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AN EVALUATION OF ONSITE TRAINING AND SUPPORTIVE SUPERVISION PLUS (OTSS+) TO IMPROVE MALARIA DIAGNOSTIC SERVICE DELIVERY IN 22 HOSPITALS IN SIERRA LEONE

Fay Cecilia Chalobah[1], Anita R.Y. Kamara[2], Dr. (Mrs) Angella Magdalene George[3]

[1]*Senior Medical Laboratory Scientist, Central Public Health Reference Laboratory-Ministry of Health (MOH)*

[2]*Lead, Malaria Case Management and Research, National malaria control program, MOH*

[3]*Ag. Head of Nursing, Njala University*

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ABSTRACT

Malaria, a formidable global health issue, disproportionately impacts sub-Saharan Africa, including Sierra Leone, where a substantial burden persists with a significant number of reported cases annually. This global health challenge necessitates a comprehensive approach to address its impact on public health, emphasizing the crucial role of accurate and prompt diagnosis in effective case management. Laboratory technicians play a pivotal role in malaria diagnosis, conducting microscopy examinations of blood samples for the detection of malaria parasites. The competency and reliability of these technicians are paramount for appropriate treatment and surveillance, as malaria diagnosis forms the cornerstone of case management. However, studies in sub-Saharan Africa highlight the challenges associated with maintaining and enhancing the skills of laboratory technicians over time. Factors such as inadequate training, inconsistent adherence to standard operating procedures, and limited access to necessary equipment contribute to the variable and often poor quality of microscopy.

The primary aim of this research is to assess the impact of supportive supervision on malaria diagnosis service delivery among laboratory technicians in Sierra Leone

The study employs a quasi-experimental design to assess the impact of supportive supervision on malaria diagnosis service delivery among laboratory technicians. A pre-designed checklist of four thematic area (Lab evaluation, Proficiency testing, External Quality Assurance and Microscopy observation) was used to collect data from 22 hospitals in three rounds of supervisory visits.

Laboratory Evaluation: There was a significant improvement from R1 (64%) to R2 (93%), with a slight decrease in R3 (81%). Stockouts of consumables for microscope microscopy and stockouts of malaria RDT showed moderate improvement from R1 to R3. For example, stockouts of malaria RDT improved from 35% to 59%. Scores related to microscopes, spare parts, and maintenance showed consistent improvement, particularly from R1 (29%) to R3 (47%). Both internal and external quality assurance scores showed an upward trend. Internal Quality Assurance increased from 49% in R1 to 81% in R3. There was a consistent improvement in this category, with scores rising from 50% in R1 to 90% in R3.

The significant improvement across the rounds in all categories, particularly in the later rounds, suggests that supportive supervision played a crucial role. implying that continuous oversight and guidance significantly enhanced both accuracy and timeliness in malaria diagnosis.

KEY WORDS: *Microscope, Malaria Diagnosis, Laboratory Evaluation*

BACKGROUND

Malaria, a formidable global health issue, disproportionately impacts sub-Saharan Africa, including Sierra Leone, where a substantial burden persists with a significant number of reported cases annually (PMI Sierra Leone Malaria Operational Plan FY 2024). This global health challenge necessitates a comprehensive approach to address its impact on public health, emphasizing the crucial role of accurate and prompt diagnosis in effective case management (WHO, 2016).

Laboratory technicians play a pivotal role in malaria diagnosis, conducting microscopy examinations of blood samples for the detection of malaria parasites. The competency and reliability of these technicians are paramount for appropriate treatment and surveillance, as malaria diagnosis forms the cornerstone of case management (F. Alombah et al., 2019). However, studies in sub-Saharan Africa highlight the challenges associated with maintaining and enhancing the skills of laboratory technicians over time. Factors such as inadequate training, inconsistent adherence to standard operating procedures, and limited access

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to necessary equipment contribute to the variable and often poor quality of microscopy (F. Alombah et al., 2019; M.Worges et al., 2018; M.J. Eliades et al., 2019).

Microscopy remains the gold standard for malaria diagnosis at the hospital level, offering advantages such as species identification, quantification, and tracking of treatment response. Despite its significance, challenges persist, including issues related to laboratory systems, infrastructure, and the expanded use of rapid diagnostic tests (RDTs). The reliance on microscopy and the need for its accuracy necessitate a multifaceted approach to address these challenges, encompassing capacity building for laboratory technicians and the establishment of quality assurance measures (M.J. Eliades et al., 2019; M.Worges et al., 2018; Ngasala & Bushukatale, 2019).

Supportive supervision emerges as a key strategy in addressing these challenges, as demonstrated by F. Alombah et al. (2019). Their study in sub-Saharan Africa underscores the positive impact of supportive supervision on malaria microscopy competencies, emphasizing its potential as an effective intervention. Similar efforts in other regions, such as Zambia and Tanzania, contribute to the understanding of supportive supervision as a valuable tool in malaria diagnosis (M. Worges et al., 2018; Ngasala & Bushukatale, 2019).
In a global context, the challenges associated with malaria diagnosis are not unique to Sierra Leone but are echoed in various sub-Saharan African countries. The Test, Treat and Track (T3) initiative launched by the World Health Organization in 2012 exemplifies a global effort to ensure proper testing, treatment, and registration of suspected malaria cases. However, the challenges identified, such as non-adherence to test results and the over-prescription of malaria drugs, demonstrate the need for targeted interventions and continuous improvement in malaria diagnosis (Lopes et al., 2020).

Addressing these challenges is vital for ensuring reliable malaria diagnosis at the hospital level. The comprehensive background on malaria as a global health issue, coupled with insights from studies in sub-Saharan African countries, underscores the importance of laboratory technicians, the challenges they face, and the potential solutions through strategies like supportive supervision. This approach aligns with the broader global initiative to improve malaria case management and contributes to the ongoing efforts to combat malaria worldwide.

In conclusion, a nuanced understanding of malaria diagnosis at the global and regional levels provides the foundation for effective interventions. The challenges identified in sub-Saharan Africa, including Sierra Leone, necessitate tailored strategies to enhance the skills of laboratory technicians, improve microscopy quality, and ensure the effective implementation of supportive supervision. Such efforts align with the broader global initiative to reduce the impact of malaria, emphasizing the importance of accurate and reliable diagnosis in achieving this goal.

Problem Statement

The research endeavours to address the pressing need for improved malaria diagnosis service delivery among laboratory technicians in Sierra Leone. Accurate and timely malaria diagnosis plays a pivotal role in determining individual patient outcomes and significantly impacts broader public health.

Accurate malaria diagnosis is fundamental for effective patient care, as misdiagnoses or delays can lead to inappropriate treatments, prolonged illness, increased healthcare costs, and adverse health effects. Timely identification of malaria cases is crucial for prompt treatment, preventing disease progression, and reducing the risk of complications.

On a public health scale, accurate malaria diagnosis is indispensable for effective disease surveillance and control. Reliable diagnostic practices contribute to accurate epidemiological data, enabling targeted interventions, efficient resource allocation, and the evaluation of malaria control programs. Inaccuracies in diagnosis can lead to flawed data, hindering evidence-based policy formulation and strategy development.

The significance of accurate and timely malaria diagnosis is underscored by the World Health Organization's recommendation of parasite-based diagnostic testing for all suspected malaria cases before treatment. Microscopy and rapid diagnostic tests (RDTs) are pivotal tools, and the proficiency of laboratory technicians in utilizing these methods directly impacts the quality of diagnosis.

Challenges in malaria diagnosis service delivery, as indicated in the U.S. President's Malaria Initiative Sierra Leone Malaria Operational Plan FY 2024, demand focused attention (U.S. President's Malaria Initiative Sierra Leone Malaria Operational Plan FY 2024). Insights from the Western and Central Africa National Malaria Programs and Partners Annual Meeting presentation highlight broader health system weaknesses that could affect malaria diagnosis services (A. Falama et al., 2023). Addressing these challenges is imperative for improving the overall healthcare landscape and ensuring optimal patient outcomes.
The research aims to fill the existing gap in understanding the intricacies of malaria diagnosis service delivery among laboratory technicians in Sierra Leone. By doing so, it strives to contribute to the broader goal of enhancing both individual patient outcomes and the effectiveness of public health interventions.

Aim of research

The primary aim of this research is to assess the impact of supportive supervision on malaria diagnosis service delivery among laboratory technicians in Sierra Leone.

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Specific Objectives

- Evaluate the proficiency levels of laboratory technicians in malaria diagnosis within selected district hospitals.
- Assess the effectiveness of supportive supervision in improving the accuracy and timeliness of malaria diagnosis conducted by laboratory technicians.
- Examine the potential benefits of improved service delivery for both healthcare professionals and patients in the context of malaria diagnosis.

Rationale of the study

The evaluation of supportive supervision's impact on malaria diagnosis holds crucial significance within the healthcare landscape. In the context of malaria, accurate and timely diagnosis is paramount for effective patient outcomes and public health. Malaria remains a significant global health challenge, particularly in sub-Saharan Africa, including Sierra Leone, where the burden is substantial. The World Health Organization (WHO) recommends parasite-based diagnostic testing, such as microscopy, for all suspected malaria cases. The choice of the microscopy technique as the primary method aligns with WHO guidelines and ensures a comprehensive evaluation of proficiency levels and challenges faced by laboratory technicians in malaria diagnosis.

Microscopy serves as the gold standard for malaria diagnosis, allowing for species identification, quantification, and tracking of treatment response. In this research, the use of microscopy is justified by its advantages over rapid diagnostic tests (RDTs), such as higher sensitivity and the ability to identify other common causes of illness. The technique's relevance to the research question lies in its role as a standard method at the hospital level and its contribution to accurate and reliable malaria diagnosis.

Improved service delivery resulting from enhanced proficiency among laboratory technicians benefits both healthcare professionals and patients. For healthcare professionals, it translates to a higher standard of care, increased confidence in diagnostic accuracy, and a reduction in misdiagnoses. Patients, on the other hand, benefit from timely and precise malaria diagnosis, leading to appropriate treatment and improved health outcomes. Additionally, improved service delivery contributes to the overall effectiveness of malaria control and elimination strategies, aligning with global health objectives. The potential benefits underscore the need to assess the impact of supportive supervision in optimizing malaria diagnosis service delivery in Sierra Leone's district hospitals.

METHODOLOGY

Research Design

The study employs a quasi-experimental design to assess the impact of supportive supervision on malaria diagnosis service delivery among laboratory technicians. This design combines elements of both experimental and non-experimental approaches, allowing for a nuanced examination of the intervention's effects while acknowledging practical, ethical, and logistical constraints.

Application to Malaria Diagnosis Service Delivery

The chosen design aligns with the complex nature of assessing the impact of supportive supervision in healthcare settings. Laboratory technicians' daily tasks involve intricate diagnostic procedures, and the quasi-experimental design recognizes the need for a pragmatic approach.

Specifics of Quasi-Experimental Design

- **Pre-Post Intervention Assessments**

The study involves baseline assessments of malaria diagnosis service delivery among laboratory technicians. Subsequently, supportive supervision is introduced, followed by post-intervention evaluations to measure any changes.

- **Non-Equivalent Control Group**

While efforts are made to control for potential confounding variables, the study acknowledges that complete equivalence in the control group may not be attainable. This non-equivalent control group design provides a practical compromise.

- **Longitudinal Data Collection:** Longitudinal data collection methods allow for the examination of changes over time. This is crucial in capturing the sustained impact of supportive supervision on the proficiency of laboratory technicians in malaria diagnosis (Campbell and Stanley, 1963).

The quasi-experimental design is well-suited for this study, striking a balance between experimental rigor and real-world applicability. It enables a thorough investigation into the impact of supportive supervision on malaria diagnosis service delivery among laboratory technicians, considering the intricate dynamics of healthcare settings.

Scope and Limitations of the Study

This study delves into the intricacies of malaria diagnosis service delivery among laboratory technicians in Sierra Leone, focusing on 22 hospitals. The geographical context of Sierra Leone confines the study's scope, emphasizing its context-specific nature. However, the findings may not be universally applicable, given the regional and healthcare system variations. The study's limitations include constraints related to sample size, potentially impacting the representation of diverse healthcare settings in the country. Additionally, the temporal aspect of the study may influence its ability to capture long-term effects, limiting generalizability over time. Despite these constraints, the study strives to ensure internal validity and reliability within its defined scope, aiming to contribute valuable insights into malaria diagnosis service delivery (Polit and Beck, 2017).

Description of Study Area

Geographical Location

This research unfolds in Sierra Leone, a country in West Africa, where the 22 hospitals chosen for investigation are distributed

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across diverse regions. The geographical locations encompass urban and rural settings, providing a comprehensive view of malaria diagnosis service delivery within the country. Each district hospital represents a distinct healthcare context, reflecting the nuances of regional healthcare systems. This diverse selection aims to capture a holistic understanding of the challenges and opportunities associated with malaria diagnosis service delivery among laboratory technicians in Sierra Leone.

Laboratory Settings

The laboratories visited during the assessment had workspaces that were typically less than 20 square meters, which is the minimum recommended size for peripheral laboratories.

The laboratories are connected to piped water, although the water taps often run dry. There is a need for distilled or deionized water for the preparation of laboratory reagents, but no water distillation units or distil water are available in the laboratories.

Waste containers and sharps boxes are available in most health facilities. A percentage of health facilities practice waste segregation and disinfect liquid waste before disposal, with some health facilities not appropriately segregating waste and not decontaminating liquid waste before pouring it down the drain. Sharps boxes are available in most health facilities.

Technician Demographic

Laboratory personnel were selected as supervisors and were trained on outreach training and supportive supervision using the four checklists; Laboratory evaluation, Microscopy Observation, Proficiency Testing and External quality Assurance, as well as the use of the electronic tool Health Network Quality Improvement System (HNQIS) during supervision.

Access to Resources

The Impact Malaria Project (IM) in collaboration with the Sierra Leone National Malaria Control Program (NMCP) has worked to improve the quality of care in malaria diagnosis and treatment. The IM project supports the NMCP on case management, malaria in pregnancy and malaria diagnostic capacity building, and essential supplies. This suggests that efforts have been made to ensure the availability of necessary resources for malaria diagnosis.

Trained Personnel

The malaria diagnostic refresher training (MDRT) conducted for laboratory technicians aimed to mentor supervisees on malaria parasite detection, species identification, and quantification of malaria parasites. This suggests that efforts have been made to enhance the skills and knowledge of the laboratory personnel involved in malaria diagnosis.

Factors Influencing Supportive Supervision

The use of the electronic tool Health Network Quality Improvement System (HNQIS) during supervision. The application was installed on tablets given to the supervisors, and it allowed them to collect and feed information directly. The use of such technology may contribute to more efficient and standardized supervision processes.

Debrief meetings; where feedback on findings, challenges, and proposed action plans are discussed with facility management and laboratory staff. These meetings provide an opportunity for communication and collaboration, which can positively influence the effectiveness of supportive supervision.

Collaborating Institutions or Partners

1. Sierra Leone National Malaria Control Program (NMCP): The NMCP is a key partner working in collaboration with the IM project. The IM project supports the NMCP on case management, malaria diagnostic capacity building, mentorship, and activities related to malaria in pregnancy (MIP). The NMCP plays a crucial role in coordinating and implementing malaria control efforts in Sierra Leone.
2. Directorate of Laboratory and Blood Safety Services (DLDBS): The DLDBS is a collaborating institution involved in the selection of health facilities for the study. The DLDBS provides technical expertise and guidance on laboratory and blood safety issues.
3. Medical Care Development Global Health (MCDI): MCDI is also a collaborating partner involved in the IM project. MCD Global Health provided the technical support and expertise in malaria diagnosis program implementation.
4. In these hospitals President's Malaria Initiative (PMI): PMI is a funding source for the IM project. PMI is a U.S. government initiative that supports malaria control and elimination efforts in partner countries. The funding provided by PMI helps to support the activities and objectives of the IM project in Sierra Leone.

Sampling Strategy

The target population of this study is the 22 public hospitals in Sierra Leone. The technicians are relevant to the research question as they play a key role in malaria diagnosis, and evaluating their proficiency levels and the impact of supportive supervision is essential.

The sampling strategy employed by the Impact Malaria Sierra Leone project involved the following steps:

1. Selection of District Hospitals: The 22 hospitals included in the study were purposefully selected based on specific criteria, such as geographic representation, availability of malaria diagnostic services, and collaboration with the project.
2. Identification of Laboratory Technicians: Within each selected district hospital, all laboratory technicians involved in malaria diagnosis were considered as the sampling frame.
3. Inclusion Criteria: All public hospitals that report to the NMCP on malaria microscopy involved in malaria

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diagnosis during the project period, were included in the study.

4. Sample Size: The sample size for the study was determined based on the available resources and logistical considerations of the Impact Malaria Sierra Leone project.

As such a purposive sampling technique was used in the study.

Data Collection Instruments

The data collection tools used in this research included:

1. **Health Network Quality Improvement System (HNQIS) Application:** This electronic tool was installed on tablets given to OTSS+ laboratory supervisors. It was used to collect information during supervision visits, enter data directly into the application, visualize scores per checklist items, and generate graphs for real-time outcomes of the supervision.
2. **Checklist:** A supervisory checklist embedded into the HNQIS was administered by the OTSS+ supervisors to assess various aspects of laboratory performance, infrastructure, waste management, human resources, and adherence to standard operating procedures (SOPs).
3. **Interviews:** OTSS+ supervisors conducted interviews with health personnel to collect relevant information and verify verbal information through physical examination or visual observation.
4. **Observation:** The supervisors observed how healthcare workers were performing laboratory procedures and their adherence to SOPs.
5. **Characterized Slides:** Ten well-characterized malaria slides were administered by OTSS+ supervisors to health facility staff for examination, as part of competency assessment and quality control.
6. **Data Entry and Analysis:** The HNQIS application facilitated data entry and this is synced into the data hub and the captured data was reviewed for missing values and duplicate entries. Data analysis was done using the HNQIS -DHIS 2 server, which generated graphs to understand the outcomes of the supervision.

Overall, these tools were used to collect data on various aspects of laboratory operations, quality assurance, and malaria diagnosis in the surveyed health facilities.

Variables and Measurements

1. Independent Variable: Supportive supervision

- Relationship: Supportive supervision is considered the independent variable because it is a treatment or intervention that is applied or implemented by the researchers. The researchers actively provide guidance, mentoring, and oversight to laboratory technicians through supportive supervision.
- Influence: The researchers expect that supportive supervision will have an influence on the dependent variable, which is the improvement in malaria diagnosis service delivery.

2. Dependent Variable: Improvement in malaria diagnosis service delivery

- Relationship: Improvement in malaria diagnosis service delivery is the dependent variable because it is the outcome or result that is expected to be influenced by the independent variable, which is supportive supervision. The level of improvement in service delivery is dependent on the presence or absence of supportive supervision.
- Influence: It is hypothesized that supportive supervision will lead to improvements in various aspects of malaria diagnosis service delivery, such as accuracy, timeliness, adherence to standard operating procedures, and overall quality of microscopy.

In summary, supportive supervision is the independent variable that is expected to have an impact on the dependent variable, which is the improvement in malaria diagnosis service delivery. By providing guidance and oversight to laboratory technicians, supportive supervision aims to enhance the quality, accuracy, and timeliness of malaria diagnosis. The level of improvement in service delivery is dependent on the presence and effectiveness of supportive supervision.

RESULTS AND DATA ANALYSIS

The data analysis plan for this research study involved the application of various statistical methods to address the research questions and test the research questions. The specific statistical tests and techniques used depend on the nature of the data and the research objectives.

Research objective 1: What is the current proficiency level of laboratory technicians in malaria diagnosis within selected district hospitals?

To address this research question, descriptive statistics was utilized. Descriptive statistics provide an overview of the proficiency levels of laboratory technicians in malaria diagnosis. Measures such as means, standard deviations, frequencies, and percentages are calculated to summarize the data. These statistics help in understanding the current level of proficiency among laboratory technicians.

Research objective 2: What are the primary challenges faced by laboratory technicians in providing accurate and timely malaria diagnosis services?

For this research question, qualitative data analysis methods were employed. The responses obtained from laboratory technicians regarding the challenges they face was analyzed thematically. Themes and patterns within the data was identified to gain insights into the primary challenges. This analysis involves techniques such as content analysis or thematic analysis.

Research objective 3: To what extent has supportive supervision improved the accuracy and timeliness of malaria diagnosis conducted by laboratory technicians?

To assess the impact of supportive supervision, inferential statistics was applied. A comparative analysis was conducted between the accuracy and timeliness of malaria diagnosis before and after the implementation of supportive supervision. This analysis involves statistical tests such as paired t-tests or chi-

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square tests to determine if there are significant differences in the diagnostic outcomes.

Research objection 4: What potential benefits can be observed for both healthcare professionals and patients with improved service delivery in the context of malaria diagnosis?

To explore the potential benefits, both qualitative and quantitative analyses are employed. Qualitative data analysis methods, such as thematic analysis, are used to identify and categorize the perceived benefits reported by healthcare professionals and patients. Additionally, quantitative data analysis techniques are applied to evaluate changes in healthcare outcomes, patient satisfaction, or other relevant metrics. This involves the use of inferential statistical tests, such as regression analysis or analysis of variance (ANOVA).

Overall, the data analysis plan will involve a combination of descriptive statistics, inferential statistics, and qualitative analysis techniques. The specific methods and tests used depends on the research questions and the type of data collected during the study.

RESULTS AND DISCUSSION

Laboratory Evaluation

The graph shows the average percentage scores of health facilities (HFs) across three rounds of evaluation. The categories assessed include various aspects of laboratory performance and maintenance, such as training, stockouts, and quality assurance

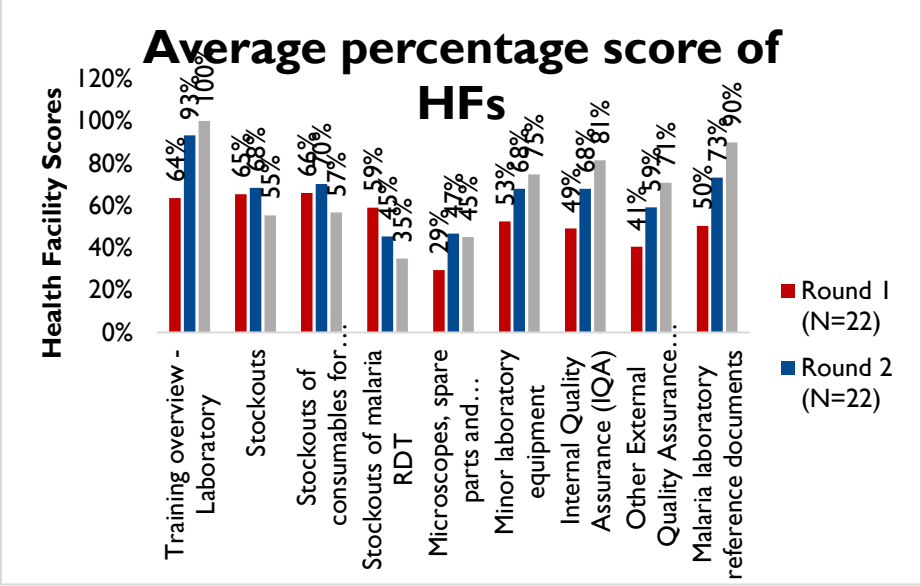

Figure 1 Stock Outs and availability of equipment

The training overview for laboratory staff demonstrated significant improvement, with scores increasing from 64% in Round 1 to 93% in Round 2, followed by a slight decrease to 81% in Round 3. Stockouts of consumables for malaria microscopy and malaria RDTs showed moderate improvement across the rounds, with stockouts of malaria RDTs improving from 35% in Round 1 to 59% in Round 3.

Scores related to equipment and maintenance, including microscopes, spare parts, and maintenance, showed consistent progress, increasing from 29% in Round 1 to 47% in Round 3. Both internal and external quality assurance exhibited upward trends, with Internal Quality Assurance (IQA) improving from 49% in Round 1 to 81% in Round 3.

Malaria laboratory reference documents also showed consistent improvement, with scores rising from 50% in Round 1 to 90% in Round 3.

Overall, the data reflects a general trend of improvement across the rounds, particularly in quality assurance, training, and the availability of laboratory reference documents. However, some areas, such as stockouts, have shown more gradual progress.

Figure 2 shows the percentage average availability of malaria Standard Operating Procedures (SOPs) across three rounds of evaluation for various types of SOPs.

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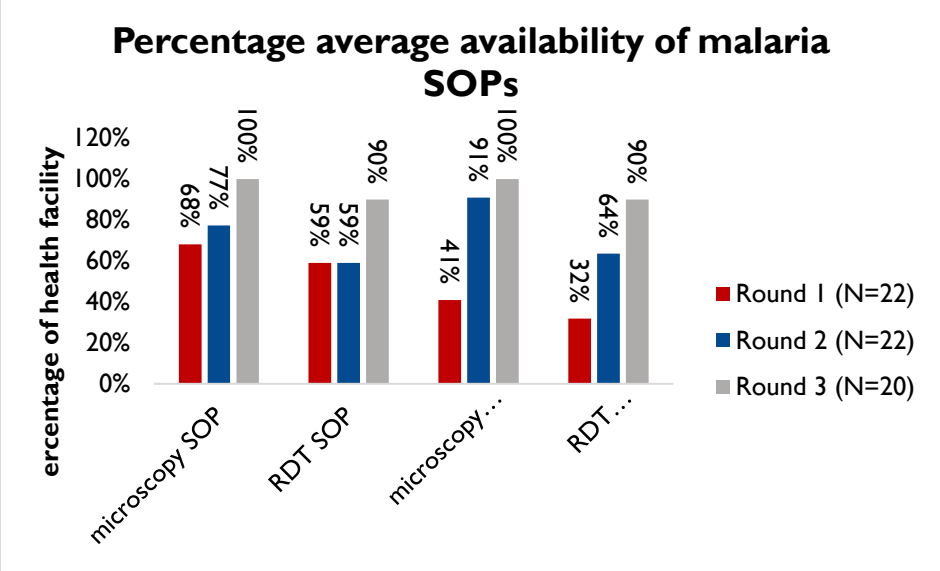

Figure 2 Shows Availability of malaria SOPs

The availability of microscopy SOPs improved steadily across the rounds, starting at 68% in Round 1, increasing to 77% in Round 2, and reaching 100% in Round 3. The availability of RDT SOPs also showed improvement, beginning at 55% in Round 1, slightly increasing to 59% in Round 2, and then jumping to 90% in Round 3.

Microscopy photomicrographs experienced a dramatic improvement in availability, rising from 41% in Round 1 to 91% in Round 2, and achieving 100% in Round 3. Similarly, the availability of RDT photomicrographs followed an upward trend, starting at 32% in Round 1, increasing to 64% in Round 2, and reaching 90% in Round 3.

In summary, the data illustrates a positive trend in the availability of malaria SOPs across the health facilities, with all categories showing substantial improvement from Round 1 to Round 3. The most notable gains were observed in the availability of microscopy photomicrographs and RDT photomicrographs.

Proficiency Testing

Proficiency testing (PT) was conducted in 22 health facilities using WHO-validated slide bank. Ten validated slides were used at the by the supervisors. These slides contained negative, positive slide with *P. falciparum, P. malariae, P. ovale* and mixed infections. The slides were given to the Laboratory technicians to read and report the result to the supervisors during the supervision visit in each health facility. The supervisor compared the Laboratory technician's result with the validated slides characteristic and provided feedback to the Laboratory technicians. The results of ten slides were reported in the HNQIS for the agreement between the result of laboratory technicians and the result of validated malaria slides.

The target of correct slide reading to meet the minimum standard competency agreement between the laboratory technicians and the PT's slide is at 80% or more for the parasite detection, 80% or more for species identification and 40% or more for parasite counting.

Fig 3 displays the average proficiency testing scores of health facilities across three rounds of evaluation in three key areas: Parasite Counting, Parasite Detection, and Species Identification.

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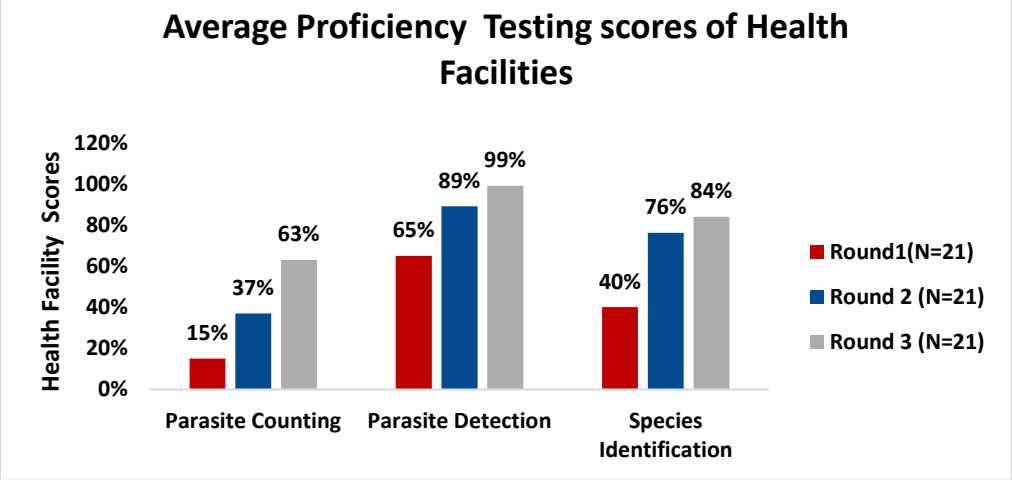

Figure 3 Average Proficiency Testing Scores of health facilities in PD,PC and SID

The scores for parasite counting demonstrated significant improvement across the rounds, beginning at 15% in Round 1, increasing to 37% in Round 2, and reaching 63% in Round 3. Parasite detection showed strong performance, with scores rising from 65% in Round 1 to 89% in Round 2, and nearly achieving perfection at 99% in Round 3.

Species identification also exhibited notable progress, with scores starting at 40% in Round 1, improving to 76% in Round 2, and reaching 84% in Round 3.

Overall, the graph highlights a positive trend in proficiency testing scores for health facilities across the three evaluated areas. The most dramatic improvement was observed in parasite counting, while parasite detection achieved near-perfect scores by Round 3. Species identification showed steady progress over the evaluation rounds.

Fig 4 compares the performance of health facilities across three rounds of assessments in three areas: **Parasite Counting**, **Parasite Detection**, and **Species Identification**.

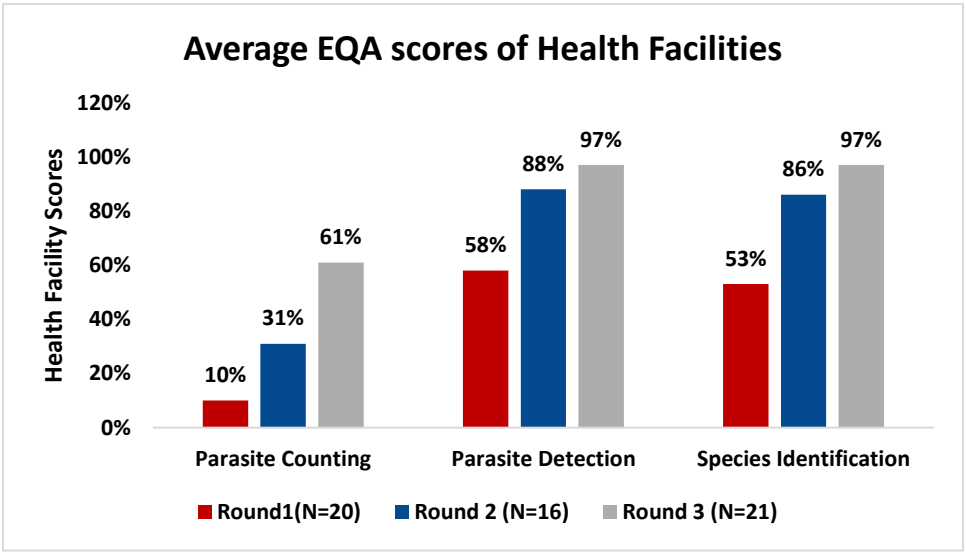

Figure 4 Average EQA Scores

Observation

From observation, it was noticed that Parasite Counting Scores started very low in Round 1 with an average of 10%, improved to 31% in Round 2, and reached 61% in Round 3.

Also, that the Parasite Detection Scores increased significantly over the rounds, from 58% in Round 1 to 88% in Round 2, and peaked at 97% in Round 3.

The Species Identification Similarly, there was marked improvement, with scores of 53% in Round 1, rising to 86% in Round 2, and achieving 97% in Round 3.

Overall, the graph illustrates a positive trend, showing that the health facilities improved their performance significantly in all

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three categories over the successive rounds of external quality assessment (EQA).

Fig 5 illustrates the performance of health facilities across three rounds of evaluations (R1, R2, and R3) in various aspects of microscopy observation. Each category reflects the quality and accuracy of different procedures related to microscopy.

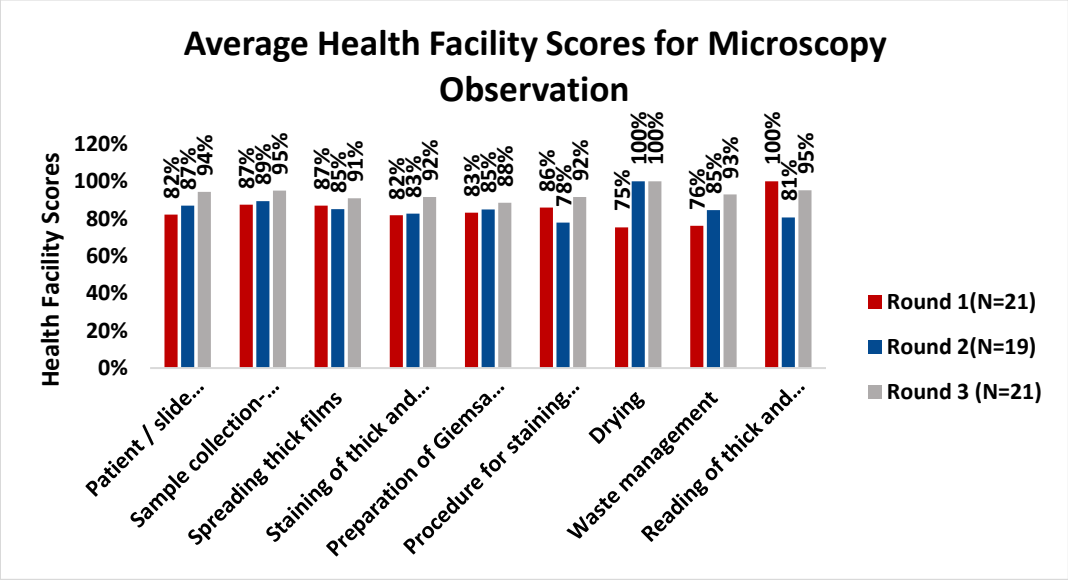

Figure 5 Show Average Health facility scores in observation

Observation

The scores for patient/slide identification were relatively high, beginning at 82% in Round 1, increasing to 87% in Round 2, and reaching 94% in Round 3. Sample collection demonstrated steady improvement, rising from 85% in Round 1 to 88% in Round 2, and further to 95% in Round 3. Spreading thick films began at 83% in Round 1, showed a slight improvement to 87% in Round 2, and reached 91% in Round 3.

In the staining of thick films, scores improved from 87% in Round 1 to 95% in Round 2 but slightly decreased to 91% in Round 3. The preparation of slides showed consistent progress, increasing from 82% in Round 1 to 89% in Round 2, and reaching 92% in Round 3. The procedure for microscopy improved from 83% in Round 1 to 88% in Round 2, with a slight increase to 89% in Round 3.

Drying of slides exhibited a significant improvement, starting at 78% in Round 1, increasing to 92% in Round 2, and achieving 100% in Round 3. Waste management showed remarkable progress, beginning at 75% in Round 1, rising to 100% in Round 2, and maintaining 100% in Round 3. The reading of thick films also improved, rising from 76% in Round 1 to 85% in Round 2, and reaching 93% in Round 3.

Overall, the data reveals a trend of steady improvement across all categories, with many achieving near-perfect scores in Round 3. This indicates enhanced performance and adherence to best practices in microscopy over the successive evaluation rounds.

SUMMARY CONCLUSION AND RECOMMENDATIONS

SUMMARY

The study assessed the current proficiency levels of laboratory technicians; identified primary challenges faced, and evaluated the impact of supportive supervision on diagnostic accuracy and timeliness. In selected districts, significant improvements in the proficiency of laboratory technicians were observed over time. Key areas of improvement included parasite detection, species identification, and microscopy observation procedures. Notably, proficiency in parasite detection rose from 58% in Round 1 to 97% in Round 3, demonstrating substantial skill enhancement.

Challenges faced by laboratory technicians were evident from initial low performance scores in specific tasks such as parasite counting (10% in Round 1) and staining of thick films (87% in Round 1). These results suggest difficulties related to technical skills or resource limitations. Although the graphs did not explicitly outline these challenges, the low scores highlight critical gaps that require targeted interventions.

Supportive supervision emerged as a transformative factor in improving diagnostic accuracy and timeliness. Significant progress was noted across all categories, particularly in later rounds. Near-perfect scores in areas like slide drying and waste management by Round 3 underscore the pivotal role of continuous guidance and mentorship in enhancing laboratory processes.

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The study also highlights potential benefits for healthcare professionals and patients. While these benefits were not directly visualized in the data, the improvement in technical proficiency indicates likely advancements in service delivery. These include more accurate and timely diagnoses, fewer instances of misdiagnosis, and overall improved patient outcomes. For healthcare workers, the gains translate into increased confidence, enhanced job satisfaction, and more efficient workflows.

Despite these successes, challenges remain. Limited funding, high staff turnover, and logistical barriers pose risks to the sustainability of the OTSS+ program (Hamer et al., 2019). To address these issues, integrating the OTSS+ model into national health policies and expanding its scope to include community-level healthcare providers is recommended. Additionally, leveraging digital tools for remote supervision and implementing refresher training programs could further strengthen the program's impact and sustainability (WHO, 2022).

In summary, the findings provide compelling evidence of the effectiveness of supportive supervision in enhancing the diagnostic capabilities of laboratory technicians. The results underscore the importance of mentorship-based interventions as a scalable solution to improve diagnostic accuracy, timeliness, and overall healthcare delivery in resource-limited settings.

CONCLUSION

The implementation of OTSS+ has demonstrated significant potential in improving malaria diagnostic service delivery in Sierra Leone. By combining hands-on training with supportive supervision, the program addresses key gaps in healthcare service delivery. However, sustained investment, policy integration, and innovation are required to ensure its long-term success

RECOMMENDATION

The findings indicate that the OTSS+ approach significantly enhances the skills and capacity of laboratory technicians and other healthcare professionals across various roles. This method emphasizes direct observation and coaching, replacing the traditional concept of supervision that lacked mentorship. Based on this analysis, continued support and mentorship are essential to further develop staff capacity and refine their skills.

- To embed OTSS+ into national health policies, it should be incorporated into the national malaria control strategy to ensure its sustainability and alignment with broader healthcare objectives. Adequate funding must be allocated to support OTSS+ initiatives, including staff training, supervision, and the procurement of diagnostic supplies. Moreover, robust monitoring and evaluation frameworks should be established to assess the effectiveness of OTSS+ and ensure accountability.
- From an institutional perspective, hospitals and laboratories require strengthened capacity through improved infrastructure and regular staff training. Decentralizing supervision by empowering regional health facilities will enhance OTSS+ implementation, improving coverage and efficiency. Human resource challenges, such as high staff turnover, should be addressed by introducing retention strategies, including incentives and career development opportunities for healthcare workers.
- Further research is necessary to evaluate the long-term impact of OTSS+ on malaria diagnostic accuracy and treatment outcomes. Additionally, the feasibility and benefits of extending OTSS+ to community health workers should be explored to strengthen primary healthcare systems. Finally, integrating digital tools, such as mobile applications, into the OTSS+ framework could improve supervision processes and enable real-time feedback mechanisms.

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