WHO Technical Consultation on External Competence Assessment of Microscopists for Malaria

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Quality assurance of malaria microscopy

Phased implementation of the QA system

Core activities
1. Make a baseline situation analysis of the resources available in the country and gaps in commodities and infrastructure.
2. Identify the QA coordinator and a national core group of microscopists undergoing external competence assessment (ECA) and certified as WHO level 1 or 2.
3. Establish a national steering committee.
4. Ensure policies, guidelines, SOPs and associated commodities and infrastructure.

Second step
5. Competence assessment
6. Training
7. Supervision

Third step
8. Cross-checking
9. Proficiency testing
10. On-site evaluation
11. Accreditation of the diagnostic centre to international standards such as ISO 9001:2008, ISO 15189:2012 or ISO 17025:2005

Structure and function of the quality assurance system

Global Malaria Programme

World Health Organization
Determinants of microscopy performance

Selection

Training

Assessment

Competency

Supervision and cross-checking

Equipment/ reagents

Availability of SOPs

Support network

Logistics

Workplace environment

Performance

<table>
<thead>
<tr>
<th>Year</th>
<th>Malaria microscopy slides examined</th>
<th>Malaria RDT examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>208,206,325</td>
<td>184,256,672</td>
</tr>
<tr>
<td>2017</td>
<td>194,188,741</td>
<td>188,346,273</td>
</tr>
</tbody>
</table>

Source: Data from national malaria programs reported to WHO for World Malaria Report 2018
The ECAMM scheme was initiated in 2005 in the Philippines under the coordination of ACTMalaria and then expanded to multiple countries by WPRO and SEARO.

Initial experiences were reviewed by WHO meetings of experts in 2006 and 2008 to define the assessment model which was implemented in 2009 and used up to today.

It was expanded to countries in the WHO African Region in 2009 in collaboration with Amref Health Africa primarily for Anglophone countries and in 2015 the University of Cheikh Anta Diop de Dakar (UCAD) primarily for Francophone countries. The first workshop was implemented in the WHO Eastern Mediterranean Region in 2016.

Up to January 2019, 218 ECAMM workshops have been held. Since 2015, WHO has run 3 workshops to train 42 ECAMM L1 as potential facilitators, and there are currently 10 facilitators (7 for AFRO and 3 for non-AFRO) and a 18 potential facilitators that are currently being mentored.
### Pre-Assessment = 18 Slides

<table>
<thead>
<tr>
<th>Slide Set</th>
<th>Slide Set</th>
<th>Monday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negatives = 5 Slides</td>
<td>Negatives = 5 slides</td>
<td>5 slides</td>
</tr>
<tr>
<td>Positives = 8 slides</td>
<td>Positive i.e. <em>P. falciparum</em> = 3 slides</td>
<td>3 slides</td>
</tr>
<tr>
<td></td>
<td>Positive i.e Mixed infection = 1 slide</td>
<td>1 slide</td>
</tr>
<tr>
<td></td>
<td>Positive Species specific (<em>Pm, Po, Pv</em>) = 4 slides</td>
<td>4 slides</td>
</tr>
<tr>
<td>Count = 5 slides</td>
<td>Count (200 – 500) = 2 slides</td>
<td>2 slides</td>
</tr>
<tr>
<td></td>
<td>Count (501 – 2,000) = 2 slides</td>
<td>2 slides</td>
</tr>
<tr>
<td></td>
<td>40,000 - 100,000 = 1 slide</td>
<td>1 slide</td>
</tr>
</tbody>
</table>

### Post Assessment = 56 Slides

<table>
<thead>
<tr>
<th>Slide Set</th>
<th>Slide Set</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negatives = 20 Slides</td>
<td>Negatives = 20 slides</td>
<td>7 slides</td>
<td>7 slides</td>
<td>6 slides</td>
</tr>
<tr>
<td>Positives = 22 slides</td>
<td>Positive i.e <em>P. falciparum</em> = 10 slides</td>
<td>3 slides</td>
<td>3 slides</td>
<td>4 slides</td>
</tr>
<tr>
<td></td>
<td>Positive i.e Mixed infection = 4 slides</td>
<td>2 slides</td>
<td>1 slides</td>
<td>1 slides</td>
</tr>
<tr>
<td></td>
<td>Positive Species specific (<em>Pm, Po, Pv</em>) = 8 slides</td>
<td>2 slides</td>
<td>3 slides</td>
<td>3 slides</td>
</tr>
<tr>
<td>Count = 14 slides</td>
<td>Count (200 – 500) = 6 slides</td>
<td>2 slides</td>
<td>3 slides</td>
<td>1 slides</td>
</tr>
<tr>
<td></td>
<td>Count (501 – 2,000) = 6 slides</td>
<td>2 slides</td>
<td>2 slides</td>
<td>2 slides</td>
</tr>
<tr>
<td></td>
<td>40,000 - 100,000 = 2 slides</td>
<td>1 slide</td>
<td>0 slide</td>
<td>1 slide</td>
</tr>
</tbody>
</table>

(These totals may vary from course to course)
External competency assessment for malaria microscopists (ECAMM)

- Primarily targets national core group of microscopists (including National Reference Laboratory) or microscopists playing key QA roles in the NMP or other national institutions involved in QA of malaria microscopy
- Conducted by an external facilitator designated by WHO
- Only those who achieved Level 1 or Level 2 are certified on that Level (Level 3 and 4 achieved certificate of participation)
- Validity of certificates is 3 years
- Should be combined with some form of re-training

National competency assessment for malaria microscopists (NCAMM)

- Targets fully trained and experienced microscopists at subnational level
- Conducted by WHO certified Level 1 from the NCG/NRL, designated by NMP
- Certification is Grade A, B, C, D (to distinguish from ECA)
- Validity of certification is 3 years
- Should be combined with some form of re-training
<table>
<thead>
<tr>
<th>Level achieved</th>
<th>Recommended roles</th>
</tr>
</thead>
</table>
| 1              | • May conduct **training of microscopists** at international, national and subnational levels (*this need additional training such as instructional skills development and advanced courses on malaria diagnosis*)  
• May conduct **assessment of microscopists at international level**, after being selected and deemed suitable, including completing the WHO ECAMM facilitator training course  
• May conduct **assessment of microscopists at national and subnational levels** (*this need additional training on how to conduct competency assessments, instructional skills development, and advanced courses on malaria diagnosis*)  
• May **conduct blinded cross-checking or validation of slides** at national/subnational levels  
• May **conduct supervisory visits** (*this may need additional training on supervision and management*)  
• May serve as **reference microscopist for therapeutic efficacy studies** of antimalarials (*this may need more advanced training on malaria diagnosis*) |
<table>
<thead>
<tr>
<th>Level achieved</th>
<th>Recommended roles</th>
</tr>
</thead>
</table>
| 2              | • May conduct *training of microscopists at national/subnational levels* *(this need additional training such as instructional skills development and advanced courses on malaria diagnosis)*  
• May *conduct supervisory visits* *(this may need additional training on supervision and management)* |
| 3              | • May *provide assistance* to WHO-certified Level 1 or 2 during training of microscopists at national/subnational level |
| 4              | • Should not be involved in training, assessment and cross-checking of slides. Consider the need for refresher training on malaria microscopy. |

*Reference: WHO External Competency Assessment for Malaria Microscopists: Program Manual 2017*
• GMP/PDT has established a multiagency team to advise on ECAMM activities, including preparations for the technical consultation, including Dr J. Carter (Amref), Prof D. Ndiaye (UCAD) and Mr K. Lilley (Army Malaria Institute), and technical resource persons from the WHO AFRO, EMRO, PAHO, SEARO and WPRO.

• The technical consultation involved 20 participants, representing independent experts on malaria microscopy, lead facilitators of WHO ECAMM workshops and co-facilitators, experts in microscopy accreditation using different schemes (e.g. from the WHO Region of the Americas/Pan American Health Organization), and experts involved in microscopy training, accreditation, and development of SOPs.

• WHO commissioned analysis by Prof M. Gatton of WHO ECAMM workshops conducted from 2009 to 2018, involving 1485 participants from 59 countries attending 125 workshops completed in this period.
Objectives of the Technical Consultation

1. To review the results of ECAMM workshops conducted since 2009 by multiple institutions, and to evaluate the need for updating the current WHO criteria for certification of competence in relation to detection, species determination and parasite density calculation, including potential impact on certification levels if new criteria will be recommended for adoption.

2. To review experiences of combination of ECAMM workshops with different forms of microscopy refresher training, and provide guidance on the ideal mix of training plus assessment, as well as recommendations on revised curricula of the pre-ECAMM refresher training and the ECAMM workshops.

3. To review the variants of malaria microscopy SOPs for slide examination in relation to detection, species determination and parasite density calculation adopted by multiple agencies, taking into consideration the SOPs developed by WHO to foster harmonization around common SOPs.

4. To review e-learning platforms recently developed for malaria microscopy and their potential application for refresher training and self-assessment, in view of the potential wider dissemination and adoption of these learning tools.
The primary aim is to have an objective, formal assessment of the competence of malaria microscopists.

**WHO competence levels and criteria**

<table>
<thead>
<tr>
<th>Competence Level</th>
<th>Parasite detection (%)</th>
<th>Species identification (%)</th>
<th>Parasite count within 25% of true count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90-100</td>
<td>90-100</td>
<td>50-100</td>
</tr>
<tr>
<td>2</td>
<td>80-89</td>
<td>80-89</td>
<td>40-49</td>
</tr>
<tr>
<td>3</td>
<td>70-79</td>
<td>70-79</td>
<td>30-39</td>
</tr>
<tr>
<td>4</td>
<td>0-69</td>
<td>0-69</td>
<td>0-29</td>
</tr>
</tbody>
</table>
Objective 1: To evaluate the need to update criteria for competence levels.

a. Criteria for parasite counting should remain at a count of 25% within the true count instead of increasing to 50%, based on the analysis of the results of ECAMM workshops conducted from 2009 to 2018 to avoid a major change in levels of competencies and losing, with the current assessment method, the capacity to distinguish four different levels of competence.
b. Scoring criteria for mixed infections will be changed, so that microscopists could be rewarded for identifying a second infection, even if they identify the wrong species. A new scoring system for mixed infections will be trialled until July and then reassessed. The analysis of the results of ECAMM workshops conducted from 2009 to 2018 showed that this change will result in an average change in species identification of $-0.6\%$ (range $-3.7\%$ to $2.5\%$), resulting in decrease in competence for $5.9\%$ of current Level 1, 2 and 3 microscopists and increase of one level for $1.2\%$ Level 4 microscopists.

New proposed scoring scheme for mixed infections:
- both species correctly identified = 1 (change from current scoring)
- 1 species correctly identified as single infection = 0.5 (change from current scoring)
- 2 species identified; one correct and one incorrect = 0.5 (change from current scoring)
- 2 species identified; both incorrect = 0

The rationale behind this new scoring is as follows:
- Complete correct answer = 1
- Each correct species = 0.5
- Identifying that two species are present = 0.5
- Identifying a species incorrectly = $-0.5$
c. It was suggested to start the assessment for ECAMM on day 3, after participants had been given more teaching and practice on species identification and parasite density calculation.

<table>
<thead>
<tr>
<th>Day 1</th>
<th>0800–0915</th>
<th>0935–1010</th>
<th>1010–1300</th>
<th>1400–1430</th>
<th>1430–1700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>Registration, administration, ECAMM structure and expectations</td>
<td>Pre-ECAMM theory test and feedback</td>
<td>Pre-ECAMM practical test (9 slides)</td>
<td>Microscope use and care</td>
<td>Pre-ECAMM practical test (9 slides)</td>
</tr>
<tr>
<td>Day 2</td>
<td>0800–0915</td>
<td>0935–1000</td>
<td>1000–1300</td>
<td>1400–1430</td>
<td>1430–1700</td>
</tr>
<tr>
<td>Tue</td>
<td>Review of practice slides</td>
<td>Parasite counting (1)</td>
<td>Test slide examination (10 slides)</td>
<td>Species revision</td>
<td>Test slide examination (9 slides)</td>
</tr>
<tr>
<td>Day 3</td>
<td>0800–0915</td>
<td>0935–1015</td>
<td>1015–1300</td>
<td>1400–1430</td>
<td>1430–1700</td>
</tr>
<tr>
<td>Wed</td>
<td>Review of test slides</td>
<td>Parasite counting (2)</td>
<td>Test slide examination (10 slides)</td>
<td>Blood elements and artefacts</td>
<td>Test slide examination (9 slides)</td>
</tr>
<tr>
<td>Day 4</td>
<td>0800–0915</td>
<td>0935–1015</td>
<td>1015–1300</td>
<td>1400–1430</td>
<td>1430–1700</td>
</tr>
<tr>
<td>Thur</td>
<td>Review of test slides</td>
<td>QA in malaria laboratory diagnosis</td>
<td>Test slide examination (10 slides)</td>
<td>Training-revision options</td>
<td>Test slide examination (8 slides)</td>
</tr>
<tr>
<td>Day 5</td>
<td>0800–0915</td>
<td>0935–1000</td>
<td>1000–1030</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fri</td>
<td>Review of test slides</td>
<td>Review and future diagnosis</td>
<td>ECAMM evaluation and closing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assessment with test slides

![Graph showing assessment progression](image)
Objective 2: To review experience & impact of pre-ECAMM refresher training (RT)

a. RT is an important and essential process and should continue to be conducted to increase skills and knowledge of participants prior to ECAMM. Analysis of workshops conducted in Africa showed impact of pre-ECAMM RT on levels of ECAMM competences, but no association in the analysis of all ECAMM workshops. More attention on contents of RT and performance outcomes of ECAMM workshops.

Harmonisation of ECAMM with WHO SOPs

WHO SOPs for malaria microscopy for basic laboratory services:

1. Cleaning and storing of slides
2. Preparation of Giemsa stock solution
3a, b. Preparation of buffered water to pH 7.2
3c. QC of Giemsa and buffered water
4. Preparation of Giemsa working solution
5a. Collection of finger-prick blood and preparation of blood film
5b. Collection of blood by venipuncture, preparation of blood films from venous blood collected in tubes with anticoagulant
6a. Labelling of malaria blood films
6b. Recording and reporting of results
7a. Giemsa staining of malaria blood films
7b. Ebola virus inactivation during Giemsa staining
8. Examination of blood film
9. Parasite counting
10. Preparation of dry blood spots
11. General safety procedures
12. Use and care of microscopes
13. Management of wastes from malaria diagnostic tests
Objective 3: Harmonisation of WHO SOPs for Malaria Microscopy and ECAMM

a. A study should be conducted to evaluate results with examination of the thick film by contiguous fields or every 5th field, and the results should inform the need for updating the current malaria microscopy SOPs. A small working of meeting participants will develop the study protocol.

b. Examination of 100 HPF of thick film is sufficient for detecting malaria parasites in the ECAMM workshop and for examination of patients with clinical malaria. The examination of 200 fields is relevant for research on low density parasitaemia.

c. Counting of parasites should be based on asexual parasites only

d. Counting of parasites in HPF of thick film should start at the first parasite seen
Conclusions of WHO Technical Consultation on ECAMM

Objective 4: To review malaria microscopy e-learning tools

a. E-learning tools could improve competence and address some of the challenges in RT of malaria microscopists. In particular, the remote location of most microscopists, and the costs and difficulties involved in leaving the workplace to attend training, could be compensated for by having training tools that are accessible at all times.

b. Such tools are intended to adjunct to training rather than an alternative to hands-on training. Their principal limitation is the requirement for access to a computer and projection equipment for group learning, and the lack of real-life training on manual microscope use and slide preparation.

c. The two tools reviewed, the CD-ROM on microscopic diagnosis of malaria and the WorldWide E-Learning Course on Malaria Microscopy (WELCOMM) can be used for learning and self-assessment.

Free download of the CD_ROM from WHO/GMP website [https://www.who.int/malaria/areas/diagnosis/microscopy_cd_rom/en/](https://www.who.int/malaria/areas/diagnosis/microscopy_cd_rom/en/)
Aims of the WELCOMM course

Make skill improvement readily accessible to all microscopists on their own time

• Structured approach to learning: combines theory and practical

• Content: all aspects of malaria microscopy

• Provide self-improvement prior to taking accreditation courses (e.g. WHO ECA)

• Measurement of performance: quizzes & exercises after each module

• Certification: available on request

• Continuing Professional Development credits: in process

• Affordable course fees

• Sustainability – assured support for website maintenance and course management
Many thanks for your kind attention