



## Research Article

### Assessment of Public Health Laboratories for Microscopic Examination of Blood Smears for Malaria in a Rural High Transmission Setting in Uganda: Findings from Baseline Survey

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#### Abstract

World Health Organization recommends malaria parasitological confirmation of all suspected cases before treatment. Microscopy remains the gold standard method for malaria diagnosis however its quality is frequently inadequate. In this project we assessed health facility laboratories on their capacity to implement malaria parasite-based diagnosis policy. Data from this baseline could inform appropriate future capacity development interventions designed to improve malaria blood smear microscopy in this region. We conducted a baseline assessment of 50 health laboratories in five districts of Mid-western region on their capacity to perform malaria diagnosis. Selected Laboratories were assessed using a standard checklist tool to capture all the data. Descriptive analysis was done using SPSS version 11 to establish status of the laboratories. Overall, 86% of targeted laboratories were assessed. 77% were run by laboratory assistants. 77% had binocular microscopes but only 87.9% were functional. 17% of staff received refresher training, 20.5% participated in malaria External Quality Assurance while 47% of received supervision for malaria. 28% had personal protective gear while 11.6% had post exposure prophylaxis kits for HIV/AIDS. Over 57% of laboratories experienced stock out of malaria supplies. 97% of the laboratories had suboptimal staffing levels. Malaria laboratory diagnosis in this region as weak and suboptimal to implement the malaria parasite-based diagnosis policy. Rapid Diagnostic Tests that do not require laboratory setting and highly trained technicians could be considered for use in this rural setting.

**Keywords:** Baseline Assessment, Quality Assurance, Malaria, Microscopy

#### BACKGROUND

Early and accurate diagnosis of malaria is essential for effective disease management and reliable malaria data for surveillance and estimation of disease burden. High-quality malaria diagnosis is important in all settings as misdiagnosis can result in significant morbidity and mortality and contributes to the emergence and spread of drug resistance [1]. World Health Organization (WHO) recommends prompt malaria diagnosis either by microscopy or malaria rapid diagnostic test (RDT) in all patients with suspected malaria before treatment is administered.

Following the WHO guidance that recommends that all suspected malaria cases should be confirmed before treatment with Artemisinin-Based Combination Therapy (ACTs), the National malaria control program in Uganda changed its malaria case management policy from presumptive to parasite-based diagnosis [3]. The two main diagnostic methods in public health facilities in Uganda are the use of Rapid Diagnostic Tests (RDTs) and microscopic examination of blood smears [3]. Since the policy change, the ministry of Health National Malaria Control Program has been scaling-up the two main diagnostic methods to cover all districts [3]. Consequently, all districts in Uganda have access to both or any of the two malaria diagnostic methods.

Microscopic examination of blood smears remains the gold standard and the main method for malaria diagnosis in public health facilities in Uganda [2]. However, its quality is frequently inadequate [3]. A good microscopy system requires a laboratory setting with qualified and skilled personnel, source of power and the basic infrastructure and space to accommodate sample processing [2, 4, 5]. However, all these essential components are rarely all present at a time in most endemic settings. There are documented WHO recommended approaches for improving the quality of malaria microscopy that include the use of proficiency testing panels and blood smear cross-checking at sentinel-sites [2]. However, before these approaches are implemented, it is important to conduct baseline assessments to allow the design of appropriate quality improvement strategies based on evidence and identified gaps [2, 5]. In this project we conducted a baseline assessment of all targeted health laboratories in five districts to understand their capacity to perform microscopic examination of Blood smears for malaria. This information could be utilized to design an appropriate intervention and capacity building plan to improve the quality of blood smear malaria microscopy in rural endemic settings.

#### METHODOLOGY AND METHODS

**Setting:** The baseline assessment was conducted in five districts of Kiboga, Hoima, Masindi, Bulisa and Kibaale in Mid-western region of Uganda between October 2012 to April 2013. The region in this catchment area serves an estimated population of 2.2 Million people. Malaria is endemic in the region and accounts for over 40% of outpatient visits at health facilities in this region. The region has a total of 388 health facilities in public, private not for profit (PNFP) and private sectors including four district hospitals and one regional hospital. The region has one of the poorest indicators for maternal and infant mortality rates of which Malaria contributes to over 15% on both indicators. Due to the rural and remote nature of facilities in this region, access to health facilities still poses challenges due to long distances and poor referral networks. There was no updated information on the number of functional laboratories with capacity to process and examine blood smears in the health facilities in this region.

**Baseline Assessment:** The objective of the baseline assessment was to establish the current capacity of health facility laboratories in processing and examining blood smears for malaria parasites to inform future capacity building and quality improvement plans. A joint team composed of central Ministry of Health, District Health Officers and the District Laboratory focal persons from the region conducted the assessment. A standard checklist tool administered to head of Laboratories and health facility in-charges was used to correct all the baseline assessment data for checking functionality status, weaknesses and key areas of focus for future quality improvement schemes.

**Selection of Laboratory Facilities:** Facilities to be assessed were selected based on the national laboratory policy that requires all higher level facilities to provide laboratory services including blood smear microscopy. Based on this selection criteria, a total of 50 health laboratory facilities composed of HC111, HCIV and hospital laboratories were selected for this assessment. The Central team from the ministry of Health team jointly conducted this assessment with the respective district health teams in all the five districts.

**Data Analysis and reporting:** Using SPSS version 11, we performed simple descriptive analysis to tabulate and report our findings.

#### RESULTS AND DISCUSSION

In this baseline assessment, our aim was to establish the capacity and status of health facility laboratories in performing malaria blood smear microscopy to inform future quality improvement and capacity building plans. Although challenges in malaria diagnosis have been documented elsewhere, we wanted to identify and document the status of malaria blood smear microscopy in this high transmission remote setting that could form a basis for implementation of future laboratory quality improvement strategies.

A total number of 50 laboratories located across five districts in this region were selected for this assessment. Data was not collected from 7 (14%) laboratories due to absence of laboratory staff and were excluded leaving 43 facilities.

#### Health Facility Characteristics by Level

A total of 43 health facilities were assessed that included 28 (65.1%) HC-III's, 10 (23.3%) HC-IV's, 4 (9.3%) district hospitals and 1 (2.3%) regional referral hospital.

**Table 1: Health Facility Characteristics by Level**

Characteristics	N	Percentage
<b>Level</b>		
Regional Referral	1	2.3%
General Hospital	4	9.3%
HC IV	10	23.3%
HC III	28	65.1%
<b>Total</b>	<b>43</b>	<b>100%</b>

In this assessment, HC111 constituted the biggest proportion (65.1%) while the regional referral hospital was only one (2.3%).

#### Availability of Key Diagnostic Equipment and Supplies

The assessment explored the availability and functionality of key diagnostic tools and supplies for malaria diagnosis in each of the health facilities. Out of the 43 facilities assessed, only 33 (77%) had binocular

microscopes in their laboratories of which 29 (87.9%) were functional.

**Table 2: Availability of Key Diagnostic Equipment and Supplies**

Characteristics	N	Percentage
<b>Availability of Binocular microscope</b>		
Yes	33	76.7%
No	10	23.3%
<b>Total</b>	<b>43</b>	<b>100%</b>
<b>Functionality of microscope</b>		
Yes	29	87.9%
No	4	12.1%
<b>Total</b>	<b>33</b>	<b>100%</b>

A microscope is essential equipment for malaria diagnosis. However, 23.3% of facilities were missing microscopes and were not able to perform and examine malaria blood smears. Most of the facilities missing microscopes either had never received one or it got damaged and put out of use. Although 12.1% of the facilities had microscopes present, they were not functional.

#### Characteristics of Laboratory Staff by cadre

A total of 43 laboratory personnel were interviewed from the 43 health facilities visited. There were 41.9% laboratory assistants, 34.9% laboratory attendants, 18.6% laboratory technicians and 4.6% laboratory technologists.

**Table 3: Characteristics of Laboratory Staff**

Characteristics	N	Percentage
<b>Designation/Title</b>		
Laboratory Technologist	2	4.6%
Laboratory Technician	8	18.6%
Laboratory Assistant	18	41.9%
Lab. Attendant	15	34.9%
<b>Total</b>	<b>43</b>	<b>100%</b>

While the ministry of health of Uganda is phasing out laboratory assistants and laboratory attendants, they were still present performing laboratory testing in health facilities in this region. Laboratory attendants do not have formal training but are trained on-job. The level of training may be directly associated with the quality of

service provided as documented in published studies [8, 9, 10].

**Table 4: Proportion of Laboratory Vacancies Filled (Staffing levels)**

Characteristics	Percentage
<b>Cadre</b>	
Laboratory Technologist	5.0%
Laboratory Technician	13.8%
Laboratory Assistant	45.0%
Lab. Attendant/Microscopist	36.2%
<b>Total</b>	<b>100%</b>

The aim of the ministry of health is to have 100% of all the available vacancies filled for each cadre. However, the proportion of filled vacancies in this region was very low. Of the total number vacancies available for technologists, only (5%) are filled with the majority being laboratory assistants (45%). The possible reasons for failure to attract and retain highly qualified technologists in this region could be related to poor remuneration, poor communication and the remote nature of the region [11].

#### Refresher training of Laboratory staff

Personnel were asked whether they had received any malaria-related training in the past 2 years. 17% of laboratory staff had received some form of training for malaria diagnosis. In-service training of service providers is important in ensuring that providers motivated and in addition to acquisition of skills pertaining to the services they provide.

**Table 5: Availability of Standard Operating Procedures Manuals**

	N	Percentage
<b>SOPs for laboratory diagnosis for malaria</b>		
Yes	20	46.5%
No	23	53.5%
<b>Total</b>	<b>43</b>	<b>100%</b>

Standard operating procedure for malaria blood smear microscopy were available in 46.5% of the laboratories. Standard operating procedures (SOPs) are important diagnostic aides in laboratories. They provide guidelines on test procedures and relevant laboratory technical information that is important for the day-to-day management of laboratory samples, specimen, facilities and equipment.

**Table 6: Implementation of Laboratory Safety Measures**

	N	Percentage
<b>Disinfectant use in lab</b>		
Yes	21	48.8%
No	22	51.2%
<b>Total</b>	<b>43</b>	<b>100%</b>
<b>Use of PPE</b>		
Yes	12	27.9%
No	31	72.1%
<b>Total</b>	<b>43</b>	<b>100%</b>
<b>Use of PEP for HIV/AIDs</b>		
Yes	5	11.6%
No	38	88.4%
<b>Total</b>	<b>43</b>	<b>100%</b>

The level of safety standards in these laboratories was assessed. The focus was put on disinfectants (Jik), personal protective equipment and post exposure prophylaxis kits for HIV/AIDS. Only (48.8%) of laboratories used government prescribed disinfectants, 27.9% of these laboratories had personal protective gear. Post exposure prophylaxis (PEP) kits for HIV/AIDS were available only in, 11.6% of the laboratories assessed.

#### Participation in External Quality Assurance Schemes

79.5% of laboratories indicated participation in at least one Quality Assurance scheme for TB compared to 20.5% for malaria. Lack of integration in running programs such as external quality assurance systems (EQA) was highly imminent. Each national disease program operates vertical schemes right from the centre.

#### Laboratory Logistics and Supplies Sources

Approximately 91% of the laboratories assessed receive their reagents and supplies through the CDC funded credit line for public and PNFP. The rest source their laboratory supplies through Primary Health Care funding, donations and private purchases.

**Table 7: Sources of Funding for Lab Supplies and Reagents**

	N	Percentage
Credit Line	39	90.7%
Other Sources	4	9.3%
<b>Total</b>	<b>43</b>	<b>100%</b>

The biggest proportion Laboratory facilities access their malaria supplies from the national Medical stores (NMS) under the CDC funded laboratory reagents credit line. Under the credit line arrangement, the CDC centrally finances the procurement of supplies that are accessed through the national central stores that ensures an efficient storage and distribution flow of laboratory reagents and supplies to all laboratories.

#### Stock Status for Laboratory Reagents

Approximately 57% of laboratories experienced stock out of malaria laboratory commodities in the past 6 months. Since frequent and prolonged stock outs severely undermine service delivery we used a measure of 6 months prior to the assessment as an appropriate timeframe.

#### Laboratory Supervision

During the 12-month period prior to this survey, only 47% of laboratory staff received any form of technical support supervision for malaria diagnosis.

#### CONCLUSION AND RECOMMENDATION

This baseline assessment reveals laboratory systems challenges that may potentially affect the implementation of blood smear microscopy to promote the new parasite based diagnosis of malaria in this region. We recommend that future strategies aimed at improving the quality of malaria blood smear microscopy should focus on addressing these gaps. Alternative and easy to use methods such as the use of Rapid Diagnosis Tests that do not require a laboratory setting and highly trained technicians could be considered for use in this rural setting.

#### LIST ABBREVIATIONS

EQA: External Quality Assurance, WHO: World Health Organization, RDTs: Rapid Diagnostic Tests, LLINS: Long Lasting Insecticide-treated Nets, IRS: Indoor Residual Spraying, SOPS: Standard Operating Procedures, CME: Continuous Medical Education, CDC: Centres for Disease Control and Prevention.

#### COMPETING INTERESTS:

All authors have no conflict of interest.

#### AUTHORS CONTRIBUTION

AB conducted the assessment and led the writing of this paper, BP, LW, MR, GG, JT, ES all participated and supervised the assessment and proof read the paper.

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