Recent developments in EUCAST

Christian G. Giske, MD/PhD
Chair of EUCAST
Karolinska Institute and
Karolinska University Hospital
ECCMID, 22 April 2017
EUCAST SC 2017

- Christian G. Giske, chair
- John Turnidge, scientific secretary
- Rafael Canton, clinical data coordinator
- Gunnar Kahlmeter, technical data coordinator/webmaster
- Sören Gatermann, Germany
- Christoffer Lindemann, Norway
- Johan Mouton, The Netherlands
- Alasdair MacGowan, UK
- Gerard Lina, France
- Arjana Tambic, Croatia
- Deniz Gur, Turkey
- Additionally: visiting members from NACs (max one per meeting)
EUCAST Subcommittees

• STANDING
  – Antifungal susceptibility testing
  – Veterinary susceptibility testing
• AD HOC
  – Intrinsic Resistance and Expert Rules
  – MIC distributions and ECOFFs
  – Polymyxins breakpoints and methods (joint with CLSI)
  – Antimycobacterial Susceptibility testing
  – Detection of resistance mechanisms
  – Relationship between WGS (NGS) and phenotypic susceptibility testing
• INACTIVE
  – Anaerobes
Implementation of EUCAST disk diffusion, April 2016

% Laboratories
- >50%
- 10-50%
- <10%
- No information

Countries not on this map: Australia, Brazil, Canada, Iceland, Israel, Morocco, New Zealand, South Africa, USA
Implementation of EUCAST disk diffusion, April 2017

% Laboratories
- >50%
- 10-50%
- <10%
- No information

Other countries: Australia, Brazil, China, Canada, Iceland, Israel, Morocco, New Zealand, South Africa, USA
Unique Pageviews for eucast.org – 2014 - 2016

Unique Pageviews

- 70,000
- 60,000
- 50,000
- 40,000
- 30,000
- 20,000
- 10,000
- 0

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2014 2015 2016
Pageviews for mic.eucast.org

Unique Pageviews for mic.eucast.org – 2014 - 2016

Unique Pageviews

© by author
Trends on Pubmed for “EUCAST”

Annual count on Pubmed

Number of hits

Year

Recent consultations

1. Redefining the INTERMEDIATE category (consultation 1 concluded; second consultation in preparation).

2. Colistin breakpoint for *Pseudomonas aeruginosa*
   – Joint CLSI/EUCAST subcommittee suggests to lower it from 4/4 to 2/2 mg/L to agree with new PK/PD data

3. Fluoroquinolone breakpoints reviewed and several revised – implemented in breakpoint table v7.0

4. 1\textsuperscript{st} report from The subcommittee on the relationship between WGS and phenotypic AST
EUCAST review/revise process

• Completed 2016
  – Fluoroquinolones
  – Colistin (together with CLSI)
  – Nitrofurazone

• Ongoing 2017
  – Temocillin (pending regulatory decisions)
  – Carbapenems (close to finalized)
  – Aminoglycosides
  – Tigecycline
The European Committee on Antimicrobial Susceptibility Testing – EUCAST

National Antimicrobial Susceptibility Testing Committees (NACs)

EUCAST recommends that countries institute a “National Antimicrobial Susceptibility Testing Committee” (or a committee corresponding to this description). Countries in the process of adopting EUCAST antimicrobial susceptibility testing guidelines will find this particularly useful during the implementation process. The chairperson, or another committee officer, should represent the country on the EUCAST General Committee.

This document presents EUCAST suggestions on

How to organise and form a NAC.

NACs are invited to provide a link to their website for EUCAST to post here.

List of and brief information on National breakpoint committees and NACs:

Australia
The EUCAST NAC SOP

- **Structure:**
  - independent committee or a subcommittee of a group with a wider antimicrobial remit

- **Membership:**
  - experts and stakeholders in antimicrobial susceptibility testing:
    - Individual experts
    - Representatives of professional organisations/societies
    - Representatives of government
    - Representatives of antibiotic use, resistance surveillance committees
    - Representatives of quality assurance agencies
NAC objectives

• To formulate strategy at a national level
  – Action through government, professional organisations or societies
  – Inclusive decision to follow EUCAST breakpoints

• To implement breakpoints and methods
  – Identify stakeholders and provide information
  – Communicate with device manufacturers to ensure no practical limitations
  – Communicate with laboratory staff to ensure that all are informed
  – Communicate with clinicians on consequences of breakpoint changes
  – Communicate with government to ensure that they are on board
  – Communicate with professional organisations/societies
    – Communicate with quality assurance agencies to ensure that they use

• EUCAST breakpoints
  – Provide guidance and support to clinical laboratories.
  – Provide practical guidelines for introducing methods
  – Provide breakpoint tables, method descriptions
National exceptions do occur, but should be few NACs should present the rationale for the decision for publication on the EUCAST website
NACs can influence the EUCAST process

- By direct participation in the Steering Committee
- By communicating with the Steering Committee and influencing the agenda
- By responding to consultations
- By fostering colleagues in AST issues and thus influencing the future recruitment to the EUCAST Steering Committee
Overview of NACs, April 2016

- **Yes**
- **In the process of forming a NAC**
- **No**
- **No information**

**Countries not on this map:**
- Australia
- Brazil
- Canada
- Iceland
- Israel
- Morocco
- New Zealand
- South Africa
- USA
Overview of NACs, April 2017

- Yes
- In the process of forming a NAC
- No
- No information

Other countries: Australia, Brazil, China, Canada, Iceland, Israel, Morocco, New Zealand, South Africa, USA
NACs outside Europe

Countries with a NAC operating under EUCAST standards

Countries with interest to establish a NAC under EUCAST standards
# Breakpoint table v7.0

## European Committee on Antimicrobial Susceptibility Testing

Breakpoint tables for interpretation of MICs and zone diameters

**Version 7.0, valid from 2017-01-01**


<table>
<thead>
<tr>
<th>Content</th>
<th>Page</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Changes</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas spp.</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td><em>Stenotrophomonas maltophilia</em></td>
<td>15</td>
<td>Link to Guidance Document on <em>Stenotrophomonas maltophilia</em></td>
</tr>
<tr>
<td>Burkholderia cepacia</td>
<td>13</td>
<td>Link to Guidance Document on <em>Burkholderia cepacia</em> group</td>
</tr>
<tr>
<td>Azeliotuberculosis spp.</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus</em> spp.</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Enterococcus spp.</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Streptococci groups A, B, C and G</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Viridans group streptococci</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td><em>Nesseria gonorrhoeae</em></td>
<td>55</td>
<td></td>
</tr>
<tr>
<td><em>Nesseria meningitidis</em></td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Gram-positive anaerobes</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td><em>Clostridium difficile</em></td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>Gram-negative anaerobes</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Helicobacter pylori</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Pasteurella multocida</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Campylobacter jejuni and coli</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Campylobacter spp.</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Aerococci, streptococci and viridans group streptococci</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td><em>Klebsiella</em></td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Micrococcus tuberculosis</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Topical agents</td>
<td>85</td>
<td>Link to Guidance Document on Topical Agents</td>
</tr>
<tr>
<td>AST-D (Nongroup species related) breakpoints</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Doses</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Expert Rules</td>
<td>-</td>
<td>Link to EUCAST Expert Rules</td>
</tr>
<tr>
<td>Detection of Resistance Mechanisms</td>
<td>-</td>
<td>Link to EUCAST Guidelines on Detection of Resistance Mechanisms</td>
</tr>
<tr>
<td>Antimicrobial susceptibility tests on groups of organisms or agents for which there are no EUCAST breakpoints</td>
<td>1</td>
<td>Link to Guidance Document on how to test and interpret results when there are no breakpoints</td>
</tr>
</tbody>
</table>
# Examples of changes

**Enterobacteriaceae**

- **General**
  - Pictures with reading examples for the tetracycline disk diffusion test added

- **New breakpoints**
  - Temozolomide (information added, see note)
  - Cefuroxime-avibactam (MIC and zone diameter)
  - Ceftriaxone iv and oral (zone diameter)
  - Nitrofurantoin (MIC and zone diameter)

- **Revised breakpoints**
  - Cefepime (zone diameter)
  - Ceftriaxone (zone diameter)
  - Cefuroxime iv and oral (zone diameter)
  - Aztreonam (zone diameter)
  - Ciprofloxacin (MIC and zone diameter)
  - Levofloxacin (MIC and zone diameter)
  - Meropenem (MIC and zone diameter)
  - Norfloxacin (valid for uncomplicated UTI only)
  - Ofloxacin (MIC and zone diameter)
  - Trimethoprim-sulfamethoxazole (zone diameter)

- **New comments**
  - Penicillins comments 5 and 6
  - Cephalosporins comment 3
  - Miscellaneous agents comment 1
  - Miscellaneous agents comments B, C and D

- **Revised comments**
  - Miscellaneous agents comment 2

**Pseudomonas spp.**

- **New breakpoints**
  - Cefazolin-avibactam (MIC and zone diameter for *P. aeruginosa*)

- **Revised breakpoints**
  - Ciprofloxacin (MIC and zone diameter)
  - Levofloxacin (MIC and zone diameter)
  - Colistin (MIC)

- **New comments**
  - Cephalosporins comment 3
  - Fluoroquinolones comments 1-2
  - Miscellaneous agents comment 1

- **Revised comments**

**Acinetobacter baumannii**

- **New breakpoints**
  - Cefazolin-avibactam (MIC and zone diameter for *A. baumannii*)

- **Revised breakpoints**
  - Ciprofloxacin (MIC and zone diameter)
  - Levofloxacin (MIC and zone diameter)
  - Colistin (MIC)

- **New comments**
  - Cephalosporins comment 3
  - Fluoroquinolones comments 1-2
  - Miscellaneous agents comment 1

- **Revised comments**

© by author
Examples of inhibition zones for *Escherichia coli* with fosfomycin.

a-c) Ignore all colonies and read the outer zone edge.

d) Record as no inhibition zone.

Examples of inhibition zones for *Stenotrophomonas maltophilia* with trimethoprim-sulfamethoxazole.

a-c) An outer zone can be seen. Report susceptible if the zone diameter ≥ 16 mm.

d) Growth up to the disk and no sign of inhibition zone. Report resistant.
Changes in cefoxitin breakpoint for staphylococci

Breakpoint table 7.1 released later

Staphylococcus spp. - Cefoxitin screen for S. epidermidis (zone diameter) revised

Staphylococcus spp. - Cefoxitin screen for S. pseudintermedius replaced with oxacillin (DD)

Topical agents - Mupirocin ECOFF changed from 1/1 to 1 mg/L (typo)

Dosages - Amoxicillin-clavulanic acid standard and high dose revised

Dosages - Ceftazidime-avibactam high dose removed (typo)
# Breakpoints for Aerococcus

**Aerococcus sanguinicola and urinae**

**EUCAST Clinical Breakpoint Tables v. 7.0, valid from 2017-01-01**

<table>
<thead>
<tr>
<th>Penicillins</th>
<th>MIC breakpoint (mg/L)</th>
<th>Disk content (µg)</th>
<th>Zone diameter breakpoint (mm)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzylpenicillin</td>
<td>S ≤ 0.125, R &gt; 0.25</td>
<td>1 unit</td>
<td>26</td>
<td>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>0.25</td>
<td>2</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Note¹</td>
<td>Note¹</td>
<td>Note²</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carbapenems</th>
<th>MIC breakpoint (mg/L)</th>
<th>Disk content (µg)</th>
<th>Zone diameter breakpoint (mm)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
<td>S ≤ 0.25, R &gt; 0.25</td>
<td>10</td>
<td>37</td>
<td>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fluoroquinolones</th>
<th>MIC breakpoint (mg/L)</th>
<th>Disk content (µg)</th>
<th>Zone diameter breakpoint (mm)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin (uncomplicated UTI only)</td>
<td>S ≤ 2, R &gt; 5</td>
<td>21“</td>
<td>21“</td>
<td>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</td>
</tr>
<tr>
<td>Levofloxacin (uncomplicated UTI only)</td>
<td>S ≤ 2, R &gt; 5</td>
<td>Note³</td>
<td>Note³</td>
<td></td>
</tr>
<tr>
<td>Norfloxacin (glomer)</td>
<td>NA</td>
<td>17“</td>
<td>17“</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glycopeptides</th>
<th>MIC breakpoint (mg/L)</th>
<th>Disk content (µg)</th>
<th>Zone diameter breakpoint (mm)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>S ≤ 1, R &gt; 5</td>
<td>95</td>
<td>13</td>
<td>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</td>
</tr>
</tbody>
</table>
AST - when there is no breakpoint?

EUCAST SOP 2016

• The breakpoint is “IE”
• The breakpoint is “—”
• The agent is not in the table
• The species is not in the table
When there are no breakpoints...

• Do not report “S”, “I” or “R”
  – These are susceptibility categories based on evidence for or against favorable clinical outcome.

• Report an MIC with a comment or only a comment
  – MIC is below or above the PK/PD breakpoint if available;
  – Compare MIC with breakpoints of a closely related organism if possible.
Disk diffusion instruction videos
EUCAST project – 10 videos (5 finalized) financed by WHO
Subtitles in “other” languages
YouTube, WHO webpage, EUCAST webpage
Warnings on EUCAST website

EUCAST warnings concerning antimicrobial susceptibility testing products or procedures.

The EUCAST disk diffusion development laboratories, a network of laboratories coordinated from the EUCAST development laboratory in Växjö, Sweden, from time to time discover products (disks, media batches, gradient tests or procedures) which are not performing to the expected standard. When this is the case we inform the manufacturer and publish a warning on this page.

We do not systematically test all products so the lack of a warning does not imply that there is no problem with the product in question.

Laboratories which experience problems with a susceptibility test method, and suspect that this may be related to a particular product, may contact EUCAST for advice.

1. Problems with piperacillin/tazobactam gradient tests from two manufacturers (see below).
2. Wide variation in disk quality in 16 disks from nine manufacturers (see below)
## Colistin AST – work from EDL

<table>
<thead>
<tr>
<th>Organism</th>
<th>E. coli and K. pneumoniae (n=32)</th>
<th>P. aeruginosa (n=21)</th>
<th>Acinetobacter spp. (n=22)</th>
<th>All isolates (n=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colistin MIC range (mg/L)</td>
<td>0.25-32</td>
<td>0.25-128</td>
<td>0.5-32</td>
<td>0.25-128</td>
</tr>
<tr>
<td>SEMPA1⁴</td>
<td>27</td>
<td>19</td>
<td>20</td>
<td>66 (96%)</td>
</tr>
<tr>
<td>MICRONAUT-S</td>
<td>31</td>
<td>21</td>
<td>20</td>
<td>72 (96%)</td>
</tr>
<tr>
<td>MIC-Strip</td>
<td>31</td>
<td>21</td>
<td>22</td>
<td>74 (99%)</td>
</tr>
<tr>
<td>EA³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etest/Oxoid MH</td>
<td>27</td>
<td>13</td>
<td>13</td>
<td>53 (71%)</td>
</tr>
<tr>
<td>Etest/BBL MH</td>
<td>20</td>
<td>11</td>
<td>1</td>
<td>32 (43%)</td>
</tr>
<tr>
<td>Etest/MHE</td>
<td>24</td>
<td>9</td>
<td>2</td>
<td>35 (47%)</td>
</tr>
<tr>
<td>MTS/Oxoid MH</td>
<td>19</td>
<td>12</td>
<td>9</td>
<td>40 (53%)</td>
</tr>
<tr>
<td>MTS/BBL MH</td>
<td>24</td>
<td>10</td>
<td>13</td>
<td>47 (63%)</td>
</tr>
<tr>
<td>ME²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etest/Oxoid MH</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Etest/BBL MH</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Etest/MHE</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>MTS/Oxoid MH</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MTS/BBL MH</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VME³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etest/Oxoid MH</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Etest/BBL MH</td>
<td>1</td>
<td>7</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Etest/MHE</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>MTS/Oxoid MH</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>MTS/BBL MH</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>18</td>
</tr>
</tbody>
</table>

© by author

Matuschek E et al. Poster ECCMID 2017
Review

The role of whole genome sequencing in antimicrobial susceptibility testing of bacteria: report from the EUCAST Subcommittee


Available published evidence does not currently support use of WGS-inferred susceptibility to guide clinical decision making. Such a paradigm shift would require large-scale education and behavioural change among microbiologists and prescribers. Gene (or mutation) absence cannot always reliably predict susceptibility, so robust evidence will be needed to show that the potential of genotypic tests for very major errors does not adversely impact on treatment outcomes. It seems likely that this may first be considered for M. tuberculosis, where the speed of WGS-generated results offers advantage over traditional AST methods. However, even if the evidence can be generated and expectations changed, for most bacteria and in most countries the current cost and speed of inferring antimicrobial susceptibility from WGS data remain prohibitive to wide adoption in routine clinical laboratories. Never-
AFST publications

**RESEARCH NOTE**

**EUCAST technical note on isavuconazole breakpoints for Aspergillus, itraconazole breakpoints for Candida and updates for the antifungal susceptibility testing method documents**

Keywords: Antifungal susceptibility testing, breakpoints, isavuconazole, itraconazole, QC MIC ranges
Original Submission: 21 December 2015; Accepted: 24 January 2016
Editor: E. Rolides
Article published online: 3 February 2016

M. C. Arendrup¹, J. Meletiadis², J. W. Mouton⁴, J. Guinea⁵, M. Cuenca-Estrella⁶, K. Lagrou⁷ and S. J. Howard⁸, for the Subcommittee on Antifungal Susceptibility Testing (AFST) of the ESCMID European Committee for Antimicrobial Susceptibility Testing (EUCAST)

1) Unit of Mycology, Department of Microbiological Surveillance and Research, Statens Serum Institut, Copenhagen, Denmark, 2) Clinical

Presented in part at the seventh Trends in Medical Mycology conference (TMM-7), Lisbon, Portugal, 11 October 2015
Corresponding author: M. C. Arendrup, Unit of Mycology, Department of Microbiology and Infection Control, Statens Serum Institut, Artillerivej 5, DK-2300 Copenhagen, Denmark
E-mail: marc@ssi.dk
Committee members are listed in the Acknowledgements

Clinical Microbiology and Infection 23 (2017) 98–103

Contents lists available at ScienceDirect

Clinical Microbiology and Infection

journal homepage: www.clinicalmicrobiologyandinfection.com

Original article

Spectrophotometric reading of EUCAST antifungal susceptibility testing of *Aspergillus fumigatus*

J. Meletiadis ¹,², *, K. Leth Mortensen ³, ⁴, P.E. Verweij ⁵, ⁶, J.W. Mouton ², M.C. Arendrup ³, ⁴, ⁷
Resistance mechanisms guidelines update

EUCAST guidelines for detection of resistance mechanisms and specific resistances of clinical and/or epidemiological importance

Version 2.0
March 2017

1 Based on version 1.0 from December 2013 by the EUCAST subcommittee for detection of resistance mechanisms and specific resistances of clinical and/or epidemiological importance. Authors of the original version are acknowledged: Christian G. Giske (Sweden; EUCAST and EARS-Net Coordination Group; chairman), Luis Martinez-Martinez (Spain), Rafael Canton (Spain; EUCAST), Stefania Stefani (Italy), Robert Skov (Denmark), Youri Glupczynski (Belgium), Patrice Nordmann (France), Mandy Wootton (UK), Vasil Miriagou (Greece), Gunnar Skov Simonsen (Norway; EARS-Net Coordination Group), Helena Zemlickova (Czech Republic; EARS-Net Coordination Group), James Cohen-Stuart (The Netherlands), and Marek Gniadkowski (Poland).
M. tuberculosis AST

Review

*Mycobacterium tuberculosis* drug-resistance testing: challenges, recent developments and perspectives

T. Schön 1,2,3, P. Miotto 4, C.U. Köser 5, M. Viveiros 3,6, E. Böttger 3,7, E. Cambau 3,8,9,10, 4

1 Department of Clinical Microbiology and Infectious Diseases, Kalmar County Hospital, Kalmar, Sweden
2 Division of Medical Microbiology, Department of Clinical and Experimental Medicine, Linköping University, Sweden
3 European Society for Clinical Microbiology and Infectious Diseases (ESCMID) Study Group for Mycobacterial Infections (ESGMYC), ESCMID, Basel, Switzerland
4 Emerging Bacterial Pathogens Unit, Div. of Immunology, Transplantation and Infectious Diseases, IRCCS San Raffaele Scientific Institute, Milan, Italy
5 Department of Medicine, University of Cambridge, Cambridge, UK
6 Unidade de Microbiologia Médica, Global Health and Tropical Medicine, GHTM, Instituto de Higiene e Medicina Tropical, IHMT, Universidade NOVA de Lisboa, UNL, Lisboa, Portugal
7 Institut für Medizinische Mikrobiologie, Nationales Zentrum für Mykobakterien, Universität Zürich, Zürich, Switzerland
8 National Reference Center for Mycobacteria and Antimycobacterial Resistance, Paris, France
9 APHM, Hôpital Lariboisière, Laboratory of Bacteriology, Paris, France
10 University Paris Diderot, INSERM U1199 UMR1137, Sorbonne Paris Cité, Paris, France
Thanks for your attention!

Photographer: Dr A-M Örmälä-Odegrip