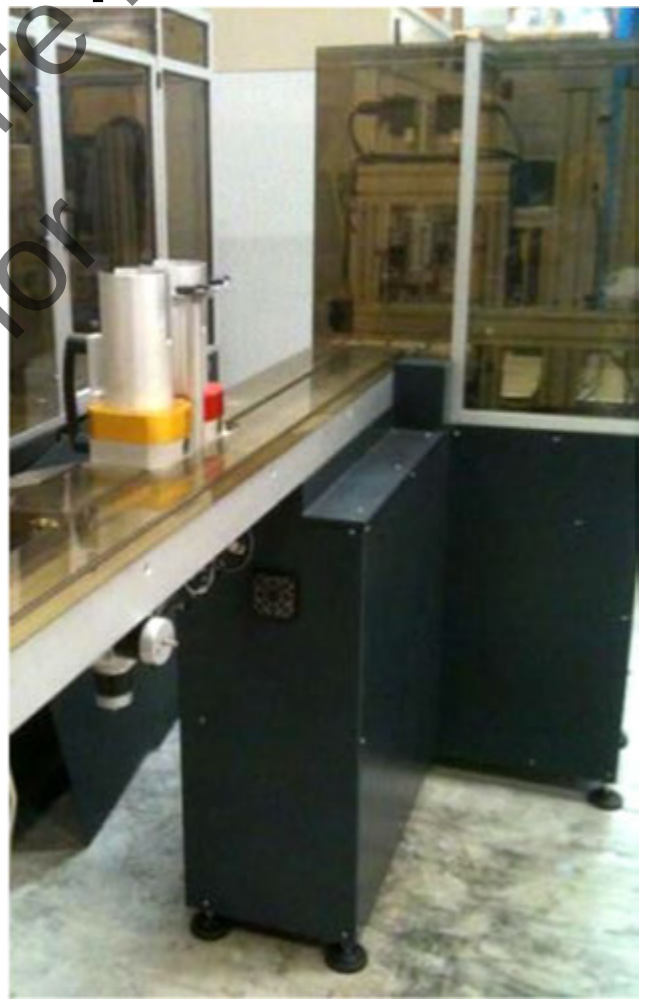



Pictures done by G. Greub at Copan (Brescia, Italia) except picture of agar, provided by I. Acerbi (Copan)

3. Automation in bacteriology

Smart incubators

Analyze the picture and sort the plate for downstream procedures



Pictures provided by I. Acerbi (Copan)

Picture by G Greub done at Copan

Smart incubators

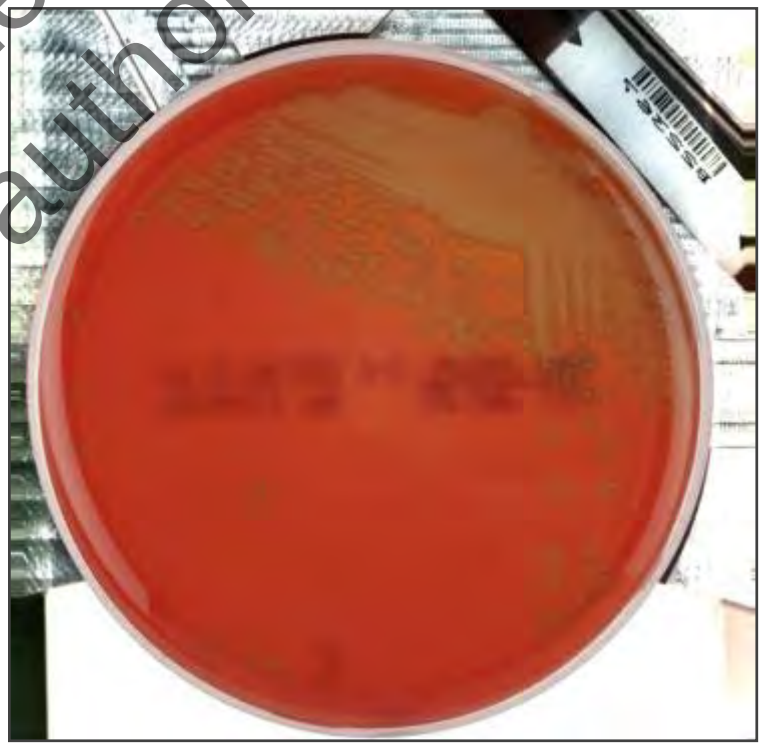
Advantages:

- less work load; only positive plates are read
- increased traceability
- increased definition with pictures
- pictures available (rare cases, teaching, …)
- plates remain incubated … (except during pictures)
- temperature in the incubator better controlled: no open door

Automated colony picking

- interface with mass spectrometry and other downstream applications
- need to orientate the microplate (looking glass)

  to locate the colony



Picture by Greub (left) & provided by I. Acerbi (Copan, right)

Automated colony picking

Advantages:

- less work load
- increased traceability
- decreased error risks
- especially appropriate for MALDI-TOF analysis (96 wells microplate)

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Automation in bacteriology

- automated system for identification +/- antibiotic susceptibility testing (Vitek, Phoenix, …)
- automated detection of growth (blood culture, mycobacteria)

Automated inoculation (3rd generation)
Smart incubators
Automated colony picking

Integrated thank to compatibility with LIS

4. Conclusions

Automation in bacteriology

- Importance of IT
  - microbiologists trained in IT
  - LIS + hospital information system
- Importance of liquid samples
- Importance of compatibility

“we may hope that companies will see the importance of maintaining a high level of compatibility with other systems”

G. Greub & G. Prod'hom, Clin Microbiol Infect 2011; 17:655.

4. Conclusions

Automation in bacteriology

- **Improved quality:**
  - **reproductibility**
  - **rate of isolated colonies**
  - **reduced time to results**
  - **less contamination**
- **Decreased workload**
  - **reduced costs ?**
  - **increased interest for work ?**
- **Risk for small laboratories**

Thank you

Bacteriology

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