IMPROVING THE QUALITY OF MALARIA SERVICE DELIVERY:
Lessons Learned from the U.S. President’s Malaria Initiative Impact Malaria Project
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COVER PHOTOS:

Top: Sam Agbor Enow (left) supervises the preparation of malaria medicine injectable artesunate by Nurse Haoua Abba at Bogo District Hospital, Far North Region, Cameroon, September 23, 2021. Sam has been trained to provide Outreach Training Supportive Supervision Plus (OTSS+) to ensure that healthcare providers know, and can follow, national guidelines for correctly diagnosing and treating malaria. Photo Credit: Mwangi Kirubi, PMI Impact Malaria.

Bottom left: Nurse Gertrude Doku teaches her team how to conduct a malaria rapid-diagnostic test (mRDT) at the Tinkong Community–Based Health Planning and Services (CHPS) Compound in Ghana. Photo Credit: Emmanuel Attramah, PMI Impact Malaria.

Bottom right: A health provider in Zambia provides care to a child with malaria while an Outreach, Training, and Supportive Supervision (OTSS) visit takes place. OTSS is a quality assurance approach at the health–facility level, that uses standard automated checklists centered on continuous improvement of the competencies of health providers in malaria diagnosis and treatment. Photo Credit: PMI Impact Malaria
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The American Journal of Tropical Medicine and Hygiene is online at www.ajtmh.org
The U.S. President’s Malaria Initiative’s Support for Improving the Quality of Malaria Case Management Services: Fifteen Years of Progress and Learning

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Abstract. Since its launch in 2005, the U.S. President’s Malaria Initiative’s (PMI) investment in malaria case management has evolved based on lessons learned from its support to countries. An initial focus on updating malaria treatment policies to adopt artemisinin-based combination therapies achieved limited success, in part because of the poor quality of diagnostic and treatment services in targeted countries. In response, the PMI supported the development, refinement, and expansion of Outreach Training and Supportive Supervision (OTSS), a quality improvement approach that combines structured, competency-based supervision with corrective measures, including on-the-job training, coaching, troubleshooting, action planning, and timely follow-up. With 15 years of experience, the OTSS approach has been adopted by more than a dozen countries, and its effectiveness in improving the quality of malaria case management services has been documented. Through the PMI Impact Malaria Project, launched in 2018, the OTSS approach was expanded beyond case management of uncomplicated malaria to support quality improvement of inpatient management of severe malaria and malaria in pregnancy services delivered through antenatal care clinics. The OTSS platform also enabled targeted countries to respond rapidly to the COVID-19 pandemic by adding modules related to clinical management and laboratory diagnosis of suspected cases. The OTSS approach has been established as an effective approach to improve the quality of clinical malaria services and can be expanded to cover other health priorities. Further innovations to improve the quality of inpatient and community-based services, and further integration and institutionalization of OTSS into country health systems are needed.

U.S. PRESIDENT’S MALARIA INITIATIVE’S EARLY SUPPORT FOR MALARIA SERVICE DELIVERY

After decades of inattention by the global community and affected countries, the launch of Roll Back Malaria in 1998 and the Abuja Declaration in 2001 heralded a renewed interest in reducing death and disease from malaria.1 Newer, more effective tools, including insecticide-treated bed nets (ITNs), artemisinin-based combination therapies (ACTs), and malaria rapid diagnostic tests (mRDTs) offered hope that the burden of malaria could be greatly reduced. The launch of the Global Fund for AIDS, Tuberculosis, and Malaria (Global Fund) in 2001 and the U.S. President’s Malaria Initiative (PMI) in 2005 mobilized new, substantial funding for malaria control for the first time in many decades. This infusion of funding enabled malaria-affected countries to scale up these new tools.

The PMI focused early investments on scaling up preventive strategies, such as ITNs and indoor residual spraying, to demonstrate that investments in malaria control could yield rapid results, making the case for expanded funding.2 This focus on achieving early wins led the PMI to target its early support for malaria case management to assisting national malaria programs (NMPs) to implement the WHO’s 2001 guidance to adopt ACTs as first-line treatment of uncomplicated malaria and to introduce mRDTs.3 Focusing on replacing failing malaria treatments, such as chloroquine, with ACTs was viewed as the most efficient means of improving malaria outcomes, particularly malaria mortality, in the short term, with the limited resources available at the time. The PMI annual report for 20072 listed its key accomplishments for malaria case management as procurement of ACTs and mRDTs, and training health workers in their use.

However, there were additional barriers to accessing high-quality malaria services. For decades, the diagnosis of a large majority of malaria cases in sub-Saharan Africa had been based solely on clinical symptoms (fever) and physical findings. Common practice at the time was that any child with a history of fever would be treated for malaria when diagnostic testing was not available, which was most often the case. This guidance was based on ample evidence that large percentages of those presenting to health facilities with fever had malaria parasitemia.4 In addition, the widespread availability of cheap and safe malaria treatments, such as chloroquine, coupled with a lack of diagnostic testing capacity in most front-line facilities provided a strong rationale for so-called “clinical” diagnosis and treatment.

Despite the PMI’s contributions to global efforts to scale up ACTs and mRDTs, the 2010 world malaria report6 estimated that less than 20% of all suspected malaria cases in sub-Saharan Africa were tested, and only 65% of all malaria cases received treatment. Just 11 countries in sub-Saharan Africa had sufficient quantities of ACTs to meet their needs, and more than half of the countries had less than half the ACTs they required.

UPDATED WHO GUIDANCE, THE LANTOS-HYDE ACT, AND NEW OPPORTUNITIES TO STRENGTHEN MALARIA SERVICE DELIVERY

This lack of progress in malaria case management stimulated the WHO to update its diagnostic and treatment guidelines in 2009 and 2010, respectively.6,7 The new treatment guidance stated, “Parasitological confirmation of the diagnosis of malaria provided by high-quality microscopy or, where
this is not available, by RDTs is recommended for all suspected cases of malaria.” The higher cost of ACTs, the growing availability of low-cost mRDTs, and decreasing malaria prevalence in countries were factors leading to this change in guidance.

The PMI was well positioned to support countries to respond to these updated guidelines after the passage of the Lantos-Hyde U.S. Global Leadership against HIV/AIDS, Tuberculosis, and Malaria Reauthorization Act of 2008, under which overall annual funding for the PMI was expanded from $30 million in 2005 to $500 million in 2010, along with expanded support from three countries to a total of 15. The PMI also had launched the Improving Malaria Diagnostics (IMaD) Project in 2007, the main objective of which was to improve the quality of malaria diagnostic testing and increase effective treatment at health facilities.

The IMaD Project, the first PMI-funded global project to tackle quality improvement (QI) for malaria, faced a difficult environment. Diagnostic testing for malaria, particularly malaria microscopy, was largely unavailable. Laboratory assessments conducted by IMaD focus countries revealed that guidelines for malaria diagnosis were not up to date, refresher trainings were rarely conducted, and supervision/QI programs were not operating. These challenges were common throughout sub-Saharan Africa at the time. In addition, many clinicians did not trust malaria microscopy results, which were often of poor quality, and they were skeptical of mRDTs, which were just being introduced to health facilities. They most often relied on their clinical judgment alone. If clinicians suspected malaria, they commonly would ignore a negative test result and prescribe malaria treatment. If clinical practice was to change, malaria diagnostic testing quality would have to improve, and clinicians would have to trust and abide by the results.

OUTREACH TRAINING AND SUPPORTIVE SUPERVISION

With increased funding and expansion to 15 countries, the PMI expanded its country support for malaria case management—including procurement of ACTs, mRDTs, and microscopy supplies—and for refresher training of clinical and laboratory staff. The PMI also supported countries in conducting therapeutic efficacy studies to monitor for the emergence of drug resistance. Aligned with the PMI strategy, a number of countries developed tailored approaches to support strengthening of malaria case management.

Through the IMaD Project and two central projects that would follow, the MalariaCare Project (2012–2017) and the PMI Impact Malaria Project (2018–2024), the PMI initiated long-term investments to develop and refine an innovative QI approach for clinical and laboratory services at front-line health facilities. This approach was informed by lessons learned from past unsuccessful approaches, which focused primarily on classroom refresher training and cross-checking of blood slides at reference laboratories. The IMaD team adopted global best practices for improving provider performance by incorporating effective methods for adult learning, including on-the-job training, coaching, troubleshooting, action planning, and follow-up, to address deficiencies identified during supervision. The effectiveness of these adult learning methods are well documented.

The resulting model was Outreach Training and Supportive Supervision (OTSS), which built on existing country supervision programs while reorienting the approach from inventory and inspection to development and improvement of health worker competencies (Figure 1). Central to the OTSS model was the promotion of a functional, collegial supervisor–supervisee relationship based on two-way communication, respect, and teamwork that emphasized shared responsibilities for making continuous improvements in health worker performance and resolving operational bottlenecks.

The OTSS model was first piloted in Ghana in 2009 in collaboration with the Public Health and Reference Laboratory, which had previously piloted a system in 2004 for monitoring the accuracy of malaria-related laboratory tests using a network of laboratory supervisors. The 2004 pilot showed it could achieve coverage of peripheral health laboratories and staff, improve testing accuracy, and build health worker morale. The IMaD Project incorporated elements of this external quality assurance program into its OTSS model.

![Figure 1](https://example.com/figure1.png)

**Figure 1.** The OTSS quality improvement approach and its key components. HNQI5 = Health Network Quality Improvement System; MIP = malaria in pregnancy; OTSS = Outreach Training and Supportive Supervision.
The IMaD Project expanded on Ghana’s existing approach by incorporating clinical supervisors, which acknowledged the complementary roles of laboratory and clinical staff in malaria diagnosis and treatment. Locally adapted, standard, paper-based checklists were introduced to assess provider practices and facility readiness to deliver malaria services (Supplemental 1). Supervisors implementing the OTSS model used a standard method to assess the readiness of health facilities to diagnose and manage appropriately patients presenting with fever, and to assess the competency of health workers in performing key tasks. Laboratory competencies were assessed by observing laboratory staff preparation of malaria blood films, performance of mRDTs, and interpretation of test results. Clinical supervisors observed providers’ abilities to assess the patient and adhere to national diagnostic testing and treatment guidelines. The checklists broke down routine procedures comprehensively into trackable steps, enabling supervisors to determine objectively whether all steps were completed and to identify areas requiring support.

Supervisor training focused both on building technical knowledge and skills, and on instilling good supervisory practices based on supportive supervision principles. Laboratory supervisors received refresher training in malaria microscopy, and clinical supervisors, on clinical case management. Training also was provided on how to provide supportive feedback through coaching, troubleshooting, and problem solving. If, during an observation, a supervisor noted incorrect or unsafe procedures, or identified poorly functioning equipment or substandard supplies, they were trained to intervene after the observation and coach the health worker on the correct procedures and to troubleshoot problems in a respectful manner.

Laboratory supervisors also cross-checked 10 clinical blood slides by microscopy during each OTSS visit. In the event of discordant results, the supervisor took corrective action onsite, including reviewing the discordant slides with the laboratory worker or coaching the laboratory worker on how to prepare Giemsa stain properly. Unlike previous approaches, when slides were sent to reference laboratories for cross-checking, the OTSS approach provided opportunities to identify, correct, and reteach malaria microscopy skills onsite during the OTSS visit. When possible, NMPs also integrated proficiency testing schemes into OTSS visits by hand-carrying sets of well-characterized slides to assess the performance of laboratories in providing accurate results. Proficiency testing could only be conducted at a small number of facilities because of the limited number of blood slides available.

Building off the 2009 Ghana pilot, supervisors in countries adopting the OTSS model were drawn from national, regional, and district-level Ministry of Health (MOH) staff to facilitate the integration and sustainability of this QI approach. National malaria programs recruited clinical supervisors primarily from district health offices or referral hospitals, whereas laboratory supervisors were drawn from referral hospitals or reference laboratories. Having skilled supervisors at the district level was necessary if this approach was to be scaled up.

If performed efficiently, an OTSS visit generally took one half to a full day to complete, depending on clinic size. After the assessment, supervisors met with health facility staff to discuss results, develop facility-wide action plans with specific benchmarks, and provide on-the-job training and coaching. If essential supplies were lacking at a health facility, the supervisor could liaise with district or regional health staff to address stock outages.

The OTSS approach did not take health facility workers away from their posts, but allowed them to be assessed in their own work environment. It also did not cause major disruptions to health service delivery during the visit. Supervisors also could identify stock outages of commodities, poorly functioning equipment, or lack of clean water and electricity. Using the information collected, OTSS supervisors targeted on-the-job training to areas of weakness, and reported deficiencies that required higher level actions, none of which could occur in a traditional classroom training approach.

Although the OTSS model formed the foundation of the PMI and the IMaD Project’s QI approach, it was only part of a more comprehensive package that included supporting countries to update their policies on the diagnosis and treatment of malaria and targeted classroom training. For instance, malaria diagnostic refresher training was used to build the skills of supervisors, and sometimes frontline staff, leading to the identification of new high-performing supervisor candidates. Additional support included developing internal quality assurance procedures, and revising and distributing national guidelines documents, standard operating procedures, and job aids. The IMaD Project also initiated plans to support country development of slide banks for training and proficiency testing schemes, and coordinated implementation efforts with partners supporting supply chain management strengthening and social behavior change to improve the availability of essential medicines and commodities, and to strengthen efforts to improve care seeking and adherence to treatment.

By the end of the IMaD Project, the OTSS approach had been adopted by eight PMI-supported countries (Angola, Benin, the Democratic Republic of the Congo, Ghana, Liberia, Malawi, Mali, and Zambia). To assess the effect of the OTSS model on laboratory and clinical practices after more than 3 years of implementation, the IMaD Project commissioned a cross-sectional survey in 2012 of a random sample of health facilities in Benin and Ghana. The results of this survey demonstrated that 74% and 88% of microscopy results reviewed in Benin and Ghana, respectively, were accurate, and that more than 80% of all patients who tested positive received malaria treatment. That study also documented that one third of those with a negative test result also were treated for malaria. The lack of baseline data or a control group, and the limited scale-up of the OTSS model at that time prevented attribution of these results to the implementation of the OTSS approach specifically. A subsequent analysis of data from four rounds of OTSS in Zambia showed significant increases over baseline in the average scores for blood film preparation, blood film staining and reading, and mRDT performance by 14.7%, 14.0%, and 14.3%, respectively. Improvement of average scores from baseline also was documented for clinical management of fever (+7.3%) and prescriber adherence to negative test results (+7.2%).

OTSS EXPANSION AND INNOVATION

The close-out of the IMaD Project and launch of the follow-on MalariaCare Project in 2012 provided an
opportunity to refine and expand the OTSS model further as a more comprehensive approach to QI, focusing on the development of clinical and laboratory staff. To improve management of children with fever, the OTSS clinical checklist was revised to assess more comprehensively clinicians’ competencies in history taking, physical examination, assessment for danger signs, and identification of nonmalaria infections.20 The laboratory checklist was streamlined based on country feedback that it was cost and labor-intensive. MalariaCare also expanded the OTSS model to three additional countries (Kenya, Mozambique, and Tanzania) and made progress in increasing geographic coverage in Zambia, Malawi, and Ghana.

During the IMaD Project and the early years of MalariaCare, paper-based checklists made it challenging to document and disseminate OTSS findings. Although supervisors could intervene and support health workers during the visit, the data collected during these visits only became available to national and subnational health authorities months after supervisors completed their visits. Manual data entry was slowed by poor readability of the completed forms, missing entries, and lost or damaged forms, and typically took as long as 6 months for the final data analysis product to be available.21 This made it difficult for supervisors to follow-up or review past findings effectively before revisiting the health facility. These delays also hampered identification of broader systemic issues that could not be addressed in a timely manner.

In 2015, MalariaCare identified an open-source, District Health Information Software 2 (DHIS2)-based electronic data collection tool developed initially to monitor private-sector providers in the Greater Mekong subregion.22 This electronic data system (EDS) tool was adapted to support data collection for OTSS using tablet computers. Data were uploaded to a website where NMPs and local health authorities could visualize and track results on dashboards. In the five countries that piloted the EDS tool (Kenya, Mali, Mozambique, Tanzania, and Zambia), data completeness improved from 23% with paper-based forms to 95% with an EDS for clinical observation, and improved from 17% to 70% for microscopy observation.20,22 The average time for data to be analyzed and available decreased from 154 days to 29 days with EDS use. This equipped NMPs and their stakeholders with timely, accurate, and complete data to guide their program planning.

Despite the successes achieved through support by the IMaD Project and MalariaCare, a common critique by some observers was that OTSS and the broader QI package were donor-funded vertical interventions that lacked sufficient country buy-in and, therefore, were unsustainable. A closer examination of OTSS model implementation in supported countries revealed signs of country ownership. The most notable was the tailoring of the OTSS approach and its implementation by countries. To varying degrees, countries tailored standard OTSS checklists to suit their specific needs and interests, although efforts were made to maintain a consistent set of core data and indicators across supported countries (e.g., percentage of patients testing negative for malaria prescribed malaria treatment). Countries, including Ghana and Zambia, also decentralized supervisory, management, and analytic functions progressively (facilitated by the EDS tool) to the district level, which also facilitated scale-up of OTSS visits to the national level.

By the end of the IMaD Project in 2012, Benin’s OTSS program had been spun-off and supported by a PMI-funded bilateral partner. At the close of MalariaCare in 2017, the National Malaria Control Program in Tanzania had taken over implementation of the OTSS model and the country’s EDS. It further adapted the approach in subsequent years, adding a data quality improvement component and rebranding the approach as the Malaria Service Delivery Quality Improvement program.23 The National Malaria Elimination Center in Zambia also took over management of the EDS tool and expanded the OTSS model nationally by dividing implementation support geographically between MalariaCare, the Promoting Advancement in Malaria Outcomes Project, and a Global Fund-supported program covering participating Churches Hospital Association of Zambia facilities. The Ghana Health Service, considering how this program would be managed appropriately in the long-term, assigned leadership of laboratory OTSS to its laboratory division, whereas clinical OTSS was led by the NMP. These early signs of country ownership, and adoption by other projects and donors, provided some hope that the OTSS model could be sustainable.

THE U.S. PRESIDENT’S MALARIA INITIATIVE IMPACT MALARIA PROJECT AND THE OTSS PLUS APPROACH

After more than a decade of PMI support for the OTSS model and the larger QI package, and with additional published evidence that these efforts improved the quality of malaria diagnosis and case management,21,24,25 the PMI Impact Malaria Project launched in 2018 with a broader mandate. It would continue expansion of OTSS and related QI activities while adding support for QI of antenatal care (ANC) services to strengthen prevention and treatment of malaria in pregnancy (MIP). It also was expected to expand the collection and use of data to drive evidence-based decision making.

In the first years of PMI Impact Malaria, the OTSS model was launched in four new countries (Cameroon, Côte d’Ivoire, Niger, and Sierra Leone).26 In tandem with these launches, OTSS checklists were reviewed and streamlined through a consultative process with multiple country stakeholders, and harmonized to ensure a core set of indicators could be measured across countries. An ANC checklist to be administered by supervisory midwives was added to assess adherence to guidance on intermittent preventive treatment in pregnancy (IPTp) and provision of ITNs for pregnant women attending ANC. A separate checklist was developed for management of pregnant women with fever/suspected malaria. In addition, a record review checklist was developed to assess the management of severe malaria and its complications in inpatient facilities.

Rebranded as Outreach Training and Supportive Supervision Plus (OTSS+), this approach also increased focus on gender-sensitive and respectful care in the checklists and the training of supervisors. For example, health workers were assessed on whether they greeted the patient or caregiver, whether they informed the patient of the diagnosis and provided counseling, and whether they provided the opportunity for the patient or caregiver to ask questions.
This OTSS+ package was then presented to each MOH/NMP for review and adaptation, with the goal of having the MOH adopt the package formally for QI of health facilities. Seven countries, including the four new countries plus Madagascar, Malawi, and Mali, adopted the new OTSS+ package formally. Kenya and Zambia adopted components of the new package, and Rwanda adopted the ANC checklist as a companion to its existing clinical supervision checklists.

Beyond the updated and expanded checklist portfolio, PMI Impact Malaria brought further innovations into the OTSS+ package, including transitioning its primary data system from an EDS to the Health Network Quality Improvement System (HNQIS). The EDS tool had already demonstrated that digital data collection was feasible to implement and improved data quality, timeliness, and supervisors’ experiences. The HNQIS, an open-source, DHIS2-based software, brought with it a few additional features that changed significantly how data could be used.27 The HNQIS software included a built-in analytic capacity that would generate offline, real-time assessment scores for each checklist, as well as provide scores for each checklist section. This functionality enabled supervisors to share checklist scores with facility staff at the conclusion of the OTSS+ visit and to develop an action plan for addressing areas of poor performance. The HNQIS also added a feature that made it easier for supervisors to document and track action plans and progress through successive visits. Action plans help drive the QI process between OTSS+ visits, providing a framework for supervisors and health workers to discuss and monitor progress. Supervisors are encouraged to review action plans from previous visits before returning to a health facility, helping them set an agenda that prioritizes unresolved issues. The HNQIS was adopted quickly in those countries that launched the OTSS+ model with the support of the PMI Impact Malaria Project. Several countries, including Kenya, Malawi, and Zambia, which had been implementing the OTSS approach prior to the PMI Impact Malaria Project, also transitioned over time from using an EDS tool to the HNQIS to gain the improved functionalities of the new system.

Data collected through the HNQIS was uploaded automatically into the project’s data hub, which enabled PMI Impact Malaria country staff and their NMP counterparts to examine trends systematically over time in their countries and allowed project headquarters staff to conduct cross-country thematic analyses. When scores or trends were unsatisfactory or unexpected, subanalyses of the components of the checklist score were often conducted to determine whether there were specific components driving those low scores. For example, a subanalysis might have demonstrated that stock outages of commodities were a major factor resulting in low competency, or—alternatively—it might be the clinician’s failure to conduct a diagnostic test on suspected malaria cases. Armed with this information, supervisors and health authorities targeted follow-up actions to the specific areas of weakness.

At the country level, the data collected through the HNQIS allowed the development of tailored data dashboards for use by project staff and NMPs at national, regional, and district levels that were accessible through a web-based, password-protected login page (Figure 2). These dashboards generated data tables and visualizations of key scores and indicators from the data hub automatically that could be used by MOH/NMP staff to assess progress in QI and to use those data in data review meetings. In many cases, this was the first time that these health authorities were equipped with real-time data on the quality of malaria service delivery to inform decision making about program management and targeting.

A NEW QUALITY IMPROVEMENT FRAMEWORK

Despite the documented improvements in the quality of care in facilities supported by the OTSS+ model and the increasing scale of its implementation, MOH/NMP staff and other stakeholders also voiced some concerns. First among

![Figure 2. Example of an autogenerated data dashboard to display trends in scores for OTSS+ indicators. HNQIS = Health Network Quality Improvement System; OTSS+ = Outreach Training and Supportive Supervision Plus.](image-url)
them were the substantial human and financial resources required to mount an OTSS+ round (a defined period of time during which a number of facilities are visited).

Although the OTSS model was originally envisioned to have a quarterly visit schedule, countries rarely had the logistical capacity, skilled human resources, or financing to visit each facility four times per year. Some countries have only managed to conduct yearly visits to the targeted facilities. Competing ITN and seasonal malaria chemoprevention (SMC) campaigns often led to delays in OTSS+ visits because key staff where taken away from their duties. Countries also often lack the financial resources and skilled human capacity to visit all facilities, and often identify and prioritize poorly performing facilities or only target selected geographic areas.

Some countries, including Cameroon, Côte d’Ivoire, and Kenya, sought to reduce the frequency of OTSS+ visits and to target support to lower performing facilities by adopting blended QI strategies that combined the OTSS+ model with complementary QI approaches, including mentorship, peer-to-peer learning, and virtual approaches. The data gathered from OTSS+ visits were often used to identify low-performing facilities, which would then be targeted for mentorship visits in between OTSS+ rounds. Mentors would use the results of previous OTSS+ visits to address specific areas of weakness. As mentored health workers improved their performance in subsequent OTSS+ visits, mentors could then move to other low-performing facilities. Deploying mentorship in this manner allowed countries to reduce the frequency of OTSS+ visits to once or twice yearly.

The COVID-19 pandemic and its resultant travel restrictions stimulated the development of creative approaches to sustain OTSS+ and other QI activities. The PMI Impact Malaria Project supported supervisors and mentors in developing WhatsApp groups to follow up on action plans, provide a forum for health workers to ask questions, and conduct virtual mentorship. In the Democratic Republic of the Congo, scheduled OTSS+ supervisor training was conducted through a blended approach, with regional trainers present in the classroom, and national and international trainers presenting through video-conferencing. Even after travel restrictions were lifted, countries have continued to use hybrid approaches to maintain contact and provide information to their supervisees.27

Another innovation deployed in all PMI Impact Malaria-supported countries focused on building district-level capacity to analyze and use data to monitor trends in key indicators, and to identify areas that required corrective actions. Using quarterly district data reviews, supervisors and facility heads shared OTSS+ and health management information system data with their peers, along with lessons learned and best practices on how to improve their performance. At the national level, lessons-learned workshops used a similar peer-to-peer learning approach, bringing together NMPs and key national stakeholders with district and regional health authorities to review the most recent round of OTSS+ visits and develop plans to address identified deficiencies.

The lessons learned from these country innovations resulted in the PMI Impact Malaria Project developing an updated QI framework, with the OTSS+ approach remaining the cornerstone of its QI efforts and its main source of QI data. Mentorship, peer-to-peer learning, and classroom training complement the OTSS+ model. Adoption of this QI framework spurred further innovations. Some components of supervisor training are currently being converted into an e-learning format. Additional e-learning courses on how to perform an mRDT, how to manage severe malaria and administer rectal artesunate, and how to assess for gestational age when deciding when to initiate IPTp also are under development.

**Diversification and Institutionalization**

Although the COVID-19 pandemic presented major challenges to OTSS+ model implementation, it also presented opportunities to test the adaptability of the approach to expand its focus beyond malaria. In 2020, PMI Impact Malaria was requested to support facility-based QI for COVID-19 in Cameroon, the Democratic Republic of the Congo, and Ghana, where it already supported the OTSS+ model.28 The PMI Impact Malaria Project worked quickly with those countries to develop OTSS+ checklists on respiratory specimen collection and processing, biosafety, personal protection, clinical triage, and management of suspected COVID-19 cases, aligned with global and national policy guidance. The existing OTSS+ networks and supervisors in these countries provided the platform to implement these new checklists. In many cases, the COVID-19 supervision was conducted in tandem with planned malaria OTSS+ visits. Based on the initial implementation of the COVID-19 OTSS+ modules, both Cameroon and the Democratic Republic of the Congo have integrated these checklists into their ongoing routine OTSS+ visits.

The OTSS model also has served as the platform for countries to expand QI activities for a broader range of public health priorities. With PMI Impact Malaria support, the Ghana Health Service developed and launched integrated supportive supervision, which is used to monitor the performance of health facilities in multiple technical areas, including child and reproductive health and malaria, as part of the implementation of the country’s national health insurance scheme. Malawi is following suit and has plans to launch “integrated OTSS,” which expands the technical focus of OTSS to cover supply chain and data quality, similar to the approach used in Tanzania. These local adaptations are likely key to the success of sustaining the intervention.29

Early in the development of the OTSS model, it was recognized that long-term success required efforts to institutionalize this approach within country primary health-care systems. With that goal in mind, OTSS+ supervisors are drawn from district and regional health authorities and facilities. District and regional health offices were engaged in implementing OTSS+ visits, chaired data review meetings, and participated in developing and implementing action plans to address cross-cutting challenges. Ministry of Health staff led the review, adaptation, validation, and formal adoption of all checklists.

Learning lessons from prior projects, during which OTSS data were sometimes lost as one project closed and another was launched, PMI Impact Malaria has prioritized institutionalization of OTSS data systems, shifting data management from the project to MOHs in the Democratic Republic of the Congo, Tanzania, and Zambia, and to bilateral projects in Benin and Côte d’Ivoire. Data system transitioning also is
underway in the remaining OTSS+ countries and is tailored to government systems and digital policies. To support this transition, the PMI Impact Malaria Project is purchasing country-based servers or securing cloud server capacity, training appropriate MOH staff in data systems administration, and building the capacity of relevant national and subnational health staff to analyze and use data.

Financing of the OTSS model also has evolved. In Ghana and Tanzania, support for OTSS visits and logistics is provided directly by the MOH, with the PMI providing funding support directly to the government. Although it is anticipated that ongoing technical assistance and financial support will continue to be a need in most countries implementing the OTSS model, in some countries, such as Ghana and Zambia, those needs are diminishing over time.

NEW CHALLENGES AND OPPORTUNITIES FOR EXPANSION

During 5 years of implementation, the PMI Impact Malaria Project has supported NMPs to conduct 11,403 OTSS+ visits to 4,805 health facilities in 10 countries. These figures do not include OTSS visits conducted by other partners and countries, including Benin and Tanzania. A small number of countries have achieved national or near-national scale, including Ghana, Madagascar, and Zambia. Many other countries are still in the process of scaling up or have targeted the OTSS+ model specifically to limited geographic areas (Niger and Cameroon) or to specific facility types (the Democratic Republic of the Congo). In the absence of reliable information on the numbers of facilities in many targeted countries, accurate estimates of the coverage of the OTSS+ approach are elusive. Nonetheless, many countries have much more work to do to expand OTSS+ to all facilities that would benefit from it.

The main barrier to additional expansion of the OTSS+ model is financial. Countries and donors often prioritize support for preventive strategies (e.g., ITNs, SMC) over support for case management. An analysis conducted in 2017 during MalariaCare, examining cost data for daily allowances and transport (the main cost drivers for the OTSS model) for the last OTSS visit in seven countries, calculated a cost range of $44 to $333 per visit. Costs were higher when supervisors had to travel longer distances, stay overnight to complete the supervision visits, or had to hire vehicles for travel. With the OTSS+ model, in which supervisors are based at the district level and can complete an OTSS+ visit and return home in a single day, costs will lower per visit. Based on these data, if we were to construct a hypothetical scenario where a medium-size country with 5,000 health facilities received OTSS visits twice yearly at a cost of $250 per visit (taking into account recent global inflation), the cost for OTSS visits would be approximately $2.5 million per year. Of course, this is an oversimplification of visit costs and does not include the costs for additional activities, such as supervisor refresher training and review meetings. Nonetheless, the cost range of running an OTSS program at scale would be a small component of many countries’ current budgets for malaria control/elimination.

The lack of skilled human resources also is a barrier to achieving scale in many countries. The experiences through the IMaD, MalariaCare, and PMI Impact Malaria projects clearly demonstrate, though, that supervisory skills can be developed and strengthened at subnational levels, facilitating OTSS+ expansion.

In most countries, OTSS+ and complementary QI approaches have focused primarily on outpatient care at public health facilities. The PMI Impact Malaria Project developed an OTSS+ severe malaria checklist for inpatient units that relies on record reviews. Given the complexity of severe malaria and its management, this approach to QI has its limitations, because it can only assess a limited number of clinical scenarios and does not provide opportunities for supervisors to observe providers and offer coaching and on-the-job training. In Cameroon, Kenya, and Niger, PMI Impact Malaria has supported NMPs to pilot alternative approaches to improve inpatient management of severe malaria. These programs seek to build mentoring relationships between well-trained and experienced clinicians and their colleagues, using tools such as individual case reviews and targeted onsite training linked to actual clinical cases in those facilities. They also use virtual approaches such as virtual mentoring and WhatsApp group chats that allow clinicians to seek timely guidance from their peers. These pilots, which are ongoing, will determine whether such approaches are feasible and effective.

As countries have scaled up integrated community case management (iCCM) programs progressively, they have been challenged on how to improve and maintain the quality of services provided outside of fixed health facilities. The lack of proven QI strategies for iCCM and the challenges of supervising a large number of highly dispersed community health workers (CHWs), often based in remote settings, has impeded countries in these efforts. Building off the lessons learned through facility OTSS+, PMI Impact Malaria has developed a competency-based observation checklist that aligns with the standard iCCM algorithm. A companion readiness checklist examines record keeping and the availability of essential equipment and commodities. This community OTSS approach is being piloted in Cameroon, Mali, and Niger, with each country using different implementation approaches (Y. M. Bernard, personal communication). For example, Cameroon organizes so-called rally posts that bring together multiple CHWs in a single accessible location, similar to a health fair. This allows patients and caretakers access to needed services, and also enables supervisors to observe multiple CHWs managing sick children at the same time and location. Approaches like this can improve efficiency, but require planning, community mobilization, and coordination of key stakeholders.

Some countries also have expanded the OTSS+ approach to a limited number of private-sector facilities, primarily private hospitals and clinics. In these settings, the current OTSS+ approach can be implemented without major adaptations. Quality improvement for other segments of the private sector—particularly private pharmacies and medicine sellers, which are often a major source of malaria treatment—still faces major regulatory and logistical barriers that must be overcome if we are to achieve the goals of eliminating disease and death from malaria.

CONCLUSION

The continued commitment of the PMI to improving the quality of service delivery is a key component of its 2021 to
2026 strategy, End Malaria Faster, which builds on progress already made to expand access to quality services, reach the unreached, tailor interventions based on data, address threats to malaria programming by developing resilient malaria services, and take advantage of opportunities to end malaria within our lifetime.35

This supplement includes articles that demonstrate the effectiveness of the OTSS+ model and complementary QI approaches in improving the quality of clinical services for malaria. The articles in this supplement also document the feasibility of implementing this approach at scale in multiple countries by building supervisory, management, and analytic capacities at national and subnational levels. The OTSS+ model has also demonstrated flexibility in incorporating new QI objectives, such as MIP, data quality monitoring, and COVID-19, as well as expanding beyond outpatient care to incorporate community and inpatient services.

Through 15 years of investment in OTSS and other QI approaches, the PMI has supported a continuous cycle of implementation, learning, refinement, and expansion that has led to measurable improvements in malaria services and the health systems that support it. However, much more can and should be done to improve the access to and quality of malaria service delivery.

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REFERENCES


Can Outreach Training and Supportive Supervision Improve Competency in Malaria Service Delivery? An Evaluation in Cameroon, Ghana, Niger, and Zambia

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Abstract. Outreach Training and Supportive Supervision (OTSS) of malaria services at health facilities has been adopted by numerous malaria-endemic countries. The OTSS model is characterized by a hands-on method to enhance national guidelines and supervision tools, train supervisors, and perform supervision visits. An independent evaluation was conducted to evaluate the effectiveness of OTSS on health worker competence in the clinical management of malaria, parasitological diagnosis, and prevention of malaria in pregnancy. From 2018 to 2021, health facilities in Cameroon, Ghana, Niger, and Zambia received OTSS visits during which health workers were observed directly during patient consultations, and supervisors completed standardized checklists to assess their performance. Mixed-effects logistic regression models were developed to assess the impact of increasing OTSS visit number on a set of eight program-generated outcome indicators, including overall competency and requesting a confirmatory malaria test appropriately. Seven of eight outcome indicators showed evidence of beneficial effects of increased OTSS visits. Odds of health workers reaching competency thresholds for the malaria-in-pregnancy checklist increased by more than four times for each additional OTSS visit (odds ratio [OR], 4.62; 95% CI, 3.62–5.88). Each additional OTSS visit was associated with almost four times the odds of the health worker foregoing antimalarial prescriptions for patients who tested negative for malaria (OR, 3.80; 95% CI, 2.35–6.16). This evaluation provides evidence that successive OTSS visits result in meaningful improvements in indicators linked to quality case management of patients attending facilities for malaria diagnosis and treatment, as well as quality malaria prevention services received by women attending antenatal services.

INTRODUCTION

Quality case management is critical to reducing the burden of malaria, including ensuring that patients receive a parasitological diagnosis and, when confirmed to have malaria, receiving prompt and appropriate treatment. With health systems in malaria-endemic areas continuing to face pressures from resource constraints (human, financial, and commodities), optimizing the quality of care received by patients seeking care within the public health sector is both of high importance and inherently challenging in a dynamic environment.

More than 15 years after the widespread rollout of rapid diagnostic tests (RDTs) for parasitological confirmation of malaria and the introduction of artemisinin-based combination treatment (ACT) for uncomplicated malaria, there continue to be gaps in the quality of diagnosis and treatment of malaria.1 Intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine–pyrimethamine (SP), a safe and effective method to protect mother and child from malaria, continues to have low coverage. Among 33 African countries with IPTp policies and moderate to high transmission, only 55% of eligible pregnant women during 2021 were estimated to have received the first dose of IPTp, and only 33% received the third IPTp dose.2 Despite national guidelines emphasizing the importance of diagnosis, treatment, and IPTp, ensuring quality of service within health facilities is a critical challenge.

A range of strategies has been tested to improve quality of malaria case management, with available evidence and estimated effects compiled in the Health Care Provider Performance Review in 2018.3 Although comparing the effect size of interventions among studies is challenging because of the diverse range of interventions tested and methodological heterogeneity, training and supervision interventions are one of the most commonly explored interventions, and they have a moderate effect size.3 An area identified for further research included identification of the attributes of training and supervision that are associated with effectiveness to refine these tools and enhance their effectiveness further. Supportive supervision as an intervention to improve quality of care has been widely adopted and is often considered a core health system strengthening approach,4 but has varying interpretations, and implementation can be irregular and have low coverage.5

Outreach Training and Supportive Supervision (OTSS) for malaria care improvement has been adopted by a number of low- and middle-income countries as part of a continuous improvement process. Supportive supervision approaches emphasize building relationships between health facility staff and supervisors who model their approach to performance improvement after a coach or mentor.5 Emphasis is also placed on using supervisory visit-generated data to monitor performance and to solve problems jointly under a paradigm that avoids finding fault with or enforcing punitive actions on specific individuals.6 OTSS activities can be considered a more hands-on method than existing routine supervision approaches, encompassing revision of national guidelines and supervision tools, consistent supervisor training and debriefing, and resources for supervisor travel. The pathways to change from outputs to outcomes are dependent on a combination of mutually reinforcing activities underpinned by dissemination of national guidelines (e.g., malaria case management, drug-based malaria prevention, malaria in pregnancy [MIP]) and the presence of trained health workers
across health system levels (public, private for profit, private not for profit, and community). The OTSS approach assumes that for patients to receive quality services, key outputs must be achieved: standardized checklists, a pool of highly qualified supervisors, the capacity to analyze and interpret the data generated, and the capacity to address areas of concern.

Previous research on the initial evaluation of the malaria-specific OTSS model (the Improving Malaria Diagnostics [IMaD] Project, 2008–2012), which used a multistep checklist to track performance, found modest but significant improvements in malaria microscopy and RDT performance in Zambia (~14% increases), as well as improvements in fever case management practices and prescriber adherence to negative malaria test results (~7% increases) from the first to the fourth OTSS visit among 88 laboratory and 64 clinical settings. Assessed laboratories were also found to have significant declines in stock outages of microscopy reagents/consumables, with significant increases in instituting the use of microscopy positive controls and conducting malaria parasite quantification.

After the second incarnation of the OTSS model for malaria (the MalariaCare Project, 2012–2017), a seven-country joint analysis that covered 1,037 health facilities found modest improvements in blood slide preparation and interpretation after two to three supervisory visits. Overall malaria microscopy performance assessed by a 30-step checklist found the mean score at baseline was 85.7%, and predicted an increase of 3.6% (P < 0.001) in facility scores after three visits. Assessment of change in RDT performance across eight countries covering 3,603 health facilities estimated that performance improved modestly, by 5.3%, from the first to the second visit (P < 0.001), and improved only by 0.6% (P = 0.10) between the second and third visits; however, average baseline scores were relatively high at 85%. The same program provided supervisory visits to 3,563 health facilities across eight countries and, using a 25-point checklist for direct observation of patient consultations, found a 6.3% increase on overall clinical performance (P < 0.001) related to febrile case management from the first to the third visit. After three visits, the analysis noted an increased percentage of health workers checking for factors associated with malaria-related morbidity and mortality (i.e., signs of severe malaria, pregnancy, and anemia).

A set of best practices were identified after the MalariaCare project, which implemented activities across 17 sub-Saharan African countries, including the development of performance evaluation tools that emphasize opportunities and prioritize time for mentorship in addition to data collection, the use of competency criteria in the selection of supervisors with ongoing skills assessment of those selected, a dynamic health facility selection scheme for enrollment into the OTSS program that assesses the intensity of and overall need for support continually, and a system that promotes the analysis of OTSS visit–generated data for decision making.

The current independent evaluation aimed to generate evidence on the effectiveness of the current malaria OTSS approach (Impact Malaria Project, 2018–2022) on malaria case management performance, RDT and microscopy performance, and on the use of IPTp during routine antenatal care (ANC) consultations in Cameroon, Ghana, Niger, and Zambia, specifically if receipt of an increased number of OTSS visits to a facility resulted in improved performance as assessed through OTSS checklists. The Impact Malaria Project introduced the OTSS+ approach, which is described as a new approach of supportive supervision at the facility level that uses standard automated checklists centered on continuous improvement of the competencies of health providers in malaria diagnosis and treatment. Specifically, this approach streamlines existing checklists used for health worker observation; includes a new module to assess provider competency in prevention and treatment of MIP during ANC; uses a digital software platform to process data instantly during the supervisory visit, which enables more immediate feedback; and expands coverage to include facilities without laboratories. For readability, the approach is referred to herein as OTSS (without the plus sign). The evaluation results are expected to inform decision making by ministries of health, funders, and implementers that are planning to introduce OTSS or, where already implemented, to consolidate and expand the use of the OTSS approach and contribute to the evidence to achieve universal access to high-quality malaria service delivery.

MATERIALS AND METHODS

Evaluation objective. The primary evaluation question was to assess whether current OTSS interventions delivered through the Impact Malaria Project improved the quality of malaria service delivery. The independent evaluation used a mixed-methods design. Qualitative components of the evaluation, including an online survey, in-depth interviews, and focus group discussions, are reported in a separate publication, whereas this work focuses on a quantitative analysis of OTSS visit records. Further results from the independent evaluation, along with background information on the IMaD, MalariaCare, and Impact Malaria OTSS projects are available elsewhere.

Study area and OTSS procedures. Data from facilities in four countries were included in this study: Cameroon, Ghana, Niger, and Zambia. These four countries were selected purposively to reflect countries with a longer history of OTSS (Ghana and Zambia) and recent adopters (Cameroon and Niger), and with francophone and anglophone settings, and to capture some variability in OTSS implementation strategy and experience. The first iteration of the OTSS program started in 2008 under the U.S. President’s Malaria Initiative (PMI)-funded IMaD Project, which ran until early 2012. The second iteration, the PMI-funded MalariaCare Project, began immediately thereafter and ran until 2017. The PMI-funded Impact Malaria Project, the focus of this evaluation, represents the third iteration of the OTSS program and has benefited from the previous 10 years of networking, capacity building, implementation activities, and operations research. Each successive version of the OTSS program built on the predecessor projects, expanding from a diagnostic-centric improvement approach to encompass malaria case management, overall quality of care, and the use of data for decision making.

During an OTSS visit, supervisors visit a health facility and observe facility staff during patient consultations, completing a standardized checklist during the observation. Separate checklists are used to assess 1) clinical case management
of malaria, 2) preparation and interpretation of RDTs, 3) preparation of blood films and reading by light microscopy, and 4) prevention of MIP procedures during routine ANC visits. Additional OTSS checklists are used in some countries but are not part of this evaluation. Checklists are similar among countries, but national malaria control programs adapt and refine template checklists to the local context. Subnational supervisors were generally recruited by regional and district directors based on specified criteria in relation to their technical skills and experience in different malaria service delivery areas. Supervisors complete a training program prior to undertaking OTSS visits, and complete checklists using a mobile-based application that includes skip patterns and calculates summary scores automatically. Supervisors may move in teams to complete multiple checklists concurrently at large facilities or may work independently to complete each checklist consecutively at smaller facilities with fewer staff and lower patient flow. Up to three health worker–client observations are completed for each checklist on each OTSS visit to a facility. When supervisors identify issues, same-day feedback and on-the-job training are provided, and action plans developed to address priority issues. Frequency of OTSS rounds is generally quarterly or biannually, but health facility prioritization differs by country, with some targeting according to geography, and others using previous OTSS performance and/or routine malaria surveillance indicators.

Data extraction. Data included in this evaluation were collected during OTSS visits to health facilities in the four target countries under the auspices of Impact Malaria. No additional primary data collection was completed for the purpose of this evaluation. The data available included all indicators collected on OTSS checklists at the individual health worker observation level (up to three health workers observed at each facility and OTSS visit), as well as automatically calculated summary scores for each OTSS checklist domain (clinical, MIP, RDT, and microscopy).


Indicator definitions across the four countries were checked for consistency of coding prior to pooling data. The OTSS summary checklist scores (clinical, MIP, RDT, and microscopy) were converted from a continuous measure (0–100) to a binary indicator of health workers being deemed competent (score ≥90) or not competent (score <90). This threshold was chosen to match the program targets used by Impact Malaria, where a score of ≥90 indicates competence. Because the same health facilities were not necessarily visited in every OTSS round, health facility name was used as a linking variable to calculate the OTSS visit iteration (e.g., first visit, second visit) independent of OTSS round. When individual checklist indicators were missing, it was assumed they were not assessed on the visit and were thus excluded from the data set for the specific outcome indicator.

Data analysis. Descriptive analysis of OTSS overall checklist scores over time used spaghetti plots, whereby a line plot is used to display individual health facilities’ scores over each visit iteration, with an overall fitted linear trend to indicate the relationship between OTSS visit iteration and outcome score.

Mixed-effect logistic regression models were generated to assess the association between increasing number of OTSS visits and changes in malaria case management performance as assessed by OTSS checklists. The continuous exposure was the OTSS visit iteration at the facility (i.e., first, second, and third OTSS visit). OTSS visits completed prior to the Impact Malaria Project (e.g., under the MalariaCare or IMaD projects) were not considered in these models (see supplemental information for sensitivity analyses incorporating MalariaCare data). Separate models were generated for each of the eight outcome indicators: overall competency (score ≥90%) for the four checklist domains (clinical malaria management, MIP, RDT, microscopy), and four key checklist indicators that reflect critical decision points (if parasitological test is requested appropriately, clinician not prescribing antimalarial drugs to patients with negative malaria test results, supervisor agreement with clinician’s final diagnosis, and whether SP is provided correctly to pregnant women eligible for IPTp) (Table 1).

Inclusion criteria for the mixed-effect models were 1) the facility received more than one OTSS visit during the Impact Malaria Project (2018–2022) where the specific OTSS checklist was completed and 2) a summary checklist score <90% on the first OTSS visit under Impact Malaria. Logistic regression models included country as a fixed effect, and facility as a random effect to account for nonindependence of observations from the same facilities. These models can be considered a dose–response design, where the dose is the OTSS visit iteration and the response is the checklist-derived score or performance indicator. All analyses were completed using RStudio (version 4.1.0; Posit, Boston, MA) and model fitting was completed with the GLMMadaptive package.15

Predicted probabilities and marginal effects of models were used to assess the potential number of OTSS rounds needed in each country to achieve acceptable results across the outcome domains, and to determine where diminishing returns might be relevant to program planners. Predicted probability plots were generated from fitted models for each outcome indicator up to the highest visit iteration observed within the pooled data set; however, this strategy resulted in out-of-range predictions for some countries (e.g., in Ghana where facilities received a maximum of two OTSS visits, but predicted probability plots for some indicators were generated for OTSS visits 3 and 4).

A sensitivity analysis expanded the mixed-effect logistic regression models to include OTSS visits completed in Ghana and Zambia under a previous OTSS implementation mechanism (MalariaCare), incorporating up to 10 total OTSS visits to individual facilities (full methods and results detailed in supplemental information). A second sensitivity analysis modified inclusion criteria for mixed-effect models to allow inclusion of health facilities that met competency thresholds on their first OTSS visit iteration under the Impact Malaria Project. Further sensitivity analyses assessed interactions between country and the eight outcome indicators. All data analysis and reporting followed Strengthening the Reporting of Observational Studies in Epidemiology guidelines.16
RESULTS

Data were available from 46,969 OTSS health worker patient observations completed under the Impact Malaria Project from the clinical checklist (n = 13,567), MIP checklist (n = 17,758), RDT checklist (n = 13,156), and microscopy checklist (n = 2,488). A total of 1,893 observations were from Cameroon, 38,080 from Ghana, 1,226 from Niger, and 5,770 from Zambia. Of 5,119 total facilities with any OTSS visit, 542 other facilities were excluded from one or more domain models because of the availability of checklist data for only one visit reported under Impact Malaria, 4,635 facilities were excluded from at least one final domain-specific data set because of the availability of checklist data for only one OTSS visit. A total of 4,183 facilities were excluded from all domain-specific data sets because of the receipt of only one OTSS visit. In addition, 542 other facilities were excluded from at least one final domain-specific data set used for logistic regression models because of high performance (overall score ≥90 on checklist) on the first OTSS visit (Table 2).

Spaghetti plots of all facilities receiving more than one OTSS visit, and the change in checklist score following each successive OTSS visit iteration, are shown in Figure 1. Increasing linear trends are apparent for Cameroon and Niger MIP scores, and Cameroon, Niger, and Zambia clinical scores. Consistent high performance is seen in most facilities for RDT checklist performance.

Mixed-effect logistic regression models using pooled data from the four countries indicate an association between the increasing number of OTSS visits received by a health facility and improving performance. Of the eight outcome indicators from at least one final domain-specific data set used for logistic regression models because of high performance (overall score ≥90 on checklist) on the first OTSS visit (Table 2).

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Mixed-effect logistic regression models using pooled data from the four countries indicate an association between the increasing number of OTSS visits received by a health facility and improving performance. Of the eight outcome indicators

### Table 1

Summary of indicators selected for use as primary indicators in models, their checklist source (domain), and outcome definition and coding.

<table>
<thead>
<tr>
<th>Domain checklist</th>
<th>Indicator</th>
<th>Outcome definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical case management</td>
<td>Health worker competent in clinical malaria management</td>
<td>1: Competent (score ≥90 on clinical checklist) 0: Not competent (score &lt;90 on clinical checklist)</td>
</tr>
<tr>
<td>RDT</td>
<td>Health worker competent in RDT preparation and interpretation</td>
<td>1: Competent (score ≥90 on RDT checklist) 0: Not competent (score &lt;90 on RDT checklist)</td>
</tr>
<tr>
<td>Microscopy</td>
<td>Health worker competent in malaria microscopy</td>
<td>1: Competent (score ≥90 on microscopy checklist) 0: Not competent (score &lt;90 on microscopy checklist)</td>
</tr>
<tr>
<td>Malaria in pregnancy</td>
<td>Health worker provided three pills of SP to pregnant women eligible for IPTp</td>
<td>1: IPTp was given to eligible women 0: IPTp was not given to eligible women</td>
</tr>
</tbody>
</table>

**OTSS** = Outreach Training and Supportive Supervision; **RDT** = rapid diagnostic test; **SP** = sulfadoxine–pyrimethamine.

### Table 2

Summary of OTSS data from Cameroon, Ghana, Niger, and Zambia: Total OTSS rounds received, reasons for facility exclusion from final domain datasets, and number of facilities retained in each OTSS domain model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cameroon</th>
<th>Ghana</th>
<th>Niger</th>
<th>Zambia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total OTSS rounds under the Impact Malaria Project</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>OTSS rounds under prior project (not included in models)</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Health facilities receiving an OTSS visit for any of the four checklists under the Impact Malaria Project</td>
<td>445</td>
<td>3,949</td>
<td>103</td>
<td>622</td>
</tr>
<tr>
<td>Health facilities excluded from one or more domain models because of the receipt of one OTSS visit for a specific domain</td>
<td>368</td>
<td>3,861</td>
<td>8</td>
<td>398</td>
</tr>
<tr>
<td>Total no. of health facilities remaining in the data set for dose–response models in each domain</td>
<td>103</td>
<td>124</td>
<td>56</td>
<td>259</td>
</tr>
</tbody>
</table>

OTSS = Outreach Training and Supportive Supervision; RDT = rapid diagnostic test.
FIGURE 1. Spaghetti plots describing the performance of individual health facilities over successive OTSS visits (grey lines), and fitted linear trend (blue line). MIP = malaria in pregnancy; OTSS = Outreach Training and Supportive Supervision; RDT = rapid diagnostic test.
assessed in separate models, there was statistical evidence for an effect of increasing OTSS visits on improved performance against seven indicators (Table 3). The only indicator for which no association was found was whether the OTSS supervisor agreed with the clinician’s classification of a patient as no malaria, uncomplicated malaria, or severe malaria ($P = 0.175$). The largest effect estimates were observed for the outcomes of health worker abstaining from providing an antimalarial prescription after negative microscopy or RDT result (odds ratio [OR], 3.80; 95% CI, 2.35–6.16), meaning a more than three times increase in the odds of correct prescribing behavior for each additional OTSS visit made to the facility. Similarly, the odds of administering SP correctly to eligible pregnant women increased by five times for each additional OTSS visit (OR, 5.20; 95% CI, 3.02–8.95). Odds of health workers reaching competency thresholds for MIP increased by more than four times for each additional OTSS visit (OR, 4.62; 95% CI, 3.62–5.88), with similar effect sizes observed for malaria RDT competency (OR, 4.47; 95% CI, 3.62–5.53). A large effect was also seen for malaria microscopy, for which each additional OTSS visit resulted in 10 times the odds of the health worker meeting the competency threshold (OR, 10.73; 95% CI, 4.04–28.52).

Predicted probability plots (Figure 2) illustrate that most competency indicators show diminishing returns to greater numbers of OTSS visits on the probability of success scale within the number of visits seen in the OTSS activities to date in the four countries. When the predicted probability of a successful outcome (e.g., competency in RDT or administering SP for IPTp to eligible women) approaches a value of one in predicted probability plots, we consider to have reached saturation. For example, RDT competency appears to reach saturation after facilities have received three prior OTSS visits. Competency in MIP also approaches saturation in Ghana when facilities have received three prior OTSS visits, whereas Cameroon, Niger, and Zambia have not yet reached saturation after the same number of OTSS visits. Other indicators such as agreement on patient classification and requesting laboratory tests appropriately have a high probability of success at baseline (no previous OTSS visits), even after exclusion of facilities from the data set that met overall clinical competency thresholds at their first OTSS visit.

<table>
<thead>
<tr>
<th>Primary outcome indicator</th>
<th>Fixed effect</th>
<th>Observations</th>
<th>Health facilities</th>
<th>OR</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health worker competent in malaria clinical management (overall score ≥ 90)</td>
<td>OTSS visit iteration, $N$</td>
<td>2,957</td>
<td>572</td>
<td>2.05</td>
<td>1.83–2.30</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>1,425</td>
<td>217</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>440</td>
<td>159</td>
<td>0.14</td>
<td>0.09–0.21</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>720</td>
<td>109</td>
<td>0.96</td>
<td>0.72–1.27</td>
<td>0.753</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>372</td>
<td>87</td>
<td>0.40</td>
<td>0.28–0.57</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Laboratory test was requested appropriately to confirm malaria</td>
<td>OTSS visit iteration, $N$</td>
<td>2,806</td>
<td>571</td>
<td>1.36</td>
<td>1.12–1.66</td>
<td>0.002</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>1,364</td>
<td>216</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>440</td>
<td>159</td>
<td>2.07</td>
<td>1.25–3.44</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>630</td>
<td>109</td>
<td>0.63</td>
<td>0.45–0.88</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>372</td>
<td>87</td>
<td>5.07</td>
<td>2.17–11.88</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Clinician did not prescribe any antimalarial drugs to an individual with negative malaria microscopy or RDT result</td>
<td>OTSS visit iteration, $N$</td>
<td>797</td>
<td>441</td>
<td>3.80</td>
<td>2.35–6.16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>394</td>
<td>176</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>224</td>
<td>136</td>
<td>0.02</td>
<td>0.01–0.03</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>118</td>
<td>76</td>
<td>0.76</td>
<td>0.32–1.81</td>
<td>0.541</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>71</td>
<td>53</td>
<td>0.76</td>
<td>0.23–2.35</td>
<td>0.611</td>
<td></td>
</tr>
<tr>
<td>Supervisor agreed with clinician’s classification of patient as not malaria, uncomplicated, or severe</td>
<td>OTSS visit iteration, $N$</td>
<td>2,465</td>
<td>554</td>
<td>1.15</td>
<td>0.94–1.40</td>
<td>0.175</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>1,358</td>
<td>216</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>215</td>
<td>142</td>
<td>0.79</td>
<td>0.45–1.40</td>
<td>0.426</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>592</td>
<td>109</td>
<td>0.82</td>
<td>0.52–1.27</td>
<td>0.370</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>300</td>
<td>87</td>
<td>3.71</td>
<td>1.58–8.72</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Health worker competent in malaria microscopy (overall score ≥ 90)</td>
<td>OTSS visit iteration, $N$</td>
<td>290</td>
<td>63</td>
<td>10.73</td>
<td>4.04–28.52</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Zambia, $n$</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>10</td>
<td>5</td>
<td>1.73</td>
<td>0.14–22.08</td>
<td>0.662</td>
<td></td>
</tr>
<tr>
<td>Ghana (ref.), $n$</td>
<td>260</td>
<td>58</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Health worker competent in malaria RDT (overall score ≥ 90)</td>
<td>OTSS visit iteration, $N$</td>
<td>1,345</td>
<td>260</td>
<td>4.47</td>
<td>3.62–5.53</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>574</td>
<td>95</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>89</td>
<td>42</td>
<td>0.88</td>
<td>0.51–1.51</td>
<td>0.639</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>456</td>
<td>75</td>
<td>0.82</td>
<td>0.59–1.14</td>
<td>0.243</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>226</td>
<td>48</td>
<td>0.62</td>
<td>0.40–0.98</td>
<td>0.040</td>
<td></td>
</tr>
<tr>
<td>Health worker competent in malaria in-pregnancy prevention and management (overall score ≥ 90)</td>
<td>OTSS visit iteration, $N$</td>
<td>1,704</td>
<td>532</td>
<td>4.62</td>
<td>3.62–5.88</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>478</td>
<td>218</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>401</td>
<td>148</td>
<td>2.25</td>
<td>1.29–3.93</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>507</td>
<td>81</td>
<td>13.37</td>
<td>7.83–22.84</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>318</td>
<td>85</td>
<td>5.35</td>
<td>3.09–9.25</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Health worker provided three pills of SP to pregnant woman eligible for IPTp</td>
<td>OTSS visit iteration, $N$</td>
<td>1,124</td>
<td>453</td>
<td>5.20</td>
<td>3.02–8.95</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Zambia (ref.), $n$</td>
<td>489</td>
<td>218</td>
<td>1.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Cameroon, $n$</td>
<td>119</td>
<td>83</td>
<td>0.28</td>
<td>0.08–1.03</td>
<td>0.056</td>
<td></td>
</tr>
<tr>
<td>Ghana, $n$</td>
<td>386</td>
<td>81</td>
<td>0.35</td>
<td>0.13–0.92</td>
<td>0.034</td>
<td></td>
</tr>
<tr>
<td>Niger, $n$</td>
<td>130</td>
<td>71</td>
<td>0.03</td>
<td>0.01–0.10</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

IPTp = intermittent preventive treatment in pregnancy; OR = odds ratio; OTSS = Outreach Training and Supportive Supervision; ref. = reference; SP = sulfadoxine–pyrimethamine.

* Fixed effects and random effect parameters are not shown.
indicating that these specific case management performance indicators are met most commonly at visited facilities.

A sensitivity analysis that permitted inclusion of facilities that met competency thresholds on their first OTSS visits found an effect of OTSS for five of the eight outcome indicators: overall clinical competency, forgoing antimalarial prescriptions for patients with a negative malaria test, competency in RDT, competency in MIP prevention, and providing IPTp to eligible women (Supplemental Table S1).

An additional sensitivity analysis of mixed-effect models indicated some evidence for interaction between country and OTSS visit iteration (Supplemental Table S2); however, data set limitations mean there is a low power to investigate fully if effect size differs among countries. Country-specific models for outcomes for which a significant interaction was identified are presented in Supplemental Table S3 and Supplemental Figure S1.

**DISCUSSION**

Independent evaluation of OTSS visit data collected in Cameroon, Ghana, Niger, and Zambia during OTSS activities conducted under the Impact Malaria Project demonstrates an impact of increasing number of OTSS visits made to a facility and improving health worker performance as assessed by checklists completed during the OTSS visit. Improvements were seen in both overall summary scores from checklists completed to capture clinical case management of malaria, MIP, RDT and microscopy competency, as well as key indicators such as requesting parasitological tests for eligible patients and abstaining from providing antimalarial drug prescriptions to patients with negative test results. Predicted probability plots indicate diminishing returns in number of OTSS visits received, with four of the eight outcome indicators reaching saturation in all four countries.

**FIGURE 2.** Predicted probability plots illustrating the modeled relationship between increasing number of OTSS visits and predicted probability of successfully achieving the outcome in each country. Out of range predictions (predicting beyond the maximum number of OTSS visits received by facilities for the specific outcome and country) are indicated by dotted lines. IPTp = intermittent preventive treatment in pregnancy; OTSS = Outreach Training and Supportive Supervision; RDT = rapid diagnostic test; SP = sulfadoxine-pyrimethamine.
countries after three or four prior OTSS visits to the facility, and only two indicators where none of the four countries reached saturation after four prior OTSS visits. However, it is an intrinsic characteristic of this type of logistic regression model to show diminishing marginal returns at some point when projecting an increasing number of visits.

Previous work has shown that supportive supervision may lead to improvements in malaria diagnostic performance, but may also demonstrate diminishing returns over multiple supervisory visits, specifically as it relates to malaria microscopy and RDT performance. These findings are in line with the current evaluation. Similar to other work, our study also showed small improvements in fever case management practices after supportive supervision activities. Routine supervision, when used as a sole intervention, as well as an audit with feedback have been associated previously with moderate improvements in health-care worker performance (median, 10.7% and 15.0%, respectively). In addition, two other studies found that increasing supervision “dose” was associated with better performance; however, a third review found that more intensive supervision may not necessarily be more beneficial.

A secondary analysis of supportive supervision strategies over 36 countries highlighted the role of supervising the supervisors, as well as supervisors engaging health-care workers in problem-solving activities as valuable to enhance the effectiveness of supervision. It is possible that the inclusion of supervisor training as part of the OTSS program activities implemented by Impact Malaria as well as the use of lessons-learned workshops with health-care workers were related to the high effectiveness of OTSS observed in our evaluation.

Our study also differs from analyses of previous malaria OTSS programs by the inclusion of a wider range of primary outcome measures, focusing on specific key steps within the checklist (such as not prescribing antimalarials after receiving negative test results), as well as a binary classification of competency from summary checklist scores, whereas prior evaluations completed linear regressions using the checklist score (0–100) as the outcome measure. Furthermore, the inclusion of indicators from MIP checklists (overall competency as well as provision of IPTp to eligible women during ANC consultations) has not been reported previously, and suggests that supervision is a valuable tool to support increased IPTp coverage among women attending ANC.

Limitations of our analysis include the outcomes being collected by OTSS supervisors during their visits, with the potential for observer bias as health workers make extra efforts to perform “correctly” while being observed by supervisors; their performance while being observed may not be representative of their usual practices. This may result in bias toward greater performance and could be mitigated by the use of fully independent observations that are not part of routine OTSS activities, or use of other performance measures that do not require direct observation. Nevertheless, the use of repeat observations (during each OTSS round) should mitigate observer bias to some degree.

The relatively small number of third, fourth, and greater OTSS visits to health facilities limits the ability of our analysis to assess fully the extent of diminishing returns with high numbers of OTSS visits. The exclusion of facilities reaching the defined competency thresholds (e.g., score ≥90% on a specific OTSS checklist) on their first OTSS visit may also have exacerbated the effect of regression to the mean for low-performing facilities and may lead to positively biased effect estimates. In addition, the varying strategies used in different countries to select facilities for OTSS visits resulted in some country data sets including relatively few facilities receiving multiple OTSS visits and a large proportion of all facilities excluded as a result of receiving only one OTSS visit during the period of interest. This was particularly true for Ghana, where facilities that had already benefited from OTSS visits were excluded from later rounds, allowing new facilities to participate in OTSS. The small number of observations available for some indicators in certain countries precluded the use of country-specific models, instead pooling data for all four countries to maximize power to assess whether OTSS is linked with improved malaria case management quality. Predicted probability plots illustrate some of the variation by country for each indicator, showing where the largest gains in performance were observed. A further limitation of the available data set for our evaluation is the lack of control or comparison facilities. Because the outcome indicators used for this evaluation are generated by the OTSS visits themselves, it is not possible to include any facilities in this evaluation that did not receive OTSS visits.

Our study focused on OTSS visits completed under the Impact Malaria Project, but both Ghana and Zambia had prior OTSS programs. A sensitivity analysis that combined available data from OTSS completed under the previous PMI-supported mechanism, MalariaCare, with the more recent OTSS data found comparable results to the main analysis, which used more recent OTSS program data (Supplemental Tables S4 and S5). However, possible effect modification by country and lack of sufficient data to investigate this fully potentially limits the generalizability of these results to other country settings.

The use of a dose–response model with the first OTSS visit being a low dose limits the ability to compare high doses of OTSS (many visits) to those facilities receiving a low dose of OTSS. In settings where OTSS visits are prioritized according to previous performance, there are no equivalent facilities receiving multiple visits to compare with facilities with no visits, whereas settings prioritizing wide geographic coverage had few facilities that received a high number of visits. Furthermore, the OTSS checklists are relatively standardized among countries included in our evaluation, limiting our ability to compare relative effect size for different components of OTSS and to make programmatic recommendations about the OTSS components that are most important. Although our evaluation identified successfully the number of prior OTSS visits that result in facilities attaining competency targets, it was not possible (with our study design) to explore questions related to the duration at which high performance can be maintained in the absence of OTSS or the ideal frequency of OTSS visits to a facility.

Last, this evaluation focused only on malaria case management performance as assessed by the observing supervisor and does not explore any patient-level outcomes, demand-side responses, or impact on malaria burden. As a result, it is difficult to explore cost-effectiveness and the importance of OTSS further, particularly in consideration of potential diminishing returns from larger numbers of repeat OTSS visits and the relative impact of other malaria
interventions. Although some OTSS data sets do include contextual data such as observed health worker cadre, if they have been supervised previously or received malaria case management training, these data were incomplete, and incorporating these contextual data into models would have reduced substantially the number of observations available for models. Use of data sets external to OTSS to indicators of health worker performance could further strengthen plausibility of the evaluation—for example, through patient exit interviews or health facility survey and/or observations separate to OTSS activities. Attempts were made in the broader independent evaluation to explore the impact of OTSS using routine health management information system (HMIS) data; however, these findings were limited by the lack of suitable indicators of health worker performance within a routine HMIS, relying on imperfect proxy indicators of ratio of total suspected malaria cases to total tested by parasitological test, and a ratio of total confirmed malaria cases to number of patients prescribed ACT. Our evaluation provides strong evidence that the receipt of multiple OTSS visits to health facilities resulted in measurable improvements in a range of indicators linked to quality case management of patients attending health facilities with suspected malaria, as well quality malaria prevention services received by pregnant women attending ANC. Pending questions include the optimal intensity of OTSS required to maintain proficiency, once acquired. Further evaluation incorporating control facilities would also serve to strengthen further the evidence of OTSS effectiveness. Key considerations for effective OTSS activities remain similar to those discussed in relation to previous OTSS programs, including the importance of qualified and trained supervisors, prioritization of facilities for visit and follow-up to underperforming facilities, and immediate feedback and action planning to address issues identified during the OTSS visit.

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Note: Supplemental material appears at www.ajtmh.org.

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Disclosure: This quantitative evaluation used existing data collected under routine OTSS activities. Although data were available at the individual health worker observation level, these were anonymized and could be linked only to the health facility. Institutional review board approval for the full mixed-methods evaluation (including primary qualitative data collection, not included herein) was received from the PSI Research Ethics Board and the ethics boards in Cameroon (Comité National D’éthique de la Recherche pour la Santé Humaine [No. 2022/05/1458/CE/CNERSH/SP]), Ghana (Ghana Health Service Ethics Review Committee [No. 012/04/22]), Niger (Niger Comité National D’éthique pour Recherche en Santé [No. 015/2022/CNERS]), and Zambia (University of Zambia Biomedical Research Ethics Committee [2532–2022]). The national malaria control programs in Cameroon, Ghana, Niger, and Zambia gave permission for the mixed-methods evaluation to take place. The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the CDC or the United States Agency for International Development.

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REFERENCES


Outreach Training and Supportive Supervision for Quality Malaria Service Delivery: A Qualitative Evaluation in 11 Sub-Saharan African Countries

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Abstract. Quality improvement of malaria services aims to ensure that more patients receive accurate diagnosis, appropriate treatment, and referral. The Outreach Training and Supportive Supervision Plus (OTSS+) approach seeks to improve health facility readiness and provider competency through onsite supportive supervision, troubleshooting, and on-the-job training. As part of a multicomponent evaluation, qualitative research was conducted to understand the value of the OTSS+ approach for malaria quality improvement. Semistructured key informant interviews, focus group discussions, and structured health facility–based interviews were used to gather stakeholder perspectives at subnational, national, and global levels. Data were collected globally and in 11 countries implementing OTSS+: in-depth data collection was done in four: Cameroon, Ghana, Niger, and Zambia. Study sites and participants were selected purposively. Verbatim transcripts were analyzed thematically, following the Framework approach. A total of 262 participants were included in the analysis; 98 (37.4%) were supervisees, 99 (37.8%) were supervisors, and 65 (24.8%) were other stakeholders. The OTSS+ approach was perceived to improve provider knowledge and skills in malaria service delivery and to improve data and supply management indirectly. Improvements were attributed to a combination of factors. Participants valued the relevance, adaptation, and digitization of supervision checklists; the quality and amount of contact with problem-solving supervisors; and the joint identification of problems and solutions, and development of action plans. Opportunities for improvement were digitized checklist refinement, assurance of a sufficient pool of supervisors, prioritization of health facilities, action plan dissemination and follow-up, and data review and use. The OTSS+ approach was perceived to be a useful quality improvement approach for malaria services.

INTRODUCTION

Quality improvement of malaria service delivery aims to ensure that more patients receive accurate diagnosis, appropriate treatment, and referral, as well as to improve the reporting of malaria cases and management of malaria supplies. Moreover, in high-burden countries, malaria is responsible for a large proportion of outpatient visits to health facilities and hospital admissions. In these contexts, quality improvement of malaria care and prevention services should, theoretically, help catalyze improvements in overall health-care quality.

Supportive supervision is one quality improvement intervention used to reach health-care providers where they practice, to enable them to offer quality services, and to improve their performance and motivation.1 Supportive supervision approaches are widely used, but are variously defined, implemented, supported, and sustained.2–5 Key elements of supportive supervision generally include open, two-way exchange and learning, provision of constructive feedback, and team-based or whole-site approaches that facilitate problem solving and are action oriented.5 Some countries use targeted supervision approaches, whereas others have shifted to integrated supportive supervision, which aims to improve the quality of primary health-care delivery across a range of diseases or health needs.5–8

Despite the wide use of supportive supervision approaches, evidence supporting their effect on improving service quality in different health areas has been limited, with only modest or no gains observed in some contexts.1,9–12 Low-quality evidence has been a reported challenge12; another possible explanation for limited evidence of effectiveness has been a failure to address systemic requirements, such as sufficient numbers of skilled human resources and supply chain management.10

In addition, challenges with designing, implementing, and sustaining supportive supervision approaches may limit long-term effects. An absence of feedback after visits, irregular visits, poor continuity between visits, top-down planning, and a failure to adhere to supervision plans because of inadequate resources for implementation have all been reported challenges.13,14 Historically, unsupportive or authoritarian supervision approaches have also been perceived to generate negative effects, with some evidence that negative feedback or unsupportive supervision may be more demotivating than no supervision at all.13,15

The Outreach Training and Supportive Supervision (OTSS) approach is a facility-level approach aimed at improving health facility readiness and provider competency through onsite supportive supervision, troubleshooting, and on-the-job training. First developed in 2007 under the U.S. President’s Malaria Initiative (PMI) Improving Malaria Diagnostics Project, the approach was continued under the MalariaCare Project from 2012 to 2017. Beginning in 2018, the Impact Malaria (IM) Project rolled out an enhanced version of the approach—Outreach Training and Supportive Supervision Plus (OTSS+)—that introduced improvements based on a review of OTSS operational considerations. The history and scope of the approach are described in the companion paper by Barat et al.16

The OTSS+ approach aims to achieve an appropriate and measurable level of health worker competence in the
management of uncomplicated and severe malaria, malaria in pregnancy, and performance of malaria rapid diagnostic tests (RDTs) and malaria microscopy. The approach also measures health facility readiness to verify that health facilities have the necessary supplies, infrastructure, and human resources to provide quality malaria services.

With the OTSS+ approach, trained supervisors observe providers, review records, and assess health facility readiness using a set of seven standardized, competency-based, and digitized checklists. Countries select and adapt the OTSS+ checklists in line with their specific policy and system needs. Not all countries use all checklists. Some countries have adapted OTSS+ checklists as part of an integrated supportive supervision checklist (Ghana), whereas others integrated OTSS+ into an existing mentoring checklist (Kenya). Provider performance is scored on several key steps in the clinical management of febrile illness. There is a minimum acceptable score (usually 90%) for a provider to be deemed competent in a specific area. Supervisors provide same-day, on-the-job training and feedback. Identified issues are discussed in a debrief session with the supervisees, health facility in-charges, and supervisors, who formulate an action plan jointly to address problem areas. Additional mentoring, coaching, or training may then be planned. The definition and use of mentoring and coaching approaches vary across countries, with some overlap in the use and meaning of terms. Mentoring typically involves the development of a long-term, sustained relationship to support capacity development. The OTSS+ approach rounds of visits are typically planned either quarterly or biannually. In between OTSS+ rounds, data review meetings and lessons-learned workshops are held at the regional, district, or subdistrict level to review OTSS+ visit data, action plans and follow-up, and malaria indicators; and to prioritize health facilities for the next round of visits.

During the MalariaCare Project, the OTSS approach was found to improve health worker performance on clinical case management of febrile patients, RDT performance, and malaria microscopy after three OTSS visits.17–19 Although clinicians showed good baseline knowledge on the clinical management of malaria, the OTSS approach was able to identify areas needing further improvement, such as health worker behaviors associated with assessing the severity of illness, managing nonmalarial fevers, and communicating effectively between patient and provider.17 A small number of evaluations of supervisors found that overall performance was high, but that development and follow-up on action plans was inconsistent.20 In Zambia, health facilities receiving OTSS visits showed improvements with regard to diagnostic skills, laboratory best practices, fever case management practices, and prescriber adherence to negative malaria test results.21

There has been little qualitative evidence regarding perceived benefits derived from the OTSS+ approach and which components of the approach contribute to or limit success. This study elicited the perspectives of supervisors, supervisees, managers, and other malaria and health system stakeholders on the value of the OTSS+ approach for improving the quality of malaria service delivery. In addition, the study sought to identify opportunities for strengthening the approach from the perspective of key implementers.

MATERIALS AND METHODS

Study design. This qualitative study was conducted as part of a multicomponent, independent evaluation of the effectiveness of the OTSS+ approach, which involved quantitative OTSS+ and health management information system data analysis, qualitative research methods, and a cross-sectional online survey of OTSS+ supervisors and other stakeholders. This article presents findings from the qualitative research. The quantitative component of the evaluation is reported separately.22

To design the study, we first developed a retrospective theory of change for the OTSS+ approach. The theory of change acknowledged numerous contextual factors that may influence health worker decision making and malaria case management to varying degrees: patient profiles and demands, patient care-seeking and risk perception, difficult access to care for follow-up, high malaria prevalence in the patient population, lack of a reliable supply of tests and drugs (rationing of testing), health system functionality and resources, and constraints related to geography, insecurity, environment, natural disasters, and pandemics. We theorized that for the approach to be effective as designed, the following would need to be true in each context: the country and health system were well engaged in the adoption and adaptation process, the provided support was appropriate and responsive to health worker needs, supervisors had the necessary qualities and capacities to be able to catalyze improvements, the right health facilities and health workers were targeted, the right amount of support was provided for both efficiency and effectiveness, and the right data were available and acted on (Table 1). These theory-based domains were used to develop domains of inquiry and were included in an overall evaluation matrix that encompassed broader domains such as relevance, effectiveness, efficiency, and sustainability. Qualitative research methods were semistructured key informant interviews (KIs) at global, national, and subnational levels; focus group discussions (FGDs) at the subnational level; and structured health facility–based interviews focused on reviewing experience and outputs from the most recent OTSS+ visit.

Study setting. The evaluation was conducted in 11 countries in sub-Saharan Africa, 10 of which were currently implementing the OTSS+ approach under the IM Project and one (Cote d’Ivoire) in which the IM Project closed in 2021. Although the OTSS+ approach uses a standardized framework, implementation of the approach varies across countries. The services covered, type of follow-up used, geographic scope, prioritization of health facilities, and frequency of OTSS+ rounds all may be adjusted on a country basis (Figure 1). Four countries (Cameroon, Ghana, Niger, and Zambia) were selected purposively for in-depth data collection in line with the principles of maximum variation sampling to identify countries that differed with regard to the scope of OTSS+ implementation (services covered), length of implementation experience (historical involvement versus more recent adoption), and linguistic/geographic region. Other factors that were considered in consultation with stakeholders were willingness and availability to support implementation of the evaluation, use of the standardized OTSS+ approach and limited use of complementary approaches, and the completion of at least three rounds of OTSS+ visits at the time of study. The remaining
seven countries were included in the study via a limited number of KIIs with national- or regional-level stakeholders. In addition, the study was conducted at a global level, targeting stakeholders located in Africa, North America, and Europe.

**Selection of study sites.** In the four selected countries, district and health facility study sites were selected purposively, as mentioned earlier, for in-person data collection using a three-stage process. One region or province was selected from all areas implementing the OTSS+ approach in the past 6 months based on feasibility, access, and health and security concerns. Within the selected region or province, all districts participating in the last round of the OTSS+ approach were identified; preference was then given to districts that had completed multiple rounds of the OTSS+ approach during the IM Project. Among eligible districts, two or three districts were selected purposively for a range of OTSS+ supervision teams (districts covered by different supervision teams) and for operational feasibility (easily accessible within a predetermined field time of 10 days and no security concerns). At least one of the districts had to include a referral facility offering severe malaria case management services.

Within selected districts, four to six health facilities were selected purposively to achieve a range of OTSS+ performance trajectories. First, all health facilities receiving multiple OTSS+ visits were identified. Using the scores from the OTSS+ visit data from the last two rounds, all health facilities were then assigned one of three performance trajectories (stable, worsening, or improving) based on the difference between performance during the past two visits. (We used the last two rounds because, in some countries, few health facilities had received more than two visits.) “Stable” was defined as a difference of less than 10% in either a positive or negative direction; “worsening,” as a difference of 10% or more in a negative direction; and “improving,” as a difference of 10% or more in a positive direction. At least two health facilities were then selected randomly from each performance category. All samples were confirmed to include a range of health facility types and services provided, and to be less than a 2-hour drive to a central location. Three health facilities in one district (one hospital and two clinics) were targeted for health facility–based interviews focused on reviewing experience and outputs from the most recent OTSS+ visit; these were selected based on midrange proximity (not clustered around the district headquarters) and ease of research team access.

In addition, in Cameroon, Niger, and Zambia, the second region implementing the OTSS+ approach in the past 6 months was targeted for limited remote KIIs; in Ghana, an additional three regions were targeted for remote KIIs.

**Selection of study participants.** The study population included stakeholders involved in OTSS+ planning, implementation, and funding at subnational, national, and global

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Example</th>
</tr>
</thead>
</table>
| The country and health system are well engaged in the adoption and adaptation process. | • Health facilities and districts are involved, feel ownership for, and help drive the quality improvement process.  
• Checklists capture the right information, balancing time/workload and content.  
• Tools are linked to wider quality improvement processes and feedback loops at all levels, including citizen/patient feedback and health worker feedback.  
• Tools are integrated across health areas as appropriate. |
| The provided support is appropriate and responsive to health worker and health facility needs. | • Appropriate adult learning and mentoring methods are used for health worker behavior change.  
• Health worker and health facility needs are addressed. The provided support “helps them get their job done.”  
• Contextual factors and drivers of health worker decision-making and prescribing behavior are understood and addressed.  
• Supervision and support avoid disruption of health facility work. |
| Supervisors have the qualities and capacity to catalyze improvements.     | • A sufficient pool of qualified cadres is available.  
• Supervision team composition and numbers provide optimal benefits (effectiveness and efficiency) per health facility and health worker.  
• There is effective interplay between laboratory and clinical supervisor cadres.  
• Supervisors have the necessary mentoring and relationship-building skills.  
• Onboarding of newly trained supervisors occurs as needed.  
• Supervisors are comfortable using digital tools for analysis and action.  
• Attention is given to equity and gender equality.  
• There is timely disbursement of funds for visits. |
| The right health facilities and health workers are targeted.              | • Health facilities and health workers are targeted for the greatest benefit. Resources are allocated optimally based on health facility performance, level, and staffing.  
• Health worker attrition and rotations are addressed; new staff are onboarded.  
• Attention is given to equity and gender equality. |
| The right amount of support is provided for both efficiency and effectiveness. | • Visit length is sufficient for both data collection and onsite training/support.  
• Duration and frequency of visits and support is appropriate to improve and maintain performance.  
• The point of diminishing returns is identified to support efficient resource allocation.  
• Supervision visits and mentoring resources are prioritized for the most benefit.  
• Environmental and external factors allow sufficient visits and interaction. |
| The right data are available and acted on.                               | • Electronic tools match program needs, are easy to use, and require minimal support.  
• Event- and case-based data are collected, analyzed, and used to improve the course of action and to allow prioritization of resources.  
• Feedback is shared and acted on regularly at all levels of the health system. |
FIGURE 1. Overview of Outreach Training and Supportive Supervision Plus (OTSS+) history, coverage, and approach in each country. HF = health facilities; IM = Impact Malaria Project; IMaD = Improving Malaria Diagnostics Project; lab = laboratories; mRDT = malaria rapid diagnostic test.
levels; subnational was divided into regional, district, and health facility levels. Prospective stakeholder lists were drawn up in consultation with the IM Project and PMI country teams.

Study participants at global, national, and regional levels were selected purposively for KIIIs based on a high level of involvement in the OTSS+ approach, including, where relevant, historical involvement, and to achieve representation of the different OTSS+ planning and implementation roles. Within each of the field study sites, district and health facility actors were selected purposively for KIIIs or FGDs based on participation in an OTSS+ visit in the past 6 months, cadre, and gender balance, when feasible. In health facilities selected for the health facility-based KII and OTSS+ visit review, the health facility in-charge and one to two health workers who participated in the supervision visit or the implementation of subsequent quality improvement actions were targeted for a KII and review of action plans.

An estimated 25 KIIIs were planned per country in the four in-depth countries and up to four KIIIs in each of the remaining seven countries. An estimated six to eight FGDs involving six to eight participants were planned in the four countries. Focus group discussions were segmented by OTSS+ and health system roles: 1) OTSS+ district and regional supervisors, 2) district or regional health management team members, and 3) supervisees (health workers) by service delivery role (clinicians, laboratory staff, and antenatal care [ANC] staff). In Ghana, an additional eight KII participants from two additional regions were targeted, in line with a request from the national malaria control program.

Data collection instruments. Six data collection instruments were developed for the different respondent groups: two semistructured interview guides, three FGD topic guides, and one structured interview questionnaire for health facility-based KIIIs (Table 2). The latter included a request to review the outputs and follow-up actions from the most recent OTSS+ visit. English versions of the tools were translated to French. English versions were piloted with national-level OTSS+ stakeholders not sampled for data collection in Zambia and Ghana, and French versions were piloted in Cameroon; key terms and concepts were reviewed and revised subsequently.

Data collection procedures. Data collection was carried out from April to June 2022 over an approximately 10-day period in each country. Data were collected by 11 research team members experienced in qualitative data collection: two-person teams conducted KIIIs and FGDs in the four countries (led by A. Z., P. C., P. Y., and I. K.), and three people (E. S., S. L., and B. A.) conducted interviews globally and in the remaining seven countries. All data collection team members participated in 1 day of remote orientation and training sessions covering ethics, data collection tools, and core topic areas; transcription; and COVID-19 prevention protocols.

Selected participants were invited for interview or FGD participation by district health officials or via phone outreach from the research team. Interviews and FGDs were 45 to 60 minutes long, conducted in English or French, and were audio recorded. All FGDs were held in person; participants from the selected study sites were requested to travel to a central location in the district. Key informant interviews were conducted either in person (n = 37) or virtually (n = 96), depending on participant location, availability, and health or security requirements. Semistructured interview topics were prioritized in line with the participant’s area of expertise, role, and involvement in the OTSS+ approach, and, as data

<table>
<thead>
<tr>
<th>Data collection instrument</th>
<th>Domains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semistructured interview guide for national- and subnational-level (regional or district) participants</strong></td>
<td>Checklist adoption and adaptation&lt;br&gt;Digital tools and data use&lt;br&gt;Effect on the quality of malaria service delivery&lt;br&gt;Sustainability and institutionalization&lt;br&gt;Learning topics: scope of supervision visits and specific approaches for improving health worker and health facility performance, supervisor capacities and team composition, health facility visit prioritization and frequency&lt;br&gt;Evolution of the approach over time and lessons applied to newer countries (global participants)</td>
</tr>
<tr>
<td><strong>FGD topic guides for supervisors, supervisees, and district health managers</strong></td>
<td>Impact of OTSS+ on job performance (supervisees)&lt;br&gt;Impact of OTSS+ on quality of care at health facility&lt;br&gt;Aspects of OTSS+ providing the most benefit&lt;br&gt;Aspects of OTSS+ that are not helpful or unnecessary&lt;br&gt;Relevance and value of OTSS+ for addressing health facility needs&lt;br&gt;Action plan development and follow-up&lt;br&gt;Feedback provided during or after OTSS+ visit&lt;br&gt;Specific strategies used to support health facilities and health workers&lt;br&gt;Supervisor qualities and capacities&lt;br&gt;Supervisor experience, training, and performance&lt;br&gt;Use of digital tools and data (supervisors, managers)&lt;br&gt;Health facility selection and prioritization (managers)&lt;br&gt;Areas for improvement of the approach</td>
</tr>
<tr>
<td><strong>Structured interview questionnaire for health facility in-charges or other staff</strong></td>
<td>OTSS+ implementation experience&lt;br&gt;Perceived outcomes and value of the OTSS+ visit&lt;br&gt;Use of digital tools&lt;br&gt;Institutionalization of OTSS+ and quality improvement processes within the health structure&lt;br&gt;Review of outputs and follow-up actions from the most recent OTSS+ visit</td>
</tr>
</tbody>
</table>

FGD = focus group discussion; OTSS+ = Outreach Training and Supportive Supervision Plus.

* The core instrument was modified for global participants.
collection progressed, areas requiring further exploration. Data collection continued until theoretical saturation was reached in each of the four countries. In total, 133 KIIs and 22 FGDs were conducted (Table 3).

**Data management and analysis.** Audio recordings of all KIIs and FGDs were transcribed using voice-to-text software: Otter.ai (Alsense, Inc., Mountain View, CA) for the English language and Sonix (Sonix Inc., San Francisco, CA) for French. Transcripts were quality-assured by A. Z., P. K., P. Y., and I. K. Three transcripts from Zambia were excluded from analysis because of poor-quality transcription—two KIIs (two participants) and one FGD (six participants)—resulting in a final sample of 152 transcripts and 262 participants (Table 3). French transcripts were translated into English using DeepL or Doc Translator, and translations were reviewed and edited for accuracy by a bilingual research assistant briefed on the scope of data collection and country contexts. All transcripts were first read in full by a senior researcher (E. S.) and then uploaded into MAXQDA 2022 (version 22.2.0) for coding and thematic analysis. Coding was conducted primarily by four researchers (E. S., M. W., S. L., and G. M.), who met regularly to review and discuss coding decisions with R. A. Thirteen transcripts (8.6%) were dual-coded, with discrepancies identified and discussed to reach consensus.

Thematic analysis followed the Framework approach.²³ An initial coding frame was developed based on the scope of inquiry and to which codes were added as review of data progressed. Coded KII and FGD transcripts were pooled for thematic analysis, which was done for efficiency and to facilitate an analytical focus on participant categories—both health system and OTSS+ roles. Subthemes were then summarized by country and by participants’ OTSS+ roles, with particular attention to triangulating supervisor and supervisee perspectives. Summary functions within MAXQDA were used to group data by categories and subcategories to facilitate the process of analysis and interpretation. In this article, we focus on presenting a thematic summary across countries, with specific attention paid to the perspectives of participants involved most directly in OTSS+ implementation.

**RESULTS**

**Study participant characteristics.** Of 262 study participants, 108 (41.2%) were women, 98 (37.4%) were supervisees, 99 (37.8%) were supervisors, and 9 (3.4%) were district or regional-level managers. The remainder constituted a range of national and other stakeholders (Table 4).

**Perceived value of the OTSS+ approach for quality improvement in malaria case management and prevention.** Stakeholders at all levels perceived that the OTSS+ approach contributed to improving health facility readiness and health worker performance in delivering malaria services. Enhanced provider awareness, knowledge, and skills was perceived to improve providers’ performance with regard to differentiating severe and uncomplicated malaria, correct use of diagnostic tools for confirmatory diagnosis, adherence to national guidelines, and interaction with patients. In addition, the OTSS+ approach was perceived to have an indirect impact on the health system, leading to improved documentation and supply management. These themes are described next.

**Provider awareness, knowledge, skills, and confidence.** The OTSS+ approach was perceived to lead to increased awareness, more in-depth knowledge, and increased confidence in the performance of both clinical and laboratory staff. Some providers described developing a deeper understanding of the theoretical reasons behind different clinical and diagnostic (microscopy and RDT) procedures, noting that supervisors took the time to explain. They in turn perceived that this understanding made them more inclined to follow standard procedures and guidelines, such as checking the RDT expiration date, wearing gloves, and waiting the right amount of time before declaring a test negative. A regional supervisor in Ghana noted that the system compels them to learn how to do “a lot of things they are not doing.” Focus group participants from Cameroon and Ghana also cited improvements in understanding the need to carry out a thorough clinical assessment before testing. Similarly, supervisors and ANC staff described improved adherence to malaria-in-pregnancy chemoprophylaxis protocols, such as directly observed therapy and increased awareness of malaria-in-pregnancy treatment guidelines, including correct antimalarial dosing and dose preparation.

<table>
<thead>
<tr>
<th>Country</th>
<th>KII completed, n</th>
<th>KII participants, n</th>
<th>FGD completed, n</th>
<th>FGD participants, n</th>
<th>Total participants, n</th>
<th>Participants retained for analysis, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameroon</td>
<td>21</td>
<td>21</td>
<td>5</td>
<td>25</td>
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<td>46</td>
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<td>Ghana</td>
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<td>32</td>
<td>6</td>
<td>42</td>
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<tr>
<td>Niger</td>
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<td>24*</td>
<td>5</td>
<td>26</td>
<td>50</td>
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<td>21</td>
<td>6</td>
<td>38</td>
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<td>N/A</td>
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<tr>
<td>Kenya</td>
<td>4</td>
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<td>Mali</td>
<td>3</td>
<td>3</td>
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<td>N/A</td>
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<td>Sierra Leone</td>
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<td>3</td>
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</tr>
<tr>
<td>Global</td>
<td>13</td>
<td>18*</td>
<td>22</td>
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</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>139</td>
<td>22</td>
<td>N/A</td>
<td>270</td>
<td>262</td>
</tr>
</tbody>
</table>

* Three KIIs were conducted with multiple participants; two KIIs (in Niger and global) had two participants, and one global KII had five participants.
mentality.' (Male, Laboratory Technician and Regional Laboratory Supervisor, Cameroon [KII 092])

Supervisors and supervisees also reported improved awareness and adoption of test-before-treat, and an improved awareness of the importance of differential diagnosis, particularly as a method to diagnose appropriately and forego the use of artemisinin-based combination therapies in patients who test negative. In addition, supervisors and supervisees perceived improvements in the differentiation of uncomplicated and severe malaria based on clinical assessment; in particular, participants in Cameroon mentioned noticeable reductions in the proportion of cases diagnosed as severe following OTSS+ visits. Participants also mentioned an increased appreciation of the importance of reserving drugs and formulations intended for the treatment of severe cases, and not using them to treat uncomplicated malaria.

[W]e couldn’t tell the difference between severe and simple malaria. And when we had cases of simple malaria, we gave the treatment of severe malaria. During the supervision, he showed how we must differentiate. (Female, Facility MCH Nurse Aide and Supervisee Cameroon [KII 081])

Πf you’re qualifying malaria to be complicated, it means that you also must [record] what complication there is . . . [and] it has opened the eyes of the clinicians . . . to search for more . . . [and] that’s a very, very important impact on us. (Female, Health Facility In-Charge and District Supervisor, Zambia [KII 066])

Supervisors and health facility in-charges reported increased confidence in health worker performance. In some cases, increased knowledge and procedural improvements were also perceived to lead to increased confidence levels of clinicians and laboratory personnel to conduct their work competently. There was also some mention of increased provider confidence in the performance of their colleagues. In Ghana, an OTSS+ supervisor noted that, following OTSS+ visits, clinicians were more inclined to send patients to the laboratory for a confirmatory diagnosis.

Patient–provider interaction. Providers commented that OTSS+ guided them to improve patient reception, patient flow, and patient-provider communication during the consultation. They perceived that these changes had in turn led to increased trust between the patient and provider, and greater patient satisfaction, which some providers observed translated to increased attendance or return use.

### Table 4: Characteristics of study participants, by gender, included in the analysis

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Total participants</td>
<td>154</td>
<td>58.8</td>
<td>108</td>
</tr>
<tr>
<td>Health system level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health facility</td>
<td>38</td>
<td>40.9</td>
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</tr>
<tr>
<td>District</td>
<td>48</td>
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</tr>
<tr>
<td>Regional</td>
<td>37</td>
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<tr>
<td>National</td>
<td>22</td>
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<td>16</td>
</tr>
<tr>
<td>Global</td>
<td>9</td>
<td>50.0</td>
<td>9</td>
</tr>
<tr>
<td>Country OTSS+ role</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Supervisee</td>
<td>41</td>
<td>41.8</td>
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<tr>
<td>Clinical staff</td>
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<td>47.3</td>
<td>29</td>
</tr>
<tr>
<td>ANC staff</td>
<td>4</td>
<td>16.7</td>
<td>20</td>
</tr>
<tr>
<td>Laboratory staff</td>
<td>11</td>
<td>57.9</td>
<td>8</td>
</tr>
<tr>
<td>Supervisor</td>
<td>72</td>
<td>72.7</td>
<td>27</td>
</tr>
<tr>
<td>Supervisor/clinician</td>
<td>43</td>
<td>69.4</td>
<td>19</td>
</tr>
<tr>
<td>Supervisor/trainer</td>
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<td>100.0</td>
<td>0</td>
</tr>
<tr>
<td>Supervisor/manager</td>
<td>14</td>
<td>70.0</td>
<td>6</td>
</tr>
<tr>
<td>Supervisor/data manager</td>
<td>13</td>
<td>86.7</td>
<td>2</td>
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<tr>
<td>Other stakeholder†</td>
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<tr>
<td>Zambia</td>
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<tr>
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<tr>
<td>Global</td>
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</table>

**ANC** = antenatal care; OTSS+ = Outreach Training and Supportive Supervision Plus.
* National government stakeholder refers to all central-level government stakeholders, including mentors and trainers.
† Other stakeholder refers to all other partners, including funders.
If the patient comes, you give him the RDT, you welcome him, and tomorrow he will go and say [to others in the community], “Go. There is [good] reception [at the health facility].” He’s happy. You are happy too. (Female, Nurse and Supervisee, Niger [KII 019])

Precisely, because the first thing is the reception of patients. I think that long before we already insisted a lot on the reception, because a well-received patient already feels safe. (Male, Health Facility In-Charge and Supervisee, Cameroon [KII 082])

Provider motivation. Providers noted their own increased satisfaction and motivation from providing improved quality of care and from observing positive health outcomes and satisfied patients. Increased provider motivation was also tied to the positive and encouraging nature of the supervisor–supervisee interaction, a key factor valued by participants.

[...] you used to see malaria-in-pregnancy going high . . . and sometimes you see miscarriages because of complicated malaria. But with [OTSS+], it has reduced, and it motivates me because there’s no need to be running to save two lives because of malaria that I could handle by using maybe the ‘net, the SP [sulfadoxine-pyrimethamine], and the drug with my little education. So I think as [an] individual I would say [OTSS+] is motivating. (Female, Midwife and Supervisee, Ghana [KII 030])

Inventory management and data registries. Supervisees, supervisors, and managers across the four countries noted two areas in which the OTSS+ approach had an indirect positive effect: inventory management and data registries. The latter was also perceived to have led to improved timeliness and completeness of data submission to the districts or health areas. These improvements were noted predominantly in the ANC unit and laboratory services, including RDT use. Managers also observed improvements in the quantification of supplies.

There has been a particularly good interaction between the central staff or a provincial officer on logistics for Coartem and RDTs for testing malaria. (Female, Provincial Nursing Officer and Supervisor, Zambia [FGD 16-02])

With the supervision, all the ANC data are currently [recorded]. It has helped us a lot. Even the new ones who entered the service recently, they can already fill in the register, because the last supervision has helped us a lot. (Male, Nurse Aide and Supervisee, Cameroon [FGD 20-01])

Factors valued by participants.

“The whole process.” Participants viewed the OTSS+ approach as a package of different components, implemented in a systematic and sustained way. When asked which aspects of the approach provided the most benefit, a common theme was that the approach was a holistic process of improvement, and that “the whole package” drove effectiveness. Within this process, quality improvements were attributed to a combination of factors. We grouped these factors into three broad thematic areas: checklist relevance, adoption, and digitization; the quality and amount of supervisory contact; and joint problem identification, solving, and action planning (Table 5).

Relevant checklists adapted for context. Most supervisors, managers, and government stakeholders felt the OTSS+ checklists provided a relevant and adequate framework for quality-of-care improvement, and that the OTSS+ approach had been well adapted at the country level. They described multiphase processes of engagement with national malaria control programs and good country ownership of the process for reviewing and adapting the checklists and digital tools. As a result of these processes, national stakeholders across countries felt they had the flexibility to adapt the standardized tools as needed for their context. Examples of context-specific changes included dropping or modifying questions that were not applicable given national malaria case management guidelines, adapting to changes in guidelines over time, modifying questions that were linked to ensure accurate identification of gaps (for example, health worker behavior and the availability of required supplies such as gloves), and reformulating questions to align with local health facility realities and customs (for example, with regard to patient reception and health worker introduction). Strong country ownership and engagement were in turn perceived to support sustainability and institutionalization of the approach. Under the IM Project, newer countries were perceived to have benefited from intercountry sharing of experiences and a stepwise approach to accelerate implementation and adoption.

So you went through the checklist and made some changes, tweaks . . . . It wasn’t significant tweaks, but it was small changes adapted to the local context, national contexts, and regional context. So we had meetings and then workshops with that. (Female, Other Stakeholder and Technical Advisor, Cameroon [KII 093])

Checklist digitization was also perceived to enhance objectivity and transparency, because checklist data could not be manipulated and could be shown directly to the health facility staff.

With the paper-based system, too, it made assessment more subjective than objective, but with this [digital tool], in all facilities it is the same criteria, because it’s programmed. If they are performing, it will show it [on the screen]. [If] they are not performing . . . , it will come and you’ll be able to give prompt feedback. And the feedback to me is very objective. (Male, Health Information Officer and Regional Supervisor, Ghana [KII 045])

Quality and amount of supervisory contact. Participants valued the onsite provision of coaching, mentoring, feedback, and other support; the use of qualified and skilled supervisors, who focused on collaborative problem-solving based on the local context; and the length and maintenance of supervisory contact.

Onsite, same-day support. A major theme was that OTSS+ supervisors “don’t wait to solve problems,” but provide onsite observation and same-day support using a variety of different methods for knowledge sharing, depending
<table>
<thead>
<tr>
<th>Thematic area</th>
<th>Factors valued</th>
<th>Opportunities for improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate checklists/tools</td>
<td>Relevant checklists adapted for context: encouraging good country engagement and ownership of the adoption and adaptation process</td>
<td>Optimizing checklists after digitization: Inflexibility of binary data entry, skip patterns, and required fields affect provider scoring.</td>
</tr>
<tr>
<td>Quality and amount of supervisory contact</td>
<td>Onsite support: providing same-day coaching, mentoring, and other support</td>
<td>Ensuring a sufficient pool of supervisors: An insufficient number of supervisors was noted in some countries. Some perceive that more district-level supervisors should be trained.</td>
</tr>
<tr>
<td></td>
<td>Helpful supervisors: using qualified, skilled, and supportive supervisors focused on problem solving</td>
<td>Prioritizing health facilities: Health facility selection was influenced by context, health system, and resource constraints. Given limited resources, it is unclear whether to prioritize follow-up visits or to reach new health facilities.</td>
</tr>
<tr>
<td></td>
<td>Length and maintenance of supervisory contact: having adequate time at the health facility during OTSS+ visits; planning and making follow-up contacts or visits</td>
<td>Determining how much support is enough: The optimal number and frequency of supervision visits to achieve adequate competency is unclear. Context-specific decision making regarding the use of different types of follow-up (e.g., integrated, remote, same supervisor or not) is needed.</td>
</tr>
<tr>
<td>Joint identification of problems and solutions</td>
<td>A collaborative approach: creating an overall environment of openness, mutual learning, and trust</td>
<td>Action plan dissemination and follow-up: There is poor availability of action plans at health facilities. Digitized action plans lack specificity. Unclear follow-up plans were noted. There is a need for monitoring action plan implementation.</td>
</tr>
<tr>
<td></td>
<td>Action planning process: developing and agreeing jointly to a feasible plan based on local context</td>
<td>OTSS+ data review and use: Actors could increase the use of OTSS+ data for planning malaria interventions outside of OTSS+ visits, particularly at the lower levels.</td>
</tr>
</tbody>
</table>

OTSS+ = Outreach Training and Supportive Supervision Plus.

We don’t go into the field to look for problems, it’s to solve, to support the service provider . . . . We have to solve [problems] on the spot because that’s also our job. You don’t go down to collect [and] come back with problems to solve; no, you have to solve the problems. (Male, Nurse and Regional Supervisor, Cameroon [KII 091])

Interpersonal communication skills included being a good listener and observer, and knowing how to probe to obtain “the real picture”; setting supervisees at ease so that they “feel free” to ask questions (supervisees appreciated that supervisors spoke “like a friend”); and being diplomatic and communicating about problems gently. For example, a supervisee and laboratory technician in Zambia noted: “Here you are lagging behind. They’re able to explain it in a nice way.” (FGD 13-01)

Supervisors’ attitudes were appreciated by supervised clinicians and mentioned frequently as differentiating the OTSS+ approach from other supervisors or supervision approaches in their countries. These attitudes included 1) humility (the supervisor is “democratic,” not a “know-it-all,” and appreciates he or she can also learn from the supervisee), 2) helpfulness (the supervisor comes with an attitude of improvement and doesn’t aim to “find fault,” but rather to mentor, “show how-to,” discuss, share knowledge, and coach supervisees to identify and solve problems); and 3)
being positive, encouraging, and supportive (the supervisor motivates and reassures health facility staff, also shares positive feedback and avoids causing frustration).

Before, as soon as they came, they threatened you, so you forgot what you knew. Now, they tell you, “Go ahead. You can also teach me. I am learning like you.” So we feel at ease. We are liberated. (Male, Nurse and Supervisor, Cameroon [FGD 20-05])

Even if what he says isn’t right, you don’t have to put him down and say it’s wrong. You accept and then you make corrections. And so, when you work in this dynamic, you retain what is positive. That’s the participatory approach. (Male, Government Stakeholder and Laboratory Supervisor, Cote D’Ivoire [KII 099])

Length and maintenance of supervisory contact. Supervisors and supervisees also underscored the importance of supervisors’ availability and ability “to take their time” or take the time that is “necessary.” Comments reflected both the overall time allotted for the visit—which ranged from half a day to 1 or 2 days, depending on a range of contextual factors, including health facility size, area of supervision, and supervision team size and composition—and supervisors’ effective use of that time to “go in depth” and exchange with health workers: “You can ask all the questions that you have because they are available.” Some supervisees also mentioned that they appreciated that supervisors made themselves available after the visit, providing their phone number or WhatsApp connection: “If there is a problem, you call him. He’ll talk to you and tell you what to do.” (Male, Nurse and Supervisor, Cameroon [FGD 20-05])

There is already an element that is quite important. It is, first of all, the regularity of this supervision . . . . An agent who is supervised, who receives feedback, feels valued. And this can perhaps contribute significantly to his work. That is already quite important to me. (Male, Advisor and Other Stakeholder, Niger [KII 005])

Joint problem solving and identification. OTSS+ supervisors’ collaborative, problem-solving approach was felt to create an overall environment of openness, mutual learning, and trust. This collaborative approach was concretized via an action planning process that was seen as assigning responsibility and encouraging ownership of the agreed actions. Participants identified three factors that supported effective action planning. First, that the plan was drawn up jointly, in agreement with—and not imposed on—health facility staff. Gaps identified during the OTSS+ visit were typically discussed in a debrief session with the supervisees, in-charge, and supervisors, who would identify areas for improvement and agree on solutions jointly. Some participants noted that, optimally, the supervisees themselves would specify the solutions and time frame, helping to foster accountability for completion of actions. In addition, participants emphasized that supervisors or district/health area malaria focal points were, for their part, also responsible for following up and coaching or mentoring as required. Second, the action planning process was perceived to be effective because the health facility in-charge was present, which ensured the challenges and context within the health facility were understood. In some countries, district health management staff were involved systematically in OTSS+ visits. This was also perceived as encouraging ownership, supporting planning and implementation of malaria interventions, and facilitating follow-up of OTSS+ visits. Third, both supervisors and health facility participants perceived that action planning was effective because the actions or recommendations were “doable.” This was seen in terms of aligning with the available health facility workforce and avoiding assigning a task beyond the capacity of the health facility or the individual provider.

[The action plan] provides ownership and assigns responsibility. . . . They sign for those gaps. You sign and they sign. So, there is no argument on the following time you go there to say, were these things done? Then, if they are not done, they need to provide an explanation. So, it is an effective way to benchmark or to check progress. (Male, Doctor and District Supervisor, Zambia [KII 064])

With the action plans that are developed, normally, we try to look at things that the facility can do, things that are within their ability to do. . . . The follow-up, we normally leave the follow-up to the districts’ health directorate level. . . . [E]ven subsequent OTSS [visits] that are done, we review the old plans to see whether they were actually implemented and what the gaps are that are still pertaining. (Male, Medical Superintendent and District Supervisor, Ghana [KII 043])

Perceived opportunities for improvement. Participants identified five main areas for strengthening the effectiveness of the approach: refining digitized checklists, ensuring a sufficient pool of supervisors, devising approaches to prioritize health facilities in need, disseminating and following up action plans, and reviewing data and their use (Table 5).

Checklists. Improvements to the OTSS+ approach over time have included streamlining and standardization of checklists. This streamlining was appreciated by participants from Ghana and Zambia, countries with historical experience using the OTSS approach. However, across most countries, supervisors observed there were still some context-specific and generalized refinements to the digitized checklists that could be made to improve usefulness or efficiency. One issue identified was the validity of percentile scoring for measures that were binary, or only covered two observations. Other issues related to skip patterns and redundancies resulting from the level of health facility being supervised. In addition, participants highlighted that the tools might be adapted for follow-up visits or contacts to reduce length, track follow-up visits, and flag improvements achieved or not achieved.

Pool of supervisors. Participants from Cameroon and Niger, in particular, reported challenges resulting from an insufficient number of trained and experienced supervisors, which was attributed to factors such as attrition over time because of staff movements, unavailability as a result of conflicting agendas, and, in some areas, insufficient numbers of qualified health workers. The inability to maintain a pool of OTSS+ supervisors was reported sometimes to limit health facility coverage and follow-up, and was perceived to be a barrier to sustainability. Several stakeholders recommended training more supervisors from the district level,
suggesting that this would improve the availability of supervisors, reduce costs, and promote ownership and engagement at the district level.

The recommendation for me is first to increase the number of regional supervisors. Even the [numbers of] district supervisors also need to be increased. Because it would now be necessary to bring the district supervisors closer to the health facilities, so a district supervisor doesn’t have to travel 200 km to go and supervise a health facility. It’s tiring. And then it’s not effective. If the district supervisors are close to the supervisees, then they can regularly carry out the activity in their districts [that would be better]. I would normally like each technician to supervise in his district. (Male, Laboratory Technician and Regional Supervisor, Cameroon [KIl 92])

**Health facility prioritization for initial and follow-up visits.**

The OTSS+ approach introduced performance criteria to aid in selecting health facilities for OTSS+ supervision visits. Participants from most countries reported using a combination of performance or needs-based criteria to determine where support was most needed (e.g., health facilities with poor malaria indicators, high attendance, a larger catchment population, new health workers) with the final selection influenced by resource and other practical constraints. In many countries, participants noted a gap between the intended and actual approaches for health facility selection and follow-up visits. Participants reported they were unable to reach all prioritized health facilities or they struggled to determine whether to prioritize follow-up visits to supervised health facilities, frequently highlighting the importance of not “abandoning” a health facility versus prioritizing resources to target “new” health facilities. In Ghana and Zambia, participants reported that follow-up visits were, at times, deprioritized. In practice, participants in many countries reported that the decision to follow up with a health facility was determined by health facility performance, evidence of action plan implementation, supervisor availability, and resource constraints, leading to variation in the duration and frequency of support within and across countries.

You don’t give up on a [health facility] … when you don’t go anymore . . . , after a while, the [health facility] falls back to the lowest level. . . . [E]ven when the structure has reached a good level of performance, you have to check from time to time to see if it is maintaining itself, if it has not dropped the good practices. (Female, Government Stakeholder and Clinical Supervisor, Côte D’Ivoire [KII 097])

To make me revisit the facility is when I am still concerned on their adherence to the treatment guidelines. Maybe they are undertesting or overtreating or otherwise when they don’t have adequate stock when the data [have] issues. And when sometimes there’s an increased number of patients for malaria compared to the normal number, . . . and I’m suspecting maybe an upsurge and they need some support. So those are some of the things that can make me revisit [a] facility again. (Female, Malaria County Coordinator and Supervisor, Kenya [KII 127])

The OTSS+ approach typically plans for three follow-up visits conducted on a quarterly basis after the first visit. Most supervisors and managers confirmed that the optimal frequency for OTSS+ visits was quarterly, because it allowed sufficient contact between health facility staff and supervisors, although several suggested that a range of frequencies may be appropriate according to health facility performance. Participants noted that the amount and frequency of follow-up also depended on the type of actions defined in the action plan and approach used for follow-up.

Across countries, participants reported trying different follow-up approaches to address specific health facility needs and to prioritize OTSS+ resource use. For example, after conducting a first OTSS+ malaria-focused visit, it might be followed by a visit through a planned integrated supervision visit, either with the same or a different supervisor. Integration with other health areas was seen as one approach for promoting efficiency and improving reach. However, integration was often seen as both a strength and a threat, with participants citing a need to balance integration with a deeper, malaria-specific assessment. Some Zambian supervisors also preferred that the same supervisor conduct all visits to maintain the relationship. Another approach was to determine the weight required for the follow-up. Actions that were easier to resolve could be followed up via a phone call, whereas other actions might require more time and resources.

**Action plan dissemination and follow-up.**

Supervisors highlighted the importance of ensuring that both the health facility and the district have access to the action plan. Poor dissemination and availability of action plans at the health facility level was deemed to hamper implementation. Of the 12 health facilities visited by the study team, we found zero facilities with either a hard or electronic copy of the action plan available onsite. However, in FGDs in Cameroon, Ghana, and Niger supervisors and providers mentioned that action plans were sometimes copied in a designated notebook or that supervisors sent the plans by e-mail or WhatsApp after the visit. However, there was little mention of these plans being disseminated internally or made visible by the health facility team. Newer versions of the digital tool include an action planning module that allows for electronic documentation and dissemination of the plan at the time of the visit. However, participants reported that the action plans remained stored in the digital tool, to which the health facilities did not have access.

Weak action plan implementation was also perceived to limit effectiveness and threaten long-term engagement by stalling performance progress, wasting resources, and leading to a breakdown in the supervisor-supervisee relationship. Supervisors and managers reported two main challenges to action plan follow-up. The first was the absence of a system for tracking action status and unclear responsibilities of the different actors (supervisor, district, health facility) regarding verification of action completion. The second challenge related to insufficient or irregular follow-up visits as a result of resource constraints or supervisor availability (as described earlier regarding health facility prioritization), or a lack of supervisor continuity in areas where follow-up visits may be integrated or conducted by a different supervisor. More follow-up was perceived to increase the likelihood of adherence and completion of the action plan, and notable improvements in malaria service delivery between visits.
Data review and use. Participants observed that OTSS+ data were used primarily by supervisors or district health managers to identify gaps in supplies and performance, provide on-the-spot capacity building, and follow-up on action plans for the health facility and district. Monthly or quarterly data review meetings at district or regional levels were described as the main forums to discuss OTSS+ visit results. A few participants noted there was an opportunity to increase the use of data generated by the OTSS+ approach at different levels in the health system to support strategic planning and allocation of resources.

DISCUSSION

In this qualitative evaluation, the OTSS+ approach was widely perceived to be an effective approach for improving health facility and health worker performance in malaria service delivery and for improving indirectly data and supply management in a range of country contexts. These qualitative findings complement the quantitative evaluation of the OTSS+ visit data collected in Cameroon, Ghana, Niger, and Zambia, which found an association between successive OTSS+ visits to a health facility and improved health worker performance as assessed by the OTSS+ checklists.25 In our study, quality improvements were reported primarily with regard to effective service delivery, and were related to improved awareness, knowledge, and adherence to case management guidelines and diagnostic protocols. In addition, health workers reported increased confidence and motivation after OTSS+ visits, which are important outcomes in contexts confronted with high rates of health worker attrition. Other studies1,15 have found that formal supportive supervision is linked to increased health worker job satisfaction, motivation, or likelihood to remain in one’s post. Madede et al.24 found that supervision helped cultivate a more open and inclusive work environment, and that health workers felt there was space “to express their ideas and be heard.” In our study, provider satisfaction and motivation were derived in part from a sense of providing quality care and seeing satisfied patients. Importantly, providers also perceived improvements in the quality of patient–provider interactions, suggesting the OTSS+ approach encouraged the adoption of more people-centered care practices—a key element of quality health care.25

The OTSS+ approach was perceived to be a “holistic” process of improvement, suggesting that both supervisors and supervisees integrated the notion of a continuous process of improvement. Perceived effectiveness was driven primarily by the relevance and appropriate adaptation of checklists, the quality of supervisor–supervisee interactions, and a sense of joint responsibility generated through a collaborative approach and action planning. These findings are consistent in part with the limited evidence on what constitutes effective supportive supervision. The use of standardized checklists has been shown to be effective for guiding systematic observation to measure performance26,27 and may be useful for facilitating data capture and use. However, a systematic review of 81 studies from 36 countries by Rowe et al.9 found that use of a checklist in itself during supervision visits was not associated with effectiveness. Participants in our study felt the checklists were relevant, and they were able to adopt and adapt the checklists in line with the needs of their context, reporting a sense of ownership for the process.

A recent review28 of successful supervision approaches found that they relied frequently on digital tools, which were integrated into existing data systems and informed by health system data. In our study, participants valued the use of digital tools, which was perceived to enhance objectivity and transparency, but reported that the use of OTSS+ data at subnational health system levels for malaria programming could be strengthened.

Studies have emphasized the overall importance of the quality of supervisor–supervisee interactions,2 and the importance and positive experience of onsite mentoring and coaching visits to individual health facilities.29 Participants in our study appreciated the onsite provision of coaching, mentoring, and other support provided by qualified and skilled supervisors who were focused on problem solving and who had enough time to “go in depth.” Although countries used different types of support (coaching, mentoring, training), we found no strong themes with regard to valuing a particular method or type of support, as long as it was in person, onsite, and appropriate to the context.

Many of the qualities and capacities ascribed to supervisors in our study reflected those that have been defined variously as making supervision “supportive.” Supervisors and supervisees both articulated supervisor attitudes and behaviors using a vocabulary that suggested deep knowledge and experience with engaging in respectful, two-way exchange focused on improvement, in stark contrast to approaches focused on inspecting, finding wrongdoing, and controlling.13 These attitudes and methods were perceived to differentiate the OTSS+ approach from other supervision approaches, both historical and contemporary, suggesting effective selection and training of OTSS+ supervisors, or suggesting that attitudes within health systems may have evolved more broadly in some contexts.

In our study, participants did not relate OTSS+ effectiveness strongly with the number of visits or visit frequency. They did perceive both the interaction length and follow-up (both intended and realized) to be a component of the quality of the interaction. Although we found participants across countries shared a common theoretical notion of the optimal frequency (i.e., quarterly), in most countries this intended schedule was difficult to operationalize as a result of planning and resource constraints. Some countries simply deprioritized follow-up visits in favor of reaching “new” health facilities; few participants expressed satisfaction that they were able to implement their health facility selection and follow-up approaches as desired. The literature on defining the right amount of support is similarly unclear. Desta et al.30 found that the optimal duration and frequency of supportive supervision visits to reach and maintain competency levels in facility-based primary health-care services in Ethiopia was five visits, separated by 6 to 9 months. In a systematic review of studies, Rowe et al.9 found the effects of supervision frequency (the number of visits per year) and dose (the number of supervision visits during a study) were unclear. It may be that the optimal frequency and duration of support is context specific and will vary in different places.

Quantitative evaluation of OTSS+ data suggested that the duration required to reach competency varies by domain, even possibly within a health facility.22 Other studies have
noted the relative importance of the quality of interactions over the frequency of visits. At the community level, a review by Hill et al.\(^3\) found that improving supervision quality has a greater impact than increasing frequency of supervision alone. The limited long-term evaluation of these kinds of approaches also makes it difficult to determine whether gains are sustained over time, with or without follow-up visits.

Although the provision of onsite support was highly valued, we found some evidence to suggest that it may be the follow-up contact itself (any type of contact) that may be critical for catalyzing improvements. Awareness that someone is following up and checking in appeared to promote accountability for and maintain attention on agreed actions. However, our evaluation of follow-up was limited by the absence of agreed definitions on what constitutes follow-up, systematic tracking of all follow-up contacts, and electronic recording and visualization of follow-up results. Further review and investigation of the different types of follow-up mechanisms (i.e., in-person return visits conducted by the same supervisor, integrated visits conducted by a different supervisor, or phone based) might help to clarify the relative value of the type, duration, and frequency of supervisory contacts.

In their recent systematic review, Rowe et al.\(^2\) found that having supervisors engage in problem solving with health-care providers was associated with greater mean effectiveness of supportive supervision. We found that joint review, problem solving, and action planning were highly valued, but that dissemination and follow-up of action plans remain persistent problems. An evaluation of OTSS supervisors at the end of the MalariaCare Project found similar perceptions that follow-up on action plans was inconsistent,\(^17\) and a recent study\(^32\) of supportive supervision in South Sudan found that action plans were followed up inadequately as a result of insufficient funding.

Avorti et al.\(^2\) called for a stronger focus on onsite, health facility–led (internal) supportive supervision, suggesting that a shift to building capacity at the lower levels of service delivery would help reduce the systemic and logistical challenges that hinder implementation. Although we found variations in implementation by country and even within countries, the OTSS+ approach is typically initiated at the regional level of the health system and, in practice, countries used a mix of approaches to identify health facilities for OTSS+ visits. Study participants emphasized the importance of involving district health management teams or their equivalent in OTSS+ visits and recommended training more supervisors at the district level. Other evidence has suggested that peer-to-peer learning is highly valued;\(^2\) however, we found little mention of peer-to-peer exchange with the OTSS+ approach. When possible, shifting quality improvement processes to the district and health facility levels might encourage greater ownership; more self-assessment, peer-to-peer learning, and internal supervision; and perhaps make more efficient use of human and financial resources, allowing for wider or a more sustained reach of health facilities in need of support. More internally driven quality improvement might also incorporate systematic community outreach and engagement in quality improvement processes. The OTSS+ approach was designed originally to target support to the health facility level. However, some countries, such as Cameroon, have begun expanding the OTSS+ approach to the community level, where a large proportion of fever cases are first seen by community health workers. Building health facility–level capacity to support community health workers more effectively is likely crucial for improving the overall quality of malaria services and patient experience across the care continuum.

These factors suggest the overall importance of context-specific adaptations, not only of the OTSS+ checklists and tools, but also for OTSS+ visit planning and follow-up processes.

Our study had a few limitations. First, the retrospective design across diverse contexts limited our ability to assess comparatively the contribution of complementary approaches within individual countries, variation in implementing partners, or other important context-specific characteristics. We used probing techniques to clarify the influence of other factors that may have contributed to improvements. Second, data were collected from a small sample of OTSS+ health facilities in the four targeted countries. This was due to the need to balance priority areas of inquiry with operational constraints, and to the small number of health facilities that had undergone multiple OTSS+ visits in some countries. Smaller sampling frames in Ghana and Zambia (resulting from the smaller number of health facilities receiving multiple visits) mean these samples may be less representative of the full range of health facilities in those countries and may overrepresent those health facilities that did not demonstrate substantial improvement or were perceived to need significant support after the initial OTSS+ visit. Third, respondents may have been inclined to share predominantly positive viewpoints, particularly if they felt they had a stake in the evaluation findings. We attempted to minimize bias through clear statements on the study intent, scope, and use of findings; a combination of onsite and offsite data collection; and triangulation of perspectives to confirm and enrich our interpretation of themes emerging from the data. Last, patient and caregiver perspectives were not included in our evaluation. Exploration of their views regarding quality-of-care improvements, such as changes in provider behavior and quality of patient–provider interactions, health facility reception, patient flow, organization of care, time spent with the provider, information about their care, opportunities to raise concerns, and explanation of treatment after OTSS+ visits would be important for confirming that quality improvements were experienced by care seekers, in line with the principles of patient-centered care.\(^2\)

**CONCLUSION**

The OTSS+ approach was perceived to be a useful quality improvement approach for malaria services in a range of country contexts. Findings confirm the importance of the quality of supervisory contact and on-the-spot problem solving. Planning and health facility targeting require further context-specific attention to ensure the right health facilities are being reached and adequately followed up for long-term effect. To that end, further investigation to understand the optimal duration, frequency, and type of follow-up supervisory contacts in different contexts may be helpful. In addition, continued attention to embedding quality improvement processes at lower levels of the health system, and improved dissemination and follow-up of action plans may support increased effectiveness and efficiency. Future evaluations of similar quality improvement interventions should
incorporate patient perspectives, in line with the principles of patient-centered care.

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Disclosure: Ethical approval was obtained from the Population Services International Review Ethics Board, as well as from the ethical review boards in the four countries where fieldwork was conducted: from the Comité National d’Éthique de la Recherche pour la Santé Humaine in Cameroon (No. 2022/05/1458/CE/CNERSH/SP), from the Ghana Health Service Ethics Review Committee in Ghana (No. 012/04/22), from the Niger Comité National d’Éthique pour Recherche en Santé in Niger (No. 015/2022/CNERS), and from the University of Zambia Biomedical Research Ethics Committee in Zambia (No. 2632–2022). National malaria control programs in the four countries also reviewed the research protocol and granted permission for evaluation implementation. Written and oral informed consent was obtained from participants for all key informant interviews and focus group discussions prior to interview and audio recording. Transcripts were de-identified prior to analysis.

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Clinical Outreach Training and Supportive Supervision Quality-of-Care Analysis: Impact of Readiness Factors on Health Worker Competencies in Malaria Case Management in Cameroon, Mali, and Niger

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Abstract. Improving the quality of malaria clinical case management in health facilities is key to improving health outcomes in patients. The U.S. President’s Malaria Initiative Impact Malaria Project has supported implementation of the Outreach Training and Supportive Supervision (OTSS) approach in 11 African countries to improve the quality of malaria care in health facilities through the collection and analysis of observation-based data on health facility readiness and health provider competency in malaria care management. We conducted a secondary analysis of longitudinal data collected during routine supervision in Cameroon (April 2021–March 2022), Mali (October 2020–December 2021), and Niger (November 2020–September 2021) using digitized checklists to assess how service readiness affects health worker competencies in managing patients with fever correctly and providing those with confirmed uncomplicated malaria cases with appropriate treatment and referral. Linear or logistic regression analyses were conducted to assess the effect of facility readiness and its components on observed health worker competencies. All countries demonstrated significant associations between health facility readiness and malaria case management competencies. Data from three rounds of OTSS visits in Cameroon, Mali, and Niger showed a statistically significant positive association between greater facility readiness scores (including the availability of commodities, materials, and trained staff) and health worker competency in case management. These findings provide evidence that health worker performance is likely affected by the tools and training available to them. These results reinforce the need for necessary tools and properly trained staff if high-quality malaria case management services are to be delivered at health facilities.

INTRODUCTION

In the face of numerous challenges to malaria control and elimination efforts, the WHO has reiterated the importance of using a primary health-care approach to strengthen health systems so that high-quality services and interventions can be delivered to and accessed by those in need.1 Improving the quality of malaria clinical case management in health facilities through timely and accurate diagnosis and treatment of confirmed cases using artemisinin-based combination therapies (ACTs) is key to improving health outcomes in patients. There is considerable evidence demonstrating the positive impact of training and supportive supervision on improving provider practices.2–5

The U.S. President’s Malaria Initiative (PMI) Impact Malaria Project, launched in 2018, has supported implementation of the Outreach Training and Supportive Supervision (OTSS) approach to improve the quality of malaria care in health facilities in 11 African countries (Cameroon, Côte d’Ivoire, Ghana, Kenya, Madagascar, Malawi, Mali, Niger, Sierra Leone, Tanzania, and Zambia).6 This approach, built on the original OTSS approach launched under the PMI Improving Malaria Diagnostics Project (2007–2011) and continued under the PMI MalariaCare Project (2012–2017),7,8 focuses on the continuous improvement of 1) service delivery readiness of health facilities, and 2) competencies of health providers in malaria diagnosis and treatment. Outreach Training and Supportive Supervision (OTSS) visit. Based on these scores, supervisors provide on-the-job training, coaching, and troubleshooting, and develop action plans to address identified gaps. The OTSS visit results and action plan are followed up between visits to address gaps in the availability of essential malaria drugs and commodities, materials (e.g., job aids and guidelines), and documentation (i.e., registers and reporting forms); and are reinforced during subsequent visits to strengthen continuously health worker competencies to manage malaria cases (including malaria in pregnancy) and perform malaria rapid diagnostic tests (RDTs) properly.

The OTSS readiness checklist (Supplemental Figure 1) collects facility-based information on the availability of malaria commodities, including RDTs and ACTs; materials, including malaria case management guidelines and job aids; documentation (registers and reporting forms); and trained personnel at the facility. The information gathered from the readiness checklist during OTSS visits enables supervisors to track progress on overall facility readiness and each individual checklist component.

The OTSS approach also uses a health provider competency-based checklist—the outpatient department (OPD) checklist (Supplemental Figure 2)—to assess clinicians’ management of suspected malaria patients. Supervisors use this checklist to...
observe the provider–patient interaction, collecting information on the competency of health workers in welcoming patients, assessing the history of fever, reviewing symptoms, performing a physical examination, requesting appropriate testing (including RDTs), making the correct classification of cases (as nonmalaria, uncomplicated malaria, or severe malaria), providing treatment to patients with positive tests, adhering to negative test results, and providing counseling to patients. This checklist generates data on the overall performance of health workers, as well as for each of the component behaviors. Previous studies have assessed the impact of facility readiness on the implementation of malaria interventions. Evidence from cross-sectional studies in particular have demonstrated the correlation between facility readiness and quality service delivery. 9–16 Similarly, the service availability and readiness assessment methodology has provided information on the availability of health system inputs and their impact on improved health outcomes. 17 However, there remains a paucity of evidence on the direct impact of these inputs, or facility readiness more generally, on the quality of care provided to febrile patients presenting at health facilities. An analysis of pooled OTSS data from nine countries supported by MalariaCare demonstrated the positive association between the overall performance of health facilities and the competency of health workers. 5 The study showed a strong positive association between overall performance and key readiness outputs (such as the availability of the most recent malaria case management guidelines and algorithms, and formally trained health workers), but found no significant association between stock-outs of ACTs and health worker competency scores. However, the study did not explore the direct association between the availability of commodities and the specific competencies of health workers in requesting RDTs and prescribing the correct malaria treatment. The study team noted the need for additional evidence on the association between health facility readiness and the quality of malaria case management.

This secondary analysis of OTSS data assesses whether health facility readiness in high-burden countries is associated with health worker competencies in diagnosing and managing patients correctly who are suspected of having malaria, and providing those with uncomplicated malaria with appropriate treatment and referral.

MATERIALS AND METHODS

A secondary analysis of longitudinal OTSS data collected during routine supervision activities in Cameroon, Mali, and Niger was conducted to assess the association between overall facility readiness and the competency of health workers in managing patients suspected of having malaria, in addition to the association between 1) the availability of trained personnel in facilities and the competency of health workers in assessing fever correctly, including requesting a malaria diagnostic test (microscopy and/or RDTs) and providing the correct treatment for patients diagnosed with malaria; 2) the availability of guidelines, documents, and materials in facilities and the competency of health workers in assessing fever correctly, including requesting malaria tests (microscopy and/or RDTs) and providing the correct treatment for patients diagnosed with malaria; 3) the availability of RDTs and microscopy commodities in facilities and the competency of health workers in requesting a malaria diagnostic test for patients with fever; and 4) the availability of first-line malaria treatment and the competency of health workers in prescribing the correct treatment.

Study design. Three countries—Cameroon, Mali, and Niger—were selected for this study because of the similarities in their implementation of OTSS: 1) all started OTSS in 2019; 2) all used the same OTSS tool and checklists, with slight adaptations for country context; and 3) all made similar investments and faced similar challenges in policy development, training, and supply chains for commodities such as RDTs and ACTs. At the time of the study, five rounds of OTSS had been implemented in Cameroon, Mali and Niger since its launch in 2019. A round is defined as a specific period during which a targeted set of facilities receive OTSS visits. The OTSS rounds should happen quarterly in each of the three countries. However, constraints—which are linked primarily to competing government priorities—resulted in each of the countries conducting OTSS rounds every 4 to 6 months. At the launch of this approach, the number of facilities to visit was selected based on PMI Impact Malaria target facilities according to availability of resources. Over time, the initial pool of facilities was increased gradually based on the expansion of Impact Malaria targets.

Three rounds were selected for each country. Rounds 3 through 5 were selected for Cameroon and Mali. For Niger, rounds 2 through 4 were selected because, starting in round 5, OTSS visits shifted to a different set of facilities that had not been visited in previous rounds, making the results from round 5 not comparable to previous rounds. The specific timing of each round is noted in Table 1.

Supervisors use digitized checklists that break down the recommended procedures into objective steps (with yes/no questions to indicate whether a step was performed) and are provided periodic refresher training to limit observer bias. Each question in the checklists is assigned a weight of

<table>
<thead>
<tr>
<th>Country</th>
<th>Round</th>
<th>Timing</th>
<th>No. of facilities</th>
<th>No. of provider observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameroon</td>
<td>3</td>
<td>April–May 2021</td>
<td>200</td>
<td>215</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>September–October 2021</td>
<td>367</td>
<td>395</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>February–March 2022</td>
<td>285</td>
<td>285</td>
</tr>
<tr>
<td>Mali</td>
<td>3</td>
<td>October–November 2020</td>
<td>235</td>
<td>484</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>March–April 2021</td>
<td>234</td>
<td>406</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>November–December 2021</td>
<td>230</td>
<td>396</td>
</tr>
<tr>
<td>Niger</td>
<td>2</td>
<td>November–December 2020</td>
<td>93</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>April 2021</td>
<td>66</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>July–September 2021</td>
<td>82</td>
<td>96</td>
</tr>
</tbody>
</table>
1 to 3 points based on its importance. In addition, data collected during the observation are reviewed and validated with the observed health provider.

Supervision data collected in the HNQIS (version 1.6.15; Population Services International, Washington, D.C.) and downloaded to a DHIS2 (version 2.36.10.1; University of Oslo, Norway) platform were extracted. Data from each OPD checklist from a round of OTSS visits in a country were matched with the corresponding facility readiness checklist. If there were multiple facility readiness checklist observations for the same facility on the same date, which could have resulted from multiple entries by the supervisor, the observation with the lowest score was retained. All observations for the OPD checklist were retained because countries perform as many as three clinical observations during one OTSS visit. Facilities with data available from both the facility readiness and the OPD checklists within each round were included in the study.

Measures and variables. We selected four variables from the OPD checklist (dependent variables) and five variables from the facility readiness checklist (independent variables) for analysis. Variables selected from the OPD checklist included case management competency score, correct classification of malaria, malaria test requested for a child with fever, and malaria treatment provided for a child who tested positive for malaria. Variables selected from the facility readiness checklist included overall readiness score, percentage of facilities with ≥50% of health workers who received classroom training, availability of materials, availability of RDTs, and availability of ACTs.

A competent health worker is defined as one who achieved an overall competency score of 90% on the OPD checklist, which is calculated using all sections of the checklist, including patient assessment, diagnosis, classification, and correct treatment and referral based on RDT result. The case management competency score data were retained as a continuous variable.

Facility readiness is defined as a health facility that achieved an overall readiness score of 90% on the facility readiness checklist, which is calculated using all sections of the checklist, including the availability of malaria commodities, materials, documentation, and ≥50% of personnel receiving classroom training. Our study looked at the availability of two commodities—RDTs and ACTs—as binary variables, where 0 = no commodity available and 1 = the commodity was available. The availability of ACTs was defined by the availability of ACT for all age groups across each country. (In Cameroon, a minimum 1-month supply was required.) In instances where ACTs were not available for a certain age group, ACTs were considered not to be available. Availability of materials is defined as a facility that scores ≥90% in having national malaria guidelines and recommended job aids, as well as necessary malaria registers and reporting forms, per the national guidelines. Our study retained the availability of materials variable as a continuous variable. Facilities with the necessary personnel is defined as those with ≥50% of their personnel (all categories) having received classroom training in malaria case management during the past 2 years.

Analyses. The study team first calculated for each country the average health facility readiness and health worker competency scores for all facilities and the proportion that met the 90% threshold score for health facility readiness and health worker competency in case management. In addition, for health facility readiness, the proportion of health facilities that have ≥50% of trained health workers, RDTs available, and ACTs available was calculated, as was the average score of health facilities that have the necessary materials (sum of availability of materials scores divided by the number of facilities). For health worker competency, the proportion of the health workers that classify malaria correctly, request a malaria test, and provide the correct treatment was generated.

Linear regressions assessed the percentage point change in case management competency score (dependent variable) with each 10% increase in overall readiness score (independent variable), the percentage point change in case management competency score (dependent variable) with each 10% increase in materials availability (independent variable), and the percentage point change in case management competency score (dependent variable) when facilities have ≥50% of trained personnel (independent variable).

Logistic regressions were conducted to assess the odds of the health worker providing correct treatment to patients (dependent variable) with the availability of ACTs (independent variable), and the odds of the health worker requesting RDT or microscopy (dependent variable) with the availability of RDT commodities (independent variable). Statistical regressions were deemed significant at $P < 0.05$.

Data management. Location data such as GPS points were not included in extracted data sets. Facility names were included in the data sets but were not used for the analysis. Analyses and results were only presented at the country level, with aggregate data to ensure results did not contain any personally identifiable information and could not be traced back to a particular individual, facility, or geographic area in-country. All data were stored in a restricted access folder.

Data validation. The research team held a validation meeting with PMI Impact Malaria country teams in November 2022 to review preliminary findings for their respective country. During the validation meeting, the research team presented and discussed the findings and relevant contextual information.

RESULTS

The final data sets used for analysis included a total of 895 observations for Cameroon, 1,286 observations for Mali, and 284 observations for Niger. Details on the number of observations and facilities for each round and country are outlined in Table 1.

Table 2 presents trends in scoring over successive OTSS rounds for the variables chosen for the linear or logistic regression analyses for Cameroon, Mali, and Niger. In the three countries, health workers demonstrated an improvement in case management competency scores through the three rounds analyzed (Figure 1). The percentage of health facilities that achieved a ≥90% overall facility readiness score increased with subsequent OTSS visits across all countries. In Cameroon, the percentage of health facilities that met this 90% threshold increased from 7.9% in round 3 to 60.4% in round 5. In Mali, the percentage that met the threshold increased from 33.1% in round 3 to 41.7% in round 5. Niger also showed an increase in the percentage that met the threshold, from 5.7% in round 2 to 29.2% in round 4. In most instances, commodity and material
availability, correct classification of malaria, requesting a malaria test, and providing correct treatment to patients remained high (reaching $80\%$) in each country across all rounds of OTSS visits analyzed. Similarly, there were improvements between the first and last assessed rounds for each country for the percentage of health worker observations that met the 90% score for case management competency across the three countries: 10.4% in round 3 to 18.9% in round 5 for Cameroon, 37.9% in round 3 to 45.6% in round 5 for Mali, and 16.3% in round 2 to 42.7% in round 4 in Niger.

Statistical regression analysis. All countries demonstrated significant associations between overall health facility readiness and case management competency (Table 3). In Cameroon and Mali, all three rounds of OTSS indicated this positive association. In Niger, only round 3 of OTSS indicated a significant relationship between overall readiness and case management competency.

Similarly, there were improvements between the first and last assessed rounds for each country for the percentage of health workers who provided the correct treatment to pregnant women. However, there were no significant improvements in the percentage of health workers who provided the correct treatment to nonpregnant women. In Cameroon, the percentage of health workers who provided the correct treatment to pregnant women was consistently high (reaching ≥80%) in each country across all rounds of OTSS visits analyzed.

This study is one of the first to assess the association between facility readiness factors and competency in malaria case management. The findings suggest that improving overall health facility readiness is associated with better case management competency. The availability of rapid diagnostic tests (RDTs) and artemisinin-based combination therapy (ACTs) was found to be associated with higher case management competency. Improved case management competency was observed in countries where there was a greater availability of RDTs and ACTs, and where health workers demonstrated a high level of training and competency.

DISCUSSION

In conclusion, the results of this study highlight the importance of improving health facility readiness as a means of enhancing case management competency in malaria. The findings support the need for continued investment in health facility readiness, including the availability of RDTs and ACTs, as well as the continued training and support of health workers to improve case management competency.

TABLE 2

<table>
<thead>
<tr>
<th>Health facility readiness</th>
<th>Cameroon, n (%)</th>
<th>Mali, n (%)</th>
<th>Niger, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health facilities that have a 90% score for overall readiness</td>
<td>215 (7.9)</td>
<td>395 (21.0)</td>
<td>285 (60.4)</td>
</tr>
<tr>
<td>Health facilities that have ≥50% of trained health workers</td>
<td>215 (36.3)</td>
<td>395 (55.7)</td>
<td>285 (91.2)</td>
</tr>
<tr>
<td>Average score of health facilities that have the necessary materials</td>
<td>215 (79.3)</td>
<td>395 (89.5)</td>
<td>283 (77.5)</td>
</tr>
<tr>
<td>Health facilities that have RDTs available</td>
<td>215 (96.3)</td>
<td>395 (90.1)</td>
<td>285 (93.7)</td>
</tr>
<tr>
<td>Health facilities that have ACTs*</td>
<td>215 (77.7)</td>
<td>395 (53.4)</td>
<td>211 (97.2)</td>
</tr>
</tbody>
</table>

*The ACT variable was calculated in a binary way (0/1) as 1 all age groups had ACTs available and 0 at least one age group did not have ACTs available.

†A malaria test was defined as an RDT or microscopy. Because of indicator wording, RDT and microscopy could not be disaggregated.

‡The variable for providing the right treatment was split into two categories: for pregnant women or for nonpregnant women. Except for Cameroon round 3, all data for nonpregnant women were used.

§Cameroon round 3 had data for pregnant women only; there were no data for nonpregnant women.

Nonpregnant women.
### Table 3

Association between provider competency and health facility readiness in Cameroon, Mali, and Niger over three rounds of OTSS

<table>
<thead>
<tr>
<th>Percentage change in case management competency score (y) when facilities have ≥50% trained personnel (x)</th>
<th>Cameroon</th>
<th>Mali</th>
<th>Niger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage change in case management competency score (y) with each 10% increase in overall readiness score (x)</td>
<td>3.7 (1.9–5.4)*</td>
<td>4.8 (3.7–5.9)*</td>
<td>2.2 (1.3–3.2)*</td>
</tr>
<tr>
<td>Percentage change in case management competency score (y) with each 10% increase in materials available (x)</td>
<td>2.1 (1.3–2.9)*</td>
<td>2.4 (1.8–3.0)*</td>
<td>0.3 (0.1 to 0.6)</td>
</tr>
<tr>
<td>Percentage change in case management competency score (y) with each 10% increase in health workers’ knowledge of malaria case management guidelines (x)</td>
<td>2.4 (1.0 to 5.9)</td>
<td>0.6 (1.6 to 2.7)</td>
<td>4.3 (0.1 to 8.8)</td>
</tr>
<tr>
<td>Percentage change in case management competency score (y) with each 10% increase in health workers’ knowledge of malaria case management guidelines (x)</td>
<td>5.4 (3.3–7.6)*</td>
<td>3.1 (1.0–5.3)*</td>
<td>3.4 (1.2–5.6)*</td>
</tr>
</tbody>
</table>

*P < 0.001.

1P < 0.01.

2P < 0.05.

Values in bold type are statistically significant.
cases correctly as uncomplicated or severe, and providing the correct treatment to patients diagnosed with malaria.

There were some limitations to our analysis. In some instances, the sample sizes were too small to run a regression analysis. In others, the lack of diversity of data between variables, particularly when the competency scores were high for some indicators, limited the ability to assess some associations. Artemisinin-based therapy availability was collected as a binary variable and was disaggregated by four age groups. The study team had to calculate manually an estimated aggregated ACT availability variable, which may have introduced some inaccuracies during the aggregation process. The limited sample size also prevented multivariable regression analysis to test for confounding effects and have more conclusive results for some variables, such as the impact of readiness adherence to a negative RDT.

Our study provides further evidence that strengthening and sustaining health facility readiness is an important input toward improving the quality of malaria case management. Based on our results, health facility readiness should be an essential component of a systems-based, integrated, and tailored approach for improving the quality of malaria services in high-burden countries. In addition, the analyses presented herein should be embedded into regular programmatic assessments on quality-of-care trends using well-defined indicators at all levels to allow corrective actions when and where gaps are identified.

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assessment in 9 sub-Saharan African countries between 2007–
Use of Supervision Data to Improve Quality of Care for Malaria in Pregnancy: Experience in Six African Countries

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Abstract. Malaria in pregnancy (MiP) intervention coverage, especially intermittent preventive treatment in pregnancy (IPTp), lags behind other global malaria indicators. In 2020, across Africa, only 32% of eligible pregnant women received at least three IPTp doses, despite high antenatal care attendance. We conducted a secondary analysis of data collected during Outreach Training and Supportive Supervision visits from 2019 to 2020 to assess quality of care and explore factors contributing to providers’ competence in providing IPTp, insecticide-treated nets, malaria case management, and respectful maternity care. Data were collected during observations of provider–patient interactions in six countries (Cameroon, Cote d’Ivoire, Ghana, Kenya, Mali, and Niger). Competency scores (i.e., composite scores of supervisory checklist observations) were calculated across three domains: MiP prevention, MiP treatment, and respectful maternity care. Scores are used to understand drivers of competency, rather than to assess individual health worker performance. Country-specific multilinear regressions were used to assess how competency score was influenced by commodity availability, training, provider gender and cadre, job aid availability, and facility type. Average competency scores varied across countries: prevention (44–90%), treatment (78–90%), and respectful maternity care (53–93%). The relative association of each factor with competency score varied. Commodity availability, training, and access to job aids correlated positively with competency in multiple countries. To improve MiP service quality, equitable access to training opportunities for different cadres, targeted training, and access to job aids and guidelines should be available for providers. Collection and analysis of routine supervision data can support tailored actions to improve quality MiP services.

INTRODUCTION

Malaria in pregnancy (MiP) is a serious public health threat that can lead to preterm deliveries, low birthweight, and neonatal death.1 To decrease the risks of MiP, the WHO recommends that pregnant women in areas of moderate to high malaria transmission receive at least three doses of intermittent preventive treatment of malaria in pregnancy (IPTp) using sulfadoxine–pyrimethamine (SP), use insecticide-treated nets (ITNs), and receive prompt diagnosis and treatment of MiP.2,3 Although there have been improvements in the uptake of these interventions, in 2020 only 57% of eligible pregnant women in 33 countries in Africa received at least one dose of IPTp and only 32% received three doses.4

Many of the interventions aimed at reducing MiP are focused on the behaviors of pregnant women, such as promoting early and regular antenatal care (ANC) attendance and sleeping under an ITN.5 However, the quality of MiP prevention and treatment care depends primarily on provider knowledge and behaviors, and onsite resources and commodities. Providers are responsible for distributing ITNs to women during their first ANC visit, supplying ongoing counseling on consistent ITN use, and ensuring that women receive IPTp doses as early as possible during their second trimester and at every subsequent ANC visit, at least 4 weeks apart. Providers at antenatal and curative service departments are also responsible for prompt testing and treatment of MiP. Although many of these interventions require pregnant women to seek care, the actual provision is dependent on the actions of the provider and the availability of commodities, as well as data capture and reporting, all of which contribute to the measurable overall quality of care (QoC).5 Quality of care is defined by the WHO as “the extent to which health care services provided to individuals and patient populations improve desired health outcomes. In order to achieve this, health care must be safe, effective, timely, efficient, equitable and people-centered.” (p.14)7 High-quality care ensures patients receive all the interventions and information needed to benefit from health services. Previous studies have documented the overall poor QoC for malaria9 and the need to overcome health system barriers.9 Quality of care for pregnant women is often measured by the number of ANC contacts, the timing of the first ANC visit, and the provision of all recommended ANC services.10 However, there are additional components of QoC that can contribute to or strengthen the overall QoC, including those relevant to this analysis: respect and preservation of dignity, competent and motivated human resources, and essential physical resources available.7 Previous research on the MiP QoC topic has found that training of providers alone or in conjunction with supportive supervision, particularly training that incorporates clinical practice, can result in improvements in health worker
performance and competency in delivering MiP services. Ensuring commodity availability is also critical to delivering appropriate care. In addition, respectful maternal care (RMC), a framework for the interpersonal care that women receive during their pregnancy, has the potential to improve health outcomes and is being incorporated increasingly into QoC measures. Respectful care encompasses respect for women’s basic human rights, including respect for women’s autonomy, and preservation of respect, dignity, feelings, choices, and preferences. When women have positive perceptions of the quality of the care they receive, they are more likely to return for follow-up appointments. In turn, women who were often treated in a humane, respectful, supportive environment are recorded as having the highest percentages of adequate ANC attendance.

The U.S. President’s Malaria Initiative (PMI) Impact Malaria Project works across 19 countries to improve malaria service delivery by supporting national malaria control and elimination programs to engage with a four-prong quality improvement approach. The cornerstone of this strategy is Outreach Training and Supportive Supervision Plus (OTSS+), a facility-level approach aimed at improving health facility and provider competency through onsite supportive supervision, coaching, troubleshooting, and on-the-job training. This approach has been found to be an effective performance appraisal system that can improve the quality of services. Providers are deemed “competent” if they attain a score ≥90% on one of the standard checklists used to assess health facility readiness or health worker performance.

Our analysis did not use a competency threshold; the research questions did not seek to determine whether competency was achieved, but rather to assess elements that influence competency scores. To assist countries in identifying and addressing gaps and causes of missed opportunities in MiP service delivery, MiP-focused OTSS+ data from six countries (Cameroon, Cote d’Ivoire, Ghana, Kenya, Mali, and Niger), collected between 2019 and 2020, were analyzed to assess provider competency and QoC for MiP prevention and treatment, and for RMC. These countries were selected based on the availability of OTSS+ data at the time of analysis through the PMI Impact Malaria Project. Each country conducted OTSS+ in different levels of facilities based on supportive supervision strategies made at the national level, and included health centers and hospitals in Cameroon; dispensaries, health centers, and hospitals in Cote d’Ivoire; dispensaries, health centers, and hospitals in Ghana; dispensaries, health centers, and hospitals in Kenya; and health centers in Mali and Niger.

MATERIALS AND METHODS

Data collection. A secondary analysis of data collected between 2019 and 2020 during rounds of OTSS+ (Supplemental Table S1) was conducted to assess QoC and explore the factors contributing to health workers’ competency in prevention of MiP, treatment of MiP, and RMC. The OTSS+ data were collected by teams in health facilities supported by Impact Malaria, comprised of ministry of health representatives, who performed observations of provider-patient interactions using a package of checklists to monitor health worker performance and health facility readiness for malaria service delivery, with support from Impact Malaria Project staff. To facilitate real-time access, this assessment used electronically collected data, stored on cloud-based platforms, from one health facility readiness checklist and one MiP checklist. These checklists were based on a standard template; each country edited the checklists to fit their national context. Although not all checklist questions included in our analysis are worded identically across countries, they are comparable in nature. Where differences exist, this is noted in the presentation of data. Not all the same health facilities were observed during each OTSS+ round.

Data cleaning and variable selection. The first step of the MiP QoC data-cleaning process identified the data elements from the MiP and facility readiness OTSS+ checklists to use for the analysis. Prevention competency in MiP included supervision checklist observations of greetings and respectful care, patient history taken, IPTp administration, ITN distribution, and other ANC interventions. Thirty-two binary checklist questions were averaged to generate a competency score. Treatment competency in MiP included supervision checklist observations of greetings, medical history taken, diagnosis, and correct treatment. Twenty-five binary checklist questions were averaged to generate a competency score. Competency in RMC included supervision checklist observations of the woman being greeted, invited to sit down, treated with respect, and asked whether she had questions. The facility readiness module provided information on stock status, provider training, and the availability of guidelines and job aids. Elements deemed most representative of influencing competency scores of health workers and providing the broadest scope were selected to answer the research questions. Data were de-identified, and select data were imported into spreadsheets. Data availability was confirmed, and data element selection was refined further to respond to research questions of interest. All personal identifiable information was masked, and data from the two OTSS+ checklists were merged based on facility name (complete match) and date of observation (approximate match) in Stata 15.1 (StataCorp, College Station, TX) (Supplemental Table S2).

Data analysis.

Descriptive statistics. The unit of analysis was supervision observations derived from the checklists of interest. Descriptive statistics were calculated for a variety of data elements to assess proportions of these elements. Calculations of the descriptive statistics, and for the statistical analysis, were performed using data sets aggregated by country (e.g., data analyses were not disaggregated by OTSS+ round) (Supplemental Figure S1).

Regression analyses. Multilinear regressions were performed to assess how the MiP prevention competency score (Supplemental Table S3), MiP treatment competency score (Supplemental Table S4), and RMC score (Supplemental Table S5) were influenced by the independent variables of interest, including commodity (SP, ITNs, rapid diagnostic tests, quinine, artemisinin-based combination therapy [ACT], and injectable artesunate) availability, training, gender, job aid availability, cadre of health worker, and facility type (see definitions in Supplemental Tables S6 and S7). To control for any confounding effects of commodity availability, multivariate analyses were conducted when assessing the relationships of noncommodity variables with MiP prevention, MiP treatment, and RMC competencies. This was done by
including the ACT availability variable for MiP treatment regressions and including the SP availability variable for MiP prevention regressions. When assessing the relationship between commodity availability and MiP prevention and MiP treatment competencies, confounding effects from other commodities were also controlled by using multivariate analyses. Two predictor variables, the availability of SP and the availability of ITNs, were regressed in a multivariate model against the dependent variable of the MiP prevention competency score. Three predictor variables—the availability of quinine tablets, injectable artesunate, and ACTs—were regressed in a multivariate model against the dependent variable of the MiP treatment competency score. Prevention and treatment competency scores for MiP for each observation were existing variables in the countries’ OTSS+ data sets and were autogenerated based on observation of health workers providing the critical elements of prevention and treatment included in the OTSS+ checklist. Of note, the analyses for Ghana did not include any models with the MiP treatment score because the OTSS+ model in that country does not collect MiP treatment data. The RMC score was calculated manually by averaging available binary data elements for each observation on whether the patient was greeted, invited to sit down, treated with respect, and asked whether she had questions (Supplemental Table S3).

**Data validation.** Country data validation meetings were held after the completion of data analysis and yielded qualitative information about data collection, the health system, and the supervision process to contextualize country-specific findings of the quantitative data analysis. Each country’s validation meeting was held virtually and included the study team and Impact Malaria teams in each country office. Impact Malaria country teams were requested to share the results with relevant counterparts in the ministries of health’s malaria and maternal health departments for additional feedback. Qualitative data from these discussions were applied to understand quantitative findings more fully.

**RESULTS**

Our analysis was performed using data from six countries and a total of 2,444 facility observations: 339 from Cameroon, 284 from Cote d’Ivoire, 951 from Ghana, 82 from Kenya, 595 from Mali, and 193 from Niger. The number of significant correlations observed was related directly to the number of observations in the country’s data set.

**Health worker competency.** Average health worker competencies differed by country, from 44% to 90% in MiP prevention, 78% to 90% in MiP treatment, and 53% to 93% in RMC (Figure 1).

**Commodity availability and competence.** Availability of SP and ITNs was high across countries, as was the availability of ACTs (except in Cameroon), whereas the availability of quinine and injectable artesunate varied considerably (Table 1).

Provider competency score in MiP service delivery was associated positively with the availability of MiP commodities, as demonstrated in the regression analysis; this relationship was statistically significant in several countries (Table 2). When SP was in stock, the MiP prevention competency score was 8% points greater in Cote d’Ivoire and 32% points greater in Ghana, compared with when SP was not in stock and when ITN stock availability was held constant. When both SP and directly observed therapy (DOT) supplies, consisting of water dispensers and cups, were in stock, MiP prevention competency was 8% points greater in Cote d’Ivoire and 31% points greater in Ghana. When ITNs were in stock, the MiP prevention competency score was 13% points greater in Cote d’Ivoire and approximately 17% points greater in both Ghana and Niger compared with when ITNs were not in stock and when SP stock availability was held constant. Notably, in Cameroon, the MiP prevention competency score was 11% points less when ITNs were in stock and when SP stock was held constant.

When quinine was in stock, the MiP treatment competency score was 6% points greater in Mali compared with

![Figure 1](image-url)
when quinine was not in stock and when ACT and injectable artesunate stock availability were held constant. When ACTs were in stock, the MiP treatment competency score was 9% points greater in Niger compared with when ACTs were not in stock and quinine and injectable artesunate stock was held constant. Ghana was the only country included that reported clindamycin stock, which was present during 47% of observations.

**Provider and facility readiness and competency.** Among observed health worker cadres reported in Cameroon, Cote d’Ivoire, and Niger, 35% were nurses, 12% were nurse assistants (a cadre present/recorded only in Cameroon), 51% were midwives, and 2% each were doctors or other (Ghana, Kenya, and Mali did not collect data on provider cadre). Availability of MiP guidelines and job aids ranged from 49% to 88%, although only the Cote d’Ivoire checklist asked about both guidelines and jobs aids. The percentage of health workers who had been trained recently ranged from 27% in Cameroon to 85% in Cote d’Ivoire. Checklist question wording with regard to training status differed greatly between countries, based on national-level stakeholder checklist validation decisions.

Although SP was available on the day of observation in most facilities across the six countries, many countries did not have adequate supplies of drinking water and cups to facilitate IPTp via DOT at ANC (Figure 2). Health facilities having the availability of all three resources on the day of observation (SP, drinking water, and cups at ANC) varied from 42% in Niger to 86% in Ghana. Of note, Ghana’s DOT supply data element only consisted of drinking water available for DOT. Ghana did not collect data on the availability of drinking cups.

**Malaria in pregnancy prevention.** A positive correlation was observed between DOT supplies (Cote d’Ivoire, Ghana), training (Cote d’Ivoire, Ghana), facility type (Cote d’Ivoire, Ghana), health worker gender (Cote d’Ivoire), and job aids (Cote d’Ivoire, Ghana) on health worker competency in the delivery of MiP prevention services (Table 3). Regression analysis also found a significant relationship between provider cadre and MiP prevention competency in Cote d’Ivoire, where midwives had lower competency scores than nurses. In Cameroon, both midwives and nurse assistants had greater competency scores than nurses.

**Malaria in pregnancy treatment.** For MiP treatment analyses, cadre and facility type data were not available for all countries. Ghana was not included in the MiP treatment analysis because they did not collect treatment competency score data in their OTSS+ checklist. There was a positive effect on MiP treatment competency of training and job aids in Cote d’Ivoire (8% and 9% points, respectively). No effect was observed for cadre, facility type, or provider gender on MiP treatment competency in any country (Table 4).

**Respectful maternity care.** A significant effect on provider competency in delivery of RMC with regard to training (Ghana, Mali), facility type (Ghana), and MiP job aids (Cote d’Ivoire, Ghana) was observed. Cadre and gender were not observed to have a significant relationship with RMC competency scores in countries for which data were available (Table 5).

**DISCUSSION**

Factors contributing to QoC for MiP are highly variable based on country and context, with different facets of
context, conditions, and providers driving care competency. Although some relationships shed light on unique dynamics in a particular country, our analysis also highlighted several relationships that transcend borders. Significant positive associations were observed between provider competency and in-stock MiP commodities, as well as key readiness factors, including training and the presence of job aids.

**Malaria in pregnancy commodities and competence.** Commodity availability correlated significantly with MiP prevention competency in three of the six countries. Thus, our analysis dispels the oft-cited attribution of low IPTp uptake to SP stock-outs.20 In the six countries included in our analysis, SP availability was generally high (73–97%). That said, the percentage of facilities that had both SP and DOT supplies available on the day of visit ranged from 42% to 86%, with five of the six countries’ availability of both at 75% or less, indicating that providers are often not able to deliver IPTp via direct observation during ANC for more reasons than just a lack of SP. Indeed, several countries’ data showed a significant positive correlation between both SP and DOT supply availability and MiP prevention competency. Notably, the Niger country validation meeting discussion indicated that women often leave ANC with SP to take later because of the low DOT supply availability, although they may be recorded as having received IPTp in the ANC register—a finding reflected in other studies.21

Insecticide-treated net availability was generally high and correlated positively with MiP prevention competency in three of the six countries. Although ITN availability correlated negatively with MiP prevention competency in Cameroon, participants in the country validation meeting believe this to be reflective of a data quality challenge. Further assessment is needed to understand more fully the causes of this correlation.

**TABLE 3**

A multivariate analysis of noncommodity variables with health worker competency score (as a percentage-point change) in the delivery of malaria in pregnancy prevention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cameroon</th>
<th>CDI</th>
<th>Ghana</th>
<th>Kenya</th>
<th>Mali</th>
<th>Niger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent training*</td>
<td>2.967†</td>
<td>7.699†</td>
<td>11.927†</td>
<td>NA§</td>
<td>3.253†</td>
<td>NA§</td>
</tr>
<tr>
<td>Job aids*</td>
<td>-3.122†</td>
<td>6.162§</td>
<td>6.008§</td>
<td>5.482§</td>
<td>-0.857†</td>
<td>7.971†</td>
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<td>Provider gender*</td>
<td>0.351†</td>
<td>-5.657Ⅹ</td>
<td>NA§</td>
<td>NA§</td>
<td>NA§</td>
<td>NA§</td>
</tr>
<tr>
<td>DOT supplies*</td>
<td>9.209†</td>
<td>5.329§</td>
<td>31.908‡</td>
<td>4.037</td>
<td>-0.052§</td>
<td>0.843†</td>
</tr>
<tr>
<td>Cadre*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>Ref.</td>
<td></td>
<td>NA§</td>
<td>NA§</td>
<td>NA§</td>
<td>Ref.</td>
</tr>
<tr>
<td>Midwives</td>
<td>29.379²</td>
<td>-5.740Ⅹ</td>
<td>NA§</td>
<td>NA§</td>
<td>NA§</td>
<td>0.107†</td>
</tr>
<tr>
<td>Nurse assistants</td>
<td>34.013²</td>
<td></td>
<td>NA§</td>
<td>NA§</td>
<td>NA§</td>
<td>NA§</td>
</tr>
<tr>
<td>Facility type*</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispensaries</td>
<td>NA**</td>
<td>Ref.</td>
<td></td>
<td></td>
<td>NA§</td>
<td>NA§</td>
</tr>
<tr>
<td>Health centers</td>
<td>NA**</td>
<td>-7.078Ⅹ</td>
<td>7.710†</td>
<td>6.481‡</td>
<td>NA§</td>
<td>NA§</td>
</tr>
<tr>
<td>Hospitals</td>
<td>NA**</td>
<td>-8.618Ⅹ</td>
<td>8.238†</td>
<td>0.310Ⅹ</td>
<td>NA§</td>
<td>NA§</td>
</tr>
</tbody>
</table>

CDI = Cote d’Ivoire; DOT = directly observed therapy; NA = not applicable; Ref. = reference value.
* The effect of sulfadoxine-pyrimethamine stock availability is held constant.
† P < 0.001.
‡ P < 0.01.
§ No available data.
Ⅹ P < 0.05.
** Observation sample sizes were widely disparate in Cameroon (health centers, n = 328; hospitals, n = 11).
At the time of data collection, the WHO-preferred treatment of uncomplicated malaria in the trimester of pregnancy was quinine + clindamycin for 7 days (or quinine monotherapy if clindamycin is not available), with an ACT or oral artesunate as an alternative if quinine + clindamycin is not available or fails. All six countries’ policies aligned with WHO recommendations. Availability of quinine was generally poor, with five of the six countries’ availability on the day of visit <75% and three countries’ availability <40%. Ghana was the only country to collect data on clindamycin availability; 47% of facilities visited had clindamycin in stock. Thus, few facilities were able to deliver the WHO-recommended treatment of uncomplicated malaria during the first trimester of pregnancy. Availability of ACTs, the first-line treatment of uncomplicated malaria in the second and third trimesters in all six countries, was >80%, with the exception of Niger at 68% and Cameroon at 55%. However, as the availability of other artemether-lumefantrine presentations was not assessed for our analysis, it is possible that other presentations are more available and can be combined to treat MiP when indicated. Availability of injectable artesunate for treatment of severe malaria was variable, ranging from 57% to 94% on the day of visit.

Variable availability of MiP treatment commodities indicates that the WHO-recommended first-line treatment of both uncomplicated and severe malaria in pregnancy is not possible consistently. Unfortunately, most countries do not disaggregate routine malaria treatment data by pregnancy status, including trimester, so there is very little visibility into the classification of MiP cases or the treatment prescribed and administered to pregnant women with malaria. Until this lack of visibility is addressed, it is difficult to ascertain the degree to which MiP is managed appropriately by providers.

**Provider and facility readiness and competency.** Training and availability of job aids correlated significantly with greater competency scores (4–12 percentage points) in several countries across RMC, MiP prevention, and MiP treatment. These findings are not surprising, but highlight the need for continuous support and advancement of health care providers to improve on-the-ground implementation of MiP policies.

### Table 4
A multivariate analysis of noncommodity variables with health worker competency score (as a percentage-point change) in the delivery of malaria in pregnancy treatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cameroon</th>
<th>CDI</th>
<th>Ghana*</th>
<th>Kenya*</th>
<th>Mali</th>
<th>Niger</th>
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<tr>
<td>Recent training*</td>
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<td>NA†</td>
<td>1.279†</td>
<td>NA†</td>
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<td>Job aids*</td>
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<td>8.882†</td>
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<td>10.75†</td>
<td>0.141†</td>
<td>8.729†</td>
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<td>Provider gender*</td>
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<td>4.190†</td>
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<td>NA†</td>
<td>NA†</td>
<td>3.161†</td>
</tr>
<tr>
<td>Cadre*</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>Ref.</td>
<td>Ref.</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>Ref.</td>
</tr>
<tr>
<td>Midwives</td>
<td>−10.284†</td>
<td>1.101†</td>
<td>NA‡</td>
<td>NA‡</td>
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<td>Dispensaries</td>
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<td>Ref.</td>
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<td>Hospitals</td>
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<td>−2.662†</td>
<td>NA**</td>
<td>NA**</td>
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CDI = Cote d’Ivoire; NA = not applicable; Ref. = reference value.
* The effect of artesinin-based combination therapy stock availability is held constant.
† The effect of sulfadoxine-pyrimethamine and artesinin-based combination therapy stock availability is held constant.
Not significant
† P < 0.05.
‡ Ghana does not have treatment competency score data.
§ No available data.
¶ P < 0.01.
** Mali and Niger only have observations at the health center facility level.
†† Observation sample sizes were widely disparate in Cameroon (health centers, n = 328; hospitals, n = 11).
‡‡ Mali and Niger only have observations at the health center facility level.

### Table 5
A multivariate analysis of noncommodity influencers on health worker competency score (as a percentage-point change) in delivery of respectful maternal care

<table>
<thead>
<tr>
<th>Influencer</th>
<th>Cameroon</th>
<th>CDI</th>
<th>Ghana*</th>
<th>Kenya*</th>
<th>Mali</th>
<th>Niger</th>
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<td>Recent training†</td>
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<td>3.828‡</td>
<td>8.518†</td>
<td>NA†</td>
<td>5.739†</td>
<td>NA†</td>
</tr>
<tr>
<td>Job aids†</td>
<td>−1.120²</td>
<td>4.871#</td>
<td>4.117‡</td>
<td>−7.488†</td>
<td>0.305†</td>
<td>2.911†</td>
</tr>
<tr>
<td>Provider gender†</td>
<td>−0.104²</td>
<td>−2.174‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>3.724‡</td>
</tr>
<tr>
<td>Cadre†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>Ref.</td>
<td>Ref.</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>Ref.</td>
</tr>
<tr>
<td>Midwives</td>
<td>−5.166†</td>
<td>−1.776‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>−1.629‡</td>
</tr>
<tr>
<td>Nurse assistants</td>
<td>−3.873†</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
<td>NA‡</td>
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<tr>
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<td></td>
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<tr>
<td>Dispensaries</td>
<td>NA**</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
<td>NA††</td>
<td>NA††</td>
</tr>
<tr>
<td>Health centers</td>
<td>NA**</td>
<td>1.363†</td>
<td>7.147‡</td>
<td>8.767†</td>
<td>NA††</td>
<td>NA††</td>
</tr>
<tr>
<td>Hospitals</td>
<td>NA**</td>
<td>0.324†</td>
<td>7.922‡</td>
<td>−15.935†</td>
<td>NA††</td>
<td>NA††</td>
</tr>
</tbody>
</table>

CDI = Cote d’Ivoire; NA = not applicable; Ref. = reference value.
* Ghana and Kenya’s respectful maternal care competency score consisted of one data element. All scores are binary at 0% or 100%.
† The effect of sulfadoxine-pyrimethamine and artesinin-based combination therapy stock availability is held constant.
‡ Not significant.
# P < 0.05.
† Not significant.
II P < 0.01.
¶ P < 0.001.
§ No available data.
** Cameron observation sample sizes were unequal (health centers, n = 328; hospitals, n = 11).
†† Mali and Niger only had observations at the health center facility level.
worker knowledge. Although offsite training can be resource intensive, on-the-job training and mentorship can be an effective, targeted way to support health worker competency. Onsite training also has the potential to reach more providers. During country validation meetings, several countries noted that large-scale malaria and/or MiP training was carried out after these rounds of supervision, likely contributing to increased provider competency moving forward.

Ensuring that MiP guidelines and job aids are available for providers’ easy reference is a lower cost intervention that may yield an important increase in the QoC experienced by pregnant women, and may provide access to appropriate information—a known barrier to IPTp delivery.

Of the three countries for which provider cadre data were available, cadre was correlated only with competency for MiP prevention; Cameroon and Cote d’Ivoire both had significant findings. The country validation meeting elucidated the reasons for these findings, which were driven by provider experience levels in Cameroon and provider access to training in Cote d’Ivoire. Country validation meeting discussions suggested that, in Cameroon, midwives have more years of specialized experience than nurses, which may lead to greater competency scores. Conversely, in Cote d’Ivoire, midwives (more often women than men) have less access to training than nurses, potentially contributing to lower competency (Supplemental Appendix S1). Both countries have already taken, or plan to take, steps to ensure that all cadres of providers have access to the training needed to support greater competency.

Of the three countries for which provider cadre data were available, gender showed a significant correlation with MiP prevention competency only in Cote d’Ivoire, where female health workers scored 5.7 percentage points less than males. This is likely a function of differences between midwife and nurse training access and competency scores; the country validation meeting discussion noted that, in Cote d’Ivoire, midwives are mostly female and nurses included in OTSS+ are mostly male.

Several countries noted that widespread malaria and/or MiP training was carried out after these rounds of supervision, likely contributing to increased provider competency moving forward. In addition, countries took note of individual results for action. For example, Cote d’Ivoire discussed shifting to more on-the-job training to ensure midwives’ skills are reinforced. The Mali team expressed an interest in a future subanalysis comparing public- and private-sector facilities’ MiP service competencies to differentiate and tailor support more effectively. Niger, Mali, and Cameroon all noted that additional training had taken place since the data collection to upgrade MiP service provision skills. In Niger’s case, the country team shared that they had noted that, after the first round of OTSS+, many midwives were not trained; training preference was given to nurses. The team addressed this and since has increased the number of trained midwives.

The country teams expressed interest in continuing this type of supervision data analysis to understand and apply the findings more effectively.

Data limitations and assumptions. The major limitations of our analysis were that the wording of OTSS+ checklist questions were not standardized and all data elements were not available for all countries. Although Impact Malaria promotes the use of standardized global checklists, OTSS+ checklists are adapted by each country to fit national needs and context. Some countries did not collect gender, cadre, and training data, which limited the scope of our analysis in those countries. In addition, the aggregated data sets were a combination of two OTSS+ checklists: the MiP checklist and the health facility readiness checklist.

Other limitations include 1) supervisor observation may have changed provider behavior by virtue of their presence and 2) stock status reflects the presence of stock on the day of the visit.

CONCLUSION

Although much of the focus on malaria interventions is on expanding access, health impact will not be achieved without improving simultaneously the QoC when patients reach a facility. In fact, poor-quality care is now a bigger barrier to reducing mortality than insufficient access, whereas high-quality health systems could prevent half of all maternal deaths each year. The use of comprehensive supervision tools not only contribute to improved clinical practice by serving as a standard rubric for supportive supervision, but also can be an important ongoing data source for countries to assess trends in health worker performance, to identify gaps in service, and to provide actionable information on how to address deficiencies in QoC more effectively. By identifying those aspects associated most strongly with reduced QoC, countries can target resources and tailor interventions more realistically, resulting in the greatest improvements in care. Although commodity availability remains paramount to ensuring appropriate access to interventions and high QoC, identification of additional factors that might otherwise have gone unacknowledged is also critical, such as health worker cadre and gender. More attention may also be focused on relatively low-input interventions, such as ensuring clinical guidelines and job aids are universally available. Improved QoC contributes to optimizing maternal attendance at ANC, thus improving outcomes for both expectant mothers and newborns.

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Disclosures: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the U.S. Agency for International Development. The data analyzed from this study were collected as part of routine quality improvement activities, specifically OTSS+ visits, that are conducted by the national malaria programs and regional and district health authorities in the targeted countries. No patient or health worker identifying information was collected during these OTSS+ visits. Identifying information for the health facilities was removed during the data cleaning process and is not included in the final database. The study obtained nonresearch determination from the Johns Hopkins Bloomberg School of Public Health Institutional Review Board (IRB), Baltimore, MD (IRB No. 00017407), and the Population Services International Research Ethics Board.

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REFERENCES


How Outreach Training and Supportive Supervision (OTSS) Affect Health Facility Readiness and Health-Care Worker Competency to Prevent and Treat Malaria in Niger: A Secondary Analysis of OTSS Data

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Abstract. The quality of health services is key to the goal of averting morbidity and mortality from malaria. From July 2020 to August 2021, PMI Impact Malaria supported the implementation of four rounds of Outreach Training and Supportive Supervision (OTSS) in 12 health districts in the two regions of Niger: Dosso and Tahoua. Through OTSS, trained supervisors conducted onsite visits to observe an average of 174 healthcare workers (HCWs) per round in 96 public primary health facilities, managing persons with fever or conducting antenatal care (ANC) consultations, and then provided instant and individualized feedback and onsite training. Data from health facility readiness, case management, and malaria in pregnancy (MiP) checklists across the four rounds were analyzed using Wilcoxon’s and the $\chi^2$ tests. These analyses highlighted improved facility readiness, including an increased likelihood that HCWs had received classroom training, and facilities had increased availability of guidelines and algorithms by round 4 compared with round 1. Median HCW performance scores showed an improvement in the correct performance and interpretation of malaria rapid diagnostic tests, in classification of malaria as uncomplicated or severe, and in the management of uncomplicated malaria across the four rounds. For MiP services, malaria prevention and the management of pregnant women with malaria also improved from round 1 to round 4. These findings provide further evidence that OTSS can achieve rapid improvements in health facility readiness and HCW competency in managing outpatients and ANC clients.

INTRODUCTION

Malaria is the major cause of morbidity and mortality in sub-Saharan Africa. According to the WHO, in 2021 the African region was the most affected, with 95% and 96% of global cases and deaths, respectively, and with two thirds of total deaths from malaria occurring among children younger than 5 years old.1 Key to averting morbidity and mortality from malaria and other febrile illnesses is the skill of health-care workers (HCWs) to make an accurate and timely diagnosis based on history, physical examination, and diagnostic testing to guide proper treatment. Systematic reviews have identified modest effects of stand-alone training and supportive supervision2 3 on the management of malaria and other febrile illnesses, with potential stronger effects when both training and supervision are used together.4 5

In one of largest systematic reviews of strategies to improve health worker performance in low- and middle-income countries, Rowe et al.9 demonstrated that training or supervision alone produced moderate effects in terms of appropriate treatment. However, when these interventions were combined, their impact on service provision was greater. Strategies that combined training, supervision, and various forms of community support generated the greatest impact on provider performance. Training and supervision form the core of many countries’ quality improvement (QI) efforts, although these activities are not usually paired in a systematic way in most countries.

In Niger, the National Malaria Program (NMP) has built the capacity of health workers to manage uncomplicated malaria cases and malaria in pregnancy (MiP) primarily through classroom training; however, challenges remain in bridging the gap between national malaria guidelines and clinical practice.7 Niger was selected as a U.S. President’s Malaria Initiative (PMI) partner country in fiscal year 2017. Since 2019, PMI Impact Malaria has supported the NMP to strengthen capacity in malaria case management and MiP through the implementation of a QI approach in primary health facilities (PHFs) in the two target regions of Dosso and Tahoua. The cornerstone for QI is the Outreach Training and Supportive Supervision (OTSS) approach (Figure 1). Using the OTSS approach, trained supervisors conduct onsite visits to health facilities using a tablet-based standardized checklist on the Health Network Quality Improvement System (HNQIS) app to observe and interview directly clinical staff conducting a consultation with a person with fever or performing an antenatal care (ANC) consultation, and to assess facility readiness, such as the availability of commodities, equipment, and case management and MiP guidelines and algorithms. Supervisors provided in real time, individualized feedback and onsite training to HCWs based on the steps in the consultation that deviated from national guidelines. They also developed action plans together with facility staff to address broader health facility issues. OTSS data were also used to identify needs for additional classroom training, and provision of guidelines, algorithms, commodities, and equipment needed for quality malaria service provision. A more detailed description of the OTSS approach can be found in Barat et al.6 in this supplement.

Supervision data are uploaded and compiled automatically in the PMI Impact Malaria data hub, which uses District Health Information System 2 software (Version 2.36.10, University of Oslo, Oslo, Norway).

Using the OTSS data set maintained in the PMI Impact Malaria data hub, we evaluated the effects of OTSS on public health facility readiness and health worker performance in...
meeting clinical and prevention standards for malaria case management in outpatient and antenatal consultations.

MATERIALS AND METHODS

Program setting and population. From July 2020 to August 2021, 12 health districts were supported by the PMI Impact Malaria Niger Project to improve malaria case management through implementation of clinical and MiP OTSS in the Dosso and Tahoua regions. Selection of these two regions was a joint programmatic decision of the NMP and the PMI regarding where to target PMI support for multiple malaria interventions, which was based primarily on the high malaria burden in these regions. Almost all PHFs in these 12 areas received OTSS visits. Four quarterly rounds of OTSS were undertaken from July 2020 through August 2021, assessing an average of 174 HCWs in approximately 96 PHFs (99 PHFs in April 2021 and 93 in August 2021). A round is defined as a specific period during which a targeted set of facilities receives an OTSS visit. Each round of supervision targeted the same facilities, although a few facilities were not visited because of security concerns or competing activities at those facilities during the OTSS round.

Within health facilities, all staff who performed clinical consultations for the management of febrile illness and ANC were observed by district supervisors using the case management and MiP checklists, respectively, and facility readiness was assessed using a standard checklist.

Study design. This study involved a secondary analysis of OTSS data generated by the facility readiness checklist, outpatient department (OPD) checklist, and the MiP checklist (Supplemental Figure 1A–C, respectively). To estimate the effect of OTSS on facility readiness and on HCW performance by individual visit and over time, the individual steps in the checklists were weighted and scored to determine provider competency or facility readiness at the aggregate level (with the maximum competency being 100%) and to obtain a facility score. Our study assessed the effects of OTSS on variables listed in Table 1, including facility readiness factors, competency in the management of sick children in the OPD, and competency in the prevention of MiP and the management of malaria in pregnant women at the ANC clinic. Details of the components of each indicator are available in Supplemental Table 1.

Data management and analysis. For each round of OTSS, data were entered in the HNQIS app, loaded onto tablet computers, and then compiled in the PMI Impact Malaria data hub. The study team extracted data from the data hub into Stata for data cleaning and analysis for the health facility readiness, case management, and MiP indicators. All data cleaning and statistical regressions were done using Stata/SE (version 15.1; Stata Corp, College Station, TX).

The structure of the data analysis consisted of selecting data elements of interest (Table 1) and assessing the performance of these variables in OTSS round 1 (R1) or round 2 (R2) versus round 4 (R4). To assess differences between scores from R1 or R2 and those from R4, we performed the Wilcoxon rank-sum test for continuous variables and the chi-squared test for categorical variables. Specifically, variables such as using and reading malaria rapid diagnostic tests (mRDTs), adhering to a negative mRDT result, classifying malaria severity, managing uncomplicated malaria, preventing MiP,
treated pregnant women with malaria, and the availability of mRDTs and case management and MiP guidelines were evalu-
ated as continuous variables that were not normally distrib-
uted using the Wilcoxon rank-sum test. Categorical variables, such as the availability of trained staff, mRDTs, and at least one artemisinin-based combination therapy (ACT) formulation, were analyzed using the χ² test. All statistical results are presented with a significance level set at \( P < 0.05 \).

**RESULTS**

The same PHFs were supported across 12 health districts in the regions of Dosso and Tahoua (Supplemental Figure 2). On average, 174 HCWs providing clinical consultations or ANC consultations in the selected PHFs were assessed by district supervisors. From July 2020 to August 2021, the four OTSS checklists were used to assess the readiness of the facilities visited (96 in R1 and 93 in R4), the use and reading of mRDTs in approximately 349 patients (113 in R1 and 109 in R4), the quality of malaria case management in 405 patients (99 in R1 and 101 in R4), and the management and prevention of MiP in 364 women (93 in R1 and 84 in R4).

The percentages of facilities scoring 90% or greater on the readiness and competency variables being assessed in our study are presented in Table 2. The proportion of PHFs with at least 50% of HCWs having received classroom training increased significantly from 28% in R2 to 48% in R4, 1 year later (\( P = 0.003, \chi^2 \) test) (Table 3). In the supervised PHFs, mRDT availability was high in both R1 and R4, at 99% and 94%, respectively (\( P = 0.09, \chi^2 \) test) (Table 3). The presence of at least one ACT formulation also was consistent across rounds: 98% in R1 and 96% in R4 (\( P = 0.430, \chi^2 \) test) (Table 3). Primary health facility availability of case management and MiP guidelines and algorithms increased significantly from R1 to R4, from 14% to 84% (\( P < 0.001, \) Wilcoxon rank-sum test) (Table 3).

Assessing key competencies, improvements were observed from R1 to subsequent rounds (Table S1). In R1, only 47% of HCWs adhered correctly to guidelines on mRDTs performance and interpretation, which increased significantly to 80% by R4 (\( P < 0.001, \) Wilcoxon rank-sum test) (Table 4). In contrast, HCWs adhered to the negative mRDT protocol during all rounds, with 96% in R1 and 100% in R4.

In R1, HCWs classified 50% of malaria cases correctly as either severe or uncomplicated. By R4, this value increased to 92% (Table 2). Competency in managing uncomplicated malaria cases also rose, from 11% in R1 to 42% in R4. The Wilcoxon rank-sum test verified these increases as statistically significant for both malaria classification and uncomplicated malaria management (\( P < 0.001 \)) (Table 4).

The proportion of ANC workers demonstrating competency in malaria prevention during pregnancy increased from 27% in R1 to 81% in R4 (\( P < 0.001 \)) (Table 4). In addition, ANC worker competency in managing pregnant women with malaria rose from 22% in R1 to 85% in R4 (\( P < 0.001, \) Wilcoxon rank-sum test) (Table 4).

**DISCUSSION**

Our study analyzed 1 year of activities to scale up OTSS in a very low-resource setting and with heterogeneous malaria

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**Table 1**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Checklist</th>
<th>Definition</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>The availability of trained staff</td>
<td>Facility readiness</td>
<td>All categories having received classroom training in the past 2 years in malaria case management</td>
<td>Binary</td>
</tr>
<tr>
<td>The availability the malaria rapid diagnostic test</td>
<td>Facility readiness</td>
<td>The presence of mRDTs at the facility today (supervision day)</td>
<td>Binary</td>
</tr>
<tr>
<td>The availability at least one formulation of ACT</td>
<td>Facility readiness</td>
<td>The presence of at least one formulation of ACT at the facility (supervision day)</td>
<td>Binary</td>
</tr>
<tr>
<td>The availability of case management and MiP guidelines/algorithms</td>
<td>Facility readiness</td>
<td>The presence of case management and MiP guidelines/algorithms at the facility (supervision day)</td>
<td>Continuous</td>
</tr>
<tr>
<td>HCW competency in using and reading mRDTs</td>
<td>mRDT observation</td>
<td>Percentage score on the checklist for assessing the correct steps for performing and reading the mRDT</td>
<td>Continuous</td>
</tr>
<tr>
<td>HCW adherence to negative mRDT results</td>
<td>OPD</td>
<td>Percentage of HCWs who complied with the negative test results</td>
<td>Continuous</td>
</tr>
<tr>
<td>HCW competency of classifying malaria cases as uncomplicated or severe</td>
<td>OPD</td>
<td>Competency of HCWs in classifying malaria cases</td>
<td>Continuous</td>
</tr>
<tr>
<td>HCW competency in managing patients with uncomplicated malaria</td>
<td>OPD</td>
<td>Percentage score in history taking, clinical examination, and treating uncomplicated malaria cases with an ACT according to national guidelines</td>
<td>Continuous</td>
</tr>
<tr>
<td>HCW competency in the prevention of MiP</td>
<td>MiP</td>
<td>Percentage score in the provision of malaria preventive services during antenatal consultations, including administering intermittent preventive treatment during pregnancy, disseminating insecticide-treated bed nets, and providing correct counseling</td>
<td>Continuous</td>
</tr>
<tr>
<td>HCW competency in managing pregnant women with malaria</td>
<td>MiP</td>
<td>Percentage score in history taking, clinical examination, diagnosis, and treatment of cases according to national guidelines</td>
<td>Continuous</td>
</tr>
</tbody>
</table>
the performance of HCWs from R1 to R4 in the prevention of MiP and in the malaria case management in pregnant women.

These improvements likely resulted from several important processes instituted by the OTSS approach, including providing instant and individualized feedback and in-service training to the HCWs on steps carried out correctly and incorrectly, which reinforces the knowledge and skills of the HCW. In addition, supervisors worked with facility teams to address their operational bottlenecks, such as lack of supplies and materials. The OTSS approach also provided a steady and sustained emphasis on improving quality over time that reinforced good practices among HCWs.

Similar results have been demonstrated in other countries. In Nepal, a randomized controlled trial of the effects of audit and feedback by district health officers using a structured checklist that focused on prescribing practices in primary health-care facilities resulted in statistically significant differences in adherence to standard treatment schedules.14 In an uncontrolled trial, Zeitz et al.15 found that supervisor use of a checklist for diarrhea case management during monthly visits to rural health facilities in Nigeria resulted in improvements in history taking, physical examination, disease classification, treatment, and counseling. In Mexico, Kim et al.16 found that structured observation and focused performance feedback by supervisors, accompanied by joint identification of opportunities for improvement, increased communication and information sharing to clients by rural doctors.

Factors such as the availability of guidelines and algorithms, and an increased level of training in malaria case management have been shown to benefit HCW performance.17 Dedicated supervision ensured by supervisors trained specifically and exclusively for frequent and regular OTSS visits provided recurring opportunities to address issues in service delivery. Whidden et al.18 determined that frequent and regular contact may have facilitated the relationship between HCW and supervisor, with both reporting respectful,
reliable, and supportive relationships. On the contrary, shortages of mRDTs and/or ACTs and/or insecticide-treated bed nets and/or intermittent preventative treatment during pregnancy may contribute to noncompliance with guidelines even in the face of interventions to improve practices.

Our study had a few important limitations. First, this article presents an analysis of program implementation data, which does not have the level of quality control of the data collected in a controlled study. However, the data collected and analyzed during the implementation of OTSS provided important information and lessons learned for the NMP and other large programs implementing malaria case management interventions in Niger. Furthermore, the use of digital checklists with built-in quality control functions likely mitigated many data quality issues that have been reported previously with use of paper-based data collection. Second, the presence of the supervisor may have caused HCWs to be more attentive and comprehensive in their patient assessments than they would have if not under observation (i.e., the Hawthorne effect). However, this analysis examines trends over successive OTSS visits, when this bias would have been present during each round, thereby reducing any likely effect on the trends documented through this analysis. Last, this analysis assessed HCW performance compared with a standard, but could not assess patients’ clinical outcomes.

It also should be noted that the success of OTSS in Niger and in other countries has depended, to varying degrees, on donor funding, which enables PMI Impact Malaria and other partners to provide technical assistance and logistical support to NMPs. In Niger, where OTSS has only been implemented for a few years in two regions, it is anticipated that ongoing technical and programmatic support for the scale-up of OTSS will be needed in the short to medium terms. The Niger NMP, however, has made an important step toward institutionalization by adopting OTSS as the recommended QI approach for malaria throughout the country. Experience from countries that have implemented OTSS for several years demonstrate that, over time and with appropriate resourcing, a national scale can be achieved, and the need for external support will be reduced as program management is decentralized.

Our analysis demonstrates that significant improvements were identified in PHF readiness and HCW performance in meeting clinical and prevention standards for malaria management in outpatient and antenatal consultations between the first round in July 2020 and the fourth round in August 2021. This assessment provides further evidence that the OTSS approach to QI can achieve rapid improvements in the readiness of health facilities and the competency of health workers managing outpatients and ANC clients. Expansion of OTSS to other areas of Niger are likely to yield similar benefits. Efforts to expand competency-based supervision to the community level are underway. If successful, the improvement of quality throughout the continuum of care is likely to improve outcomes of those seeking care for malaria.

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Disclosure: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U.S. Agency for International Development. The secondary analysis of the OTSS data received approval from the Niger National Ethics Committee on May 25, 2022 and a nonresearch determination from the PSI Research Ethics Board on December 5, 2022. All personally identifiable information was excluded from the analysis and all data were aggregated to a level at which results could not be connected to any individual HCW, health facility, or geographic area.

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Understanding Antenatal Care Service Quality for Malaria in Pregnancy through Supportive Supervision Data in Tanzania

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Abstract. Malaria in pregnancy (MiP) is associated with maternal anemia, spontaneous abortion, and infant and maternal death. In Tanzania, MiP service data are collected through routine Malaria Services and Data Quality Improvement (MSDQI) supportive supervision rounds at antenatal care (ANC) facilities. Using structured assessment tools, the U.S. President’s Malaria Initiative Impact Malaria Project reviewed two annual rounds of MSDQI data (492 facilities in 2021 and 522 facilities in 2022), including ANC records and client satisfaction interviews. We assessed coverage of key MiP care components, used logistic regression to analyze uptake of the recommended three or more doses of intermittent preventive treatment in pregnancy (IPTp3+), and assessed client satisfaction. Coverage of most MiP care components exceeded 80%; however, only 38% of women received all components. Odds of receiving IPTp3+ were much lower among late ANC initiators than among those who initiated ANC during their first trimester (odds ratio [OR], 0.46; 95% CI, 0.38–0.57). Uptake of IPTp3+ increased almost exponentially by number of ANC visits. Women with seven visits were 30 times more likely than those with three visits to receive IPTp3+ (OR, 30.71; 95% CI, 11.33–83.22). Just 54% of clients had anemia screening and only 46% received IPTp3+. Client satisfaction with services and provider communication was high (98% and 97%, respectively); only 8% of client visits exceeded 3 hours. Increased ANC visits could boost IPTp3+ coverage. Routine MSDQI supportive supervision data are useful to assess quality of care, identify service delivery gaps, and guide policies to improve quality of MiP services.

INTRODUCTION

Malaria in pregnancy (MiP) is a major global public health problem associated with increased maternal anemia, intrapartum growth restriction, stillbirth, and infant and maternal death.1 Plasmodium falciparum malaria infections contribute to an estimated 50,000 maternal deaths and 200,000 stillbirths annually.2 Control of MiP in Tanzania relies on a three-pronged approach recommended by the WHO: intermittent preventive treatment in pregnancy (IPTp) with at least three doses of sulfadoxine–pyrimethamine (SP) beginning early in the second trimester and administered at least 1 month apart, prompt case management, and use of insecticide-treated nets (ITNs), which are distributed during antenatal care (ANC).3 In Tanzania, as part of prevention and sentinel surveillance, all women are to be screened for malaria at their first antenatal visit; those negative for malaria and eligible for IPTp receive one dose of intermittent preventive treatment in pregnancy (IPTp1) (and additional doses during subsequent visits), whereas those positive for malaria are given a course of antimalarials and begin IPTp the following visit. Tanzania’s 2021 to 2025 Malaria Strategic Plan aims to achieve 85% coverage of the recommended three or more doses of intermittent preventive treatment in pregnancy (IPTp3+) (when not contraindicated), 85% use of ITNs by pregnant women, and 100% prompt, high-quality case management by 2025.4

For more than 20 years, MiP interventions have been delivered through ANC platforms, with the expectation that well-integrated services will lead to improved health outcomes.5 High coverage of ANC, and quality MiP services delivered during these visits, are essential to prevent malaria-associated morbidity and mortality among pregnant women in countries with a high burden of malaria. However, globally, MiP service coverage provided through ANC has lagged behind other ANC care components.6

In Tanzania, application of quality improvement approaches has increased coverage of key MiP interventions and contributed to improved services.7 The Tanzania Ministry of Health (MOH) delivers MiP and other ANC services to pregnant women through an integrated platform guided by the National Malaria Control Program (NMCP) and the Reproductive and Child Health Services (RCHS) Department. To ensure quality of reproductive health and ANC services, including MiP services, the NMCP and the RCHS Department collaboratively developed a structured supervision tool called Malaria Services and Data Quality Improvement (MSDQI) to assess readiness to provide malaria services, clinical performance under observation, data completeness, adherence to guidelines, and client satisfaction.

The MSDQI tool evolved from the checklist-based Outreach Training and Supportive Supervision (OTSS) approach to supportive supervision and quality improvement developed by the U.S. President’s Malaria Initiative (PMI) in 2007.8 In Tanzania, OTSS was expanded to include data quality audits and client satisfaction components, and to engage other facility departments involved in malaria service provision not covered under OTSS, including ANC clinics, inpatient departments, and logistics and supply chains. This integrated quality improvement package was first used in 2017 by the United States Agency for International Development–funded Boresha Afya projects operating in 11
regions of Tanzania, and was rolled out nationally by the MOH NMCP beginning in 2017. From 2019 to 2022, the PMI Impact Malaria Project continued to support the Tanzania MOH and the President’s Office of the Regional Administration and Local Government of Tanzania to implement MSDQI in three regions: Mtwara, Lindi, and Katavi.

During MSDQI supportive supervision visits, trained supervisors—including staff from implementing partners and the MOH at national, regional, and council levels—use the standardized, checklist-based set of MSDQI modules to assess diagnostic and treatment practices of ANC providers, and laboratory, inpatient, and outpatient departments. The modules include sections on facility readiness, clinical performance (involving direct observation and register/record modules), client experience, facility readiness and provider performance, and laboratory, inpatient, and outpatient departments. The standardized, checklist-based set of MSDQI modules to the MOH at national, regional, and council levels.

Using data from the MSDQI tool and data reported in Tanzania’s national health management information system (HMIS), the Tanzania NMCP works to ensure that all facilities receive at least one MSDQI visit per year.

Measuring quality of malaria in pregnancy services. Quality of care can be assessed through numerous modalities, including service availability and readiness, provider practices, service provision, and client experience. Because service delivery of components in a package of care can vary widely, assessment of service quality using more than one data source can facilitate identification of gaps. Multiple national surveys have evaluated ANC quality through facility readiness and provider performance, finding some limitations in staff availability, infrastructure, and specialized commodities. Provider behavior, attitudes, communication, discriminatory treatment, and failure to ensure privacy can affect the quality of ANC care. Service provision data permit measurement of intervention coverage by indicating whether clients received care according to clinical guidelines. Several studies have used service provision data to assess care components received as a measure of “effective coverage” of ANC. Although some studies of ANC quality included MiP components or used integrated ANC and MiP quality scores, there is a dearth of evidence focused on receipt of specific MiP care components during ANC.

Client experiences are more subjective and multifaceted than service records. Client experiences encompass factors beyond services received, including provider communication and behavior, privacy and respect, facility conditions, wait times, costs incurred, and financial, geographic, or social difficulties accessing care. However, client satisfaction drives demand for and uptake of services, as satisfied clients are more likely to return and to recommend ANC services to others. In 2017, the Lancet Global Health Commission on High-Quality Health Systems called for research linking patient experience with health-care use. Satisfaction data can identify areas to improve patient experience and increase use.

Study aims. Provision and documentation of key care components during ANC serve as a proxy for MiP service quality. Data on service provision vis-a-vis MiP guidelines and client satisfaction can be triangulated to describe quality of MiP care. We conducted a retrospective analysis of ANC register and client satisfaction data collected through MSDQI supportive supervision visits to facilities in PMI Impact Malaria Project areas in Tanzania. The descriptive analysis elucidates the quality of MiP care components provided during ANC. In this article, we describe how MiP care components are provided at supported facilities through several lenses: coverage of MiP interventions during ANC, how gestational age at first ANC visit affects timing and doses of IPTp, and client satisfaction with ANC services.

MATERIALS AND METHODS

Malaria Services and Data Quality Improvement setting, approach, and data sources. Reproductive health services, including MiP services, are offered by three types of facilities providing primary health care in Tanzania: district hospitals, health centers, and dispensaries. PMI Impact Malaria supported implementation of two annual rounds of MSDQI supportive supervision (2021 and 2022) at hospitals, health centers, and dispensaries providing reproductive health services across three regions in southeastern and western Tanzania: Lindi, Mtwara, and Katavi. During each round of MSDQI supervision at each facility, trained MOH malaria supervisors at the district level conducted a retrospective review of ANC register records of 10 women who had recently given birth. Supervisors also collected primary data by surveying two current ANC clients about services they received and their satisfaction with those services on the day of supervision. During the second round (2022), a subset of facilities with inpatient services and malaria microscopy services were visited twice. Supervisors were trained in supportive supervision skills and had received orientation on the MSDQI tool, including electronic data collection. All data collected via the electronic MSDQI tool were uploaded to the HMIS.

Record reviews followed MSDQI guidelines, retrieving 10 ANC records for pregnant women who had initiated ANC care 9 months prior to the MSDQI visit. This strategy assumed that all women would have delivered by the time of the MSDQI supervision visit; each record was confirmed in the labor and delivery register. If fewer than 10 eligible records were in the register, all available records were selected. Starting from the most recent record 9 months prior to supervision and working backward, the 10 most recent records were identified. Sampling for the client satisfaction component followed MSDQI tool guidelines, selecting the first two clients attending their first ANC visit on the day of supervision. If there were no new clients, MSDQI guidelines allowed sampling of clients attending later ANC visits.

Study design. PMI Impact Malaria, in collaboration with regional and district health management teams, conducted a retrospective review of service provision records and responses to client satisfaction surveys collected during the two annual rounds of MSDQI supportive supervision (2021 and 2022). Facilities that received supportive supervision visits during either round were included. The retrospective analysis featured three categories of analyses using Stata version 14.2 (StataCorp, College Station, TX): 1) frequency analysis to compute coverage of key MiP interventions; 2)
logistic regression analyses to assess coverage of MiP components by facility type, uptake of IPTp by facility type; and uptake of IPTp based on gestational age at first ANC visit and number of ANC visits; and 3) frequency analysis to evaluate client satisfaction with services.

**Tools and indicators.** Service provision data were extracted from ANC register records retrieved during MSDQI supervision and exported to Excel (Microsoft, Redmond, WA). Using the MSDQI tool, zeros recorded in the register by supervisors indicate a service that was not provided, so completed fields serve as a proxy of coverage. Indicators extracted included gestational age at first ANC visit, whether hemoglobin level was tested at the first ANC visit and later visits, whether malaria testing/screening occurred at the first ANC visit, whether malaria rapid diagnostic test (mRDT) results were recorded, hematinic provision (iron and/or folic acid, any dose), ITN provision, and total number of IPTp doses received.

The MSDQI tool’s client satisfaction module was structured as multiple-choice questions with two or three possible responses (i.e., yes/no, yes/partially/no, or yes/no/not applicable). In addition to client responses, the client satisfaction tool also included supervisor appraisals of client explanations of how to take dispensed medications at home and when to return to the clinic. Variables in the MSDQI client satisfaction module included whether women had received key MiP care components, whether they received prescribed medications or commodities/services and provider communication, total time spent at the facility, and satisfaction with services.

**Data analysis.**

**Service provision data.** Before analysis, we cleaned the data to remove duplicates. We assessed completeness of register data and used frequency analysis to compute coverage of MiP care components using the indicators mentioned earlier and the median number of ANC visits by trimester of ANC initiation. Using Stata statistical software (StataCorp), we also used logistic regression to compute odds ratios (ORs) for the uptake of total IPTp doses based on gestational age at first ANC visit. Each of these regressions were restricted to the subset of women receiving each total dose, with women in that subset initiating ANC at \( \leq 12 \) weeks’ gestation serving as the reference group. We also conducted regression analyses to examine associations between number of ANC visits and receipt of IPTp3+, as well as between facility type and coverage of each MiP intervention and total number of IPTp doses.

Variables in the logistic regression models included binary variables for documentation of each MiP care component: month of gestation when women initiated ANC services (converted from weeks recorded in the ANC record to 4-week intervals coded as 1–10); four binary variables for receipt of a total of zero, one, two, or three or more doses of IPTp; number of ANC visits (coded as 1–9), and a categorical variable for health facility type (dispensary, health center, or hospital). To increase sample size, and because all records were unique, we combined records from the 2021 and 2022 rounds of supportive supervision, controlling for round of data collection and facility type. Gestational age categories were later reorganized into trimester variables (\( \leq 12 \) weeks, 13–26 weeks, and \( \geq 27 \) weeks) to compute ORs.

For the IPTp uptake analyses by gestational age at the first ANC visit, we ran five separate regressions with each binary “IPTp total dose” variable as the outcome variable and month (and for three or more total doses, also trimester) of ANC initiation as the independent variable. To assess how the number of ANC visits was associated with uptake of IPTp3+, we conducted another regression analysis with the subset of women who received three or more doses as the outcome variable, number of ANC visits as the independent variable, and three visits as the reference group (the minimum to receive IPTp3). Regressions for each MiP intervention by facility type were conducted for all records where facility type was specified, with dispensaries as the reference group. Last, to assess where women receive IPTp doses, we ran three regression analyses on subsets of women who received one, two, or three or more total doses, with facility type as the independent variable, total number of doses as the outcome variable, and dispensaries as the reference group. None of the regressions compared subsets of women who received different total numbers of IPTp doses.

**Client satisfaction data.** We used frequency analysis to assess whether key services had been provided (content of care), whether clients could explain correctly how to take medications and when to return to the clinic (effectiveness of provider communication), and client satisfaction with services. Partial satisfaction (somewhat) was analyzed separately from complete satisfaction (yes) responses.

### RESULTS

A total of 492 of 690 facilities in 20 districts in the three PMI-supported regions received supportive supervision visits during round 1 of MSDQI supervision (2021); 522 of 690 facilities received visits in round 2 (2022). Of the 562 discrete facilities visited at least once during the two rounds and included in the analysis, most \((n = 452)\) were visited twice (Table 1). Most facilities were dispensaries \((n = 466, 83\%)\), followed by health centers \((n = 71, 13\%)\) and then hospitals \((n = 23, 4\%)\). The service provision analysis reviewed ANC records for 11,296 pregnancies \((n = 5,079\) in round 1, \(n = 6,217\) in round 2) (Table 1), with 80% at the dispensary level. The proportion of clients initiating ANC in the first, second, and third trimesters, respectively, was 37% \((n = 3,203)\).

<table>
<thead>
<tr>
<th>Facility type</th>
<th>No. of facilities in study regions, (n)</th>
<th>Round 1, 2021; (n) (%)</th>
<th>Round 2, 2022; (n) (%)</th>
<th>(n) (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispensary</td>
<td>582</td>
<td>415 (84.3)</td>
<td>439 (84.1)</td>
<td>466 (82.9)</td>
</tr>
<tr>
<td>Health center</td>
<td>70</td>
<td>61 (13.5)</td>
<td>65 (12.5)</td>
<td>71 (12.6)</td>
</tr>
<tr>
<td>Hospital</td>
<td>38</td>
<td>14 (2.8)</td>
<td>16 (3.0)</td>
<td>23 (4.1)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>–</td>
<td>2 (0.4)</td>
<td>2 (0.4)</td>
<td>2 (0.4)</td>
</tr>
<tr>
<td>Total</td>
<td>690</td>
<td>492</td>
<td>522</td>
<td>562</td>
</tr>
</tbody>
</table>

*Most facilities were visited in both rounds.
58% ($n = 5,054$), and 5% ($n = 442$). Clients initiating ANC in the first, second, and third trimesters attended a median of four, three, and two visits, respectively (Table 2).

For the client satisfaction analysis, 1,035 responses ($n = 469$ in round 1, $n = 566$ in round 2) were included (Supplemental Table 1). In round 2, because facilities with inpatient and microscopy services were visited twice, 31 facilities had three or four clients surveyed; almost half the facilities (46% in round 1 and 44% in round 2) had no clients on the date of supervision.

**Coverage of key malaria in pregnancy care components.** Documented coverage of each of the MiP care components in reviewed ANC records was generally high. For gestational age and each MiP care component, the percentage of records documenting these was also consistent in both rounds, with the exception of a 19-percentage point difference in hemoglobin testing between rounds (44% versus 63% in rounds 1 and 2, respectively). Hemoglobin testing results were the least frequently recorded of all services (54% of records). Receipt of each of the other MiP care components during ANC was recorded in more than 75% of records, with the exception of IPTp3+ (Figure 1). Although 80% of records documented receipt of at least IPTp1, only 46% documented IPTp3+. Thirty-eight percent of records documented receipt of all MiP care components captured in the register (hemoglobin level, mRDT, hematinc provision, ITN provision, and any IPTp).

**Relationship between initiation of antenatal care and receipt of three or more doses of intermittent preventive treatment in pregnancy.** When they initiated ANC, most pregnant women who ultimately received IPTp3+ were in their first or second trimester (Figure 2). A slightly greater proportion of women who initiated ANC in the second trimester versus the first trimester received IPTp3+ (57% versus 50%, respectively, $P < 0.001$). Regression analysis revealed that women who initiated ANC in the third trimester versus the first trimester were less than half as likely to receive IPTp3+ (OR, 0.46; 95% CI, 0.38–0.57) (Table 3). Women who initiated ANC during the second trimester versus the first trimester were slightly more likely to receive

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### Table 2

<table>
<thead>
<tr>
<th>Facility type</th>
<th>No. of facilities in study regions, $n$</th>
<th>Round 1, 2021; $n$ (%)</th>
<th>Round 2, 2022; $n$ (%)</th>
<th>$n$ (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispensary</td>
<td>582</td>
<td>4,309 (84.8)</td>
<td>4,694 (75.5)</td>
<td>9,003 (79.7)</td>
</tr>
<tr>
<td>Health center</td>
<td>70</td>
<td>610 (12.0)</td>
<td>1,224 (19.7)</td>
<td>1,834 (16.2)</td>
</tr>
<tr>
<td>Hospital</td>
<td>38</td>
<td>140 (2.8)</td>
<td>279 (4.5)</td>
<td>419 (3.7)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>–</td>
<td>20 (0.3)</td>
<td>20 (0.3)</td>
<td>40 (0.4)</td>
</tr>
<tr>
<td>Total</td>
<td>690</td>
<td>5,079</td>
<td>6,217</td>
<td>11,296</td>
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</table>

*Most facilities were visited in both rounds.
IPTp3+ (OR, 1.21; 95% CI, 1.10–1.32). Among women who initiated ANC after the fifth month of pregnancy, the odds of receiving IPTp3+ decreased steadily for each month ANC initiation was delayed until delivery (Table 3). There were 2,291 women (20.3%) who received zero doses of IPTp; these women were less likely to initiate ANC during the second trimester (when IPTp1 is first indicated) than the first or third trimesters.

**Relationship between number of antenatal care visits and receipt of three or more doses of intermittent preventive treatment in pregnancy.** Controlling for round number and type of facility, the likelihood of receiving IPTp3+ increased steadily with each ANC visit after reaching the minimum of three visits (Table 4). Pregnant women who completed four visits were more than four and a half times more likely to receive IPTp3+ compared with those who completed three visits (OR, 4.52; 95% CI, 3.88–5.26). Women who completed seven visits were 30 times more likely to have received IPTp3+ than those with three visits; the results describe an almost exponential relationship between number of ANC visits and IPTp3+ coverage through the eighth ANC visit. Very few women completed eight or nine visits; ORs either could not be computed or were deemed outliers.

**Coverage of malaria in pregnancy care components by facility type.** Provision of ITNs and gestational age documentation were significantly more likely at dispensaries than health centers or hospitals; anemia testing was more likely at health centers and hospitals than dispensaries (Supplemental Table 2). When controlling for round, regression analysis revealed that the odds of women receiving just one dose of IPTp was marginally more likely at health centers than at dispensaries (OR, 1.16; 95% CI, 1.02–1.33) (Supplemental Table 3). However, the odds of receiving IPTp3+ were somewhat greater among women seeking ANC from hospitals than dispensaries (OR, 1.34; 95% CI, 1.08–1.67).

**Client satisfaction.** Client satisfaction was comparable in both rounds. Overall, clients reported high rates of malaria testing at the first visit (98%), and receipt of tests and medicines their provider ordered (89% and 72%, respectively) (Table 5). In terms of quality and content of provider communication, most clients reported their provider had explained how to take medicines received, how to use an ITN, and when to return for their next ANC visit. Ninety-eight percent reported satisfaction with the services they received, and 97% reported satisfaction with provider communication. Ninety-two percent reported spending less than 3 hours at a visit; 40% reported visits of less than 1 hour—the Tanzania MOH ideal.

**DISCUSSION**

**Coverage as a quality indicator.** Routine data collected via the checklist-based MSDQI tool proved useful for generating a picture of how a suite of MiP services was being provided through integrated ANC in several regions in Tanzania. Overall coverage of key MiP services was high, as was client satisfaction with services; however, analysis of MSDQI data highlighted some gaps in quality of care.

Receipt of MiP services is one critical dimension of quality of care.21 In our study, provision of MiP care components serves as an indicator of high-quality care. Overall, although coverage of IPTp3+ was only 46%, falling far short of Tanzania’s target of 85%, the average coverage in countries implementing this strategy is 35%, demonstrating that Tanzania is performing comparatively well.22 In addition, coverage of most key MiP interventions during ANC was high, indicating that most facilities under MSDQI supervision in this analysis were offering quality MiP care through integrated ANC in accordance with national guidelines. Triangulated with self-reported client satisfaction, which was high across all metrics, and indications that clients understood provider communication, these results illustrate how data collected through routine supportive supervision can be used to assess quality of MiP services.

Client satisfaction with ANC is generally fairly high across studies in low- and middle-income countries, even where ANC coverage is low. In studies that have documented low satisfaction,23–26 high costs, disrespectful interactions with health-care providers, and long wait times are frequent complaints from clients about the quality of services received. Several studies and a systematic review and meta-analysis27–28 found that client
TABLE 3

First antenatal care visit with receipt of IPTp (regression results)

<table>
<thead>
<tr>
<th>No. of IPTp doses received</th>
<th>Month 2</th>
<th>Month 3</th>
<th>Month 4</th>
<th>Month 5</th>
<th>Month 6</th>
<th>Month 7</th>
<th>Month 8</th>
<th>Month 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.857</td>
<td>0.896</td>
<td>0.794</td>
<td>0.865</td>
<td>0.872</td>
<td>0.902</td>
<td>0.872</td>
<td>0.912</td>
</tr>
<tr>
<td>2</td>
<td>0.884</td>
<td>0.901</td>
<td>0.865</td>
<td>0.873</td>
<td>0.872</td>
<td>0.872</td>
<td>0.872</td>
<td>0.872</td>
</tr>
<tr>
<td>≥3</td>
<td>0.994</td>
<td>0.994</td>
<td>0.994</td>
<td>0.994</td>
<td>0.994</td>
<td>0.994</td>
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</table>

This table presents five separate regression analyses (by month for zero, one, and two total doses, and by month and trimester for three or more total doses). IPTp = intermittent preventive treatment in pregnancy; Ref. = Reference.

Satisfaction is greatest when wait times are less than 1 hour. Antenatal care clients in Mozambique reported more positive experiences and increased numbers of visits after an appointment scheduling pilot study reduced wait times, suggesting that improving client experiences may improve uptake of critical services, including IPTp+.

Policy and program utility of Malaria Services and Data Quality Improvement data. At 46%, IPTp+ uptake remains far below Tanzania’s national target of 85%, but it is in line with other studies from Tanzania reporting suboptimal uptake of IPTp+.

Both demand- and supply-side issues likely contribute to low uptake of IPTp. From the demand side, almost half of women presented for ANC during the second trimester, which is the ideal window during pregnancy to deliver MiP interventions. Early ANC initiators were slightly less likely than those who initiated ANC during the second trimester to receive IPTp+, despite a greater median number of ANC visits. This may be attributable in part to IPTp guidelines, because SP is not indicated during the first trimester and it is possible that those who initiate ANC during the first trimester have several visits before they are eligible for IPTp.

Late ANC initiation reduced the likelihood of receiving IPTp+ significantly, similar to findings from Malawi, where women who initiated ANC during the first two trimesters were more than twice as likely to receive IPTp+ than those initiating ANC during the third trimester. Although the share of late ANC initiators made up only 7.4% of our sample, this group attended a median of only two visits, in line with other studies that demonstrated that delaying ANC limits the total number of visits (and SP doses) possible before delivery. Late ANC initiators are more likely to be less well educated, be of greater parity, live farther from the facility, have a mistimed or unplanned pregnancy, be unable to afford opportunity costs of ANC attendance, lack partner support, or lack understanding of the benefits of ANC.

A study of ANC satisfaction in Nigeria found that most respondents (89%) had a poor understanding of MiP services. Similar findings from central Tanzania suggest that efforts to increase demand through education about the content, timing, and purpose of MiP services during ANC could improve IPTp coverage.

Coverage of IPTp+ among early ANC adopters improved during the second round, and is potentially attributable to MSDQI (although coverage of other interventions was relatively stable between rounds). Uptake of IPTp in most countries is low even where ANC coverage is relatively high, and where governments have endeavored to solve SP stock-outs.

From the supply side, facility readiness is crucial: analysis of data from the Tanzania Service Provision Assessment (SPA) found that women who attended ANC at facilities with high readiness scores were 2.1 times more likely to receive IPTp than those attending facilities with low readiness scores. Stock-outs of SP affect facility readiness adversely and may account in part for differences in IPTp+ uptake between rounds. Multiple studies in Tanzania and
other sub-Saharan African countries reported a negative association between SP stock-outs and receipt of IPTp. The greater odds of receiving IPTp3+ at hospitals than dispensaries or health centers in our study may be because SP is less subject to stock-outs in hospitals than smaller facilities. Health management information system data from the same years as the records included in this assessment revealed that 37% and 27% of MSDQI facilities in 2020 and 2021, respectively, experienced SP stock-outs (defined in Tanzania as commodity unavailability on one or more days in a month).45 Stock-outs were rare at hospitals (3% in 2020 and 0% in 2021), but occasional in health centers (13% in 2020 and 15% in 2021) and common in dispensaries (84% in 2020 and 85% in 2021). Stock-outs at dispensaries may affect adversely the perceptions of ANC quality provided there and may encourage “bypassing” them in favor of higher level facilities. Alternatively, pregnant women who seek ANC from hospitals may be consulting providers who have greater levels of training or more experience. In SPAs from Kenya and Namibia, ANC received from more experienced providers was associated with a greater number of ANC visits.26

Promoting greater number of ANC visits can increase IPTp3+ uptake.5,48 In 2016, the WHO shifted its focus from ANC coverage to content, as achieving the recommended number of ANC visits does not ensure receipt of recommended interventions.11 However, a greater number of visits was clearly associated with increased odds of receiving IPTp3+, as they offered more opportunities to obtain SP. The WHO recommends at least eight ANC contacts, which few pregnant women in our sample or other studies achieved; attendance decreases markedly in most populations after the second visit, and only 65% of Tanzanian women achieve four or more visits—more than our sample median.49 A lack of provider knowledge about IPTp protocols and lack of client understanding of IPTp may contribute to poor uptake and adherence.

Results from our study can guide program and policy efforts to promote ANC attendance in Tanzania and to ensure adequate stocks of SP at the dispensary level. Efforts by health-care providers and community service organizations are needed to encourage women, particularly those living in areas of high malaria transmission, to attend a sufficient number of visits and initiate ANC early enough to receive IPTp3+.45 Additional efforts to promote ANC and IPTp uptake, such as promotion of ANC services by community health workers or delivery of IPTp at the community level, may lead to increases in IPTp3+ coverage.50

**Using Malaria Services and Data Quality Improvement data to identify service delivery quality gaps.** Analysis of MSDQI data also revealed important gaps in quality of care. Coverage analysis identified hemoglobin testing as a potentially overlooked intervention during ANC, as results were

### Table 4

<table>
<thead>
<tr>
<th>No. of antenatal care visits during pregnancy, OR (95% CI)</th>
<th>3</th>
<th>4 (n = 1,735)</th>
<th>5 (n = 1,161)</th>
<th>6 (n = 586)</th>
<th>7 (n = 153)</th>
<th>8+ (n = 33)</th>
<th>9+ (n = 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odds of receipt of IPTp3+</td>
<td></td>
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</tr>
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<td>Ref.*</td>
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<tr>
<td>P = 0.00</td>
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<td>P = 0.00</td>
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<tr>
<td>4.52 (3.88–5.26), 7.78 (6.31–9.60), 14.18 (9.87–20.37), 30.71 (11.33–83.22), 6.56 (2.32–18.60), NA†</td>
<td></td>
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</tbody>
</table>

IPTp = intermittent preventive treatment in pregnancy; IPTp3+ = three or more doses of intermittent preventive treatment in pregnancy; NA = not applicable; OR = odds ratio; Ref. = reference value. Regression performed on subset of women documented as receiving 3 or more doses of IPTp. Values in bold type are statistically significant.

* Three visits selected as reference based on logic that a minimum of 3 visits is required to receive at least 3 doses of IPTp.

† Could not be computed because of small sample size.

### Table 5

**Malaria Services and Data Quality Improvement client satisfaction survey results**

<table>
<thead>
<tr>
<th>Client response/supervisor appraisal</th>
<th>Round 1, 2021 (n = 1,035), %</th>
<th>Round 2, 2022 (n = 895), %</th>
<th>Overall (n = 1,930), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received all tests ordered by the health-care provider at this facility</td>
<td>88</td>
<td>90</td>
<td>89</td>
</tr>
<tr>
<td>Yes</td>
<td>86</td>
<td>87</td>
<td>86</td>
</tr>
<tr>
<td>Somewhat</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Client could explain correctly the use of dispensed drugs at home*</td>
<td>81</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Yes</td>
<td>81</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Somewhat</td>
<td>12</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Told how to use an ITN</td>
<td>84</td>
<td>88</td>
<td>86</td>
</tr>
<tr>
<td>Told by health-care provider when to return to the health facility</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Client could explain correctly when to return to the health facility*</td>
<td>94</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Wait time to get all RCH services</td>
<td>44</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>&lt;1 hour</td>
<td>44</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>1–3 hours</td>
<td>49</td>
<td>54</td>
<td>52</td>
</tr>
<tr>
<td>&gt;3 hours</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Satisfied with services provided by health facility staff</td>
<td>87</td>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Yes</td>
<td>87</td>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Somewhat</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Satisfied with communication from health providers</td>
<td>89</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Yes</td>
<td>89</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Somewhat</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Tested for malaria during the first antenatal care visit†</td>
<td>96 (n = 296)</td>
<td>99 (n = 357)</td>
<td>98 (n = 653)</td>
</tr>
</tbody>
</table>

† Subset of clients attending first antenatal care visit.
not documented (i.e., not performed) for almost half of pregnant women, especially those attending ANC at dispensaries. Symptomatic MiP is a key contributor to maternal anemia, the leading cause of malaria-related morbidity and mortality among pregnant women. In Cameroon, malaria diagnosed at the first ANC visit was associated with low hemoglobin levels and anemia. In areas of high malaria transmission in Tanzania, anemia prevalence is also high. In southeastern Tanzania, a recent study reported a 68.5% anemia prevalence at the first ANC visit. Insufficient equipment and commodity availability or lack of provider skill may be responsible, as odds of anemia testing were greatest in hospitals. A study in Tanzania found that half of rural health clinics had no instrument to measure hemoglobin, and only 37% of women had received a hemoglobin test. In areas with deficient infrastructure, supply chain interventions could prevent stock-outs and improve testing rates. A cluster-randomized trial in Mozambique that distributed anemia testing supply kits with 1-day training reported that anemia screening increased from 15% at baseline to 98% during the trial. Failure to screen for anemia is a hallmark of substandard ANC. Data from Ghana and Tanzania on ANC care quality revealed that lower quality care was associated with a greater prevalence of anemia and worse maternal and perinatal outcomes. Possibly because they are usually less busy, dispensaries were more likely than health centers and hospitals to document gestational age and distribute ITNs.

Limitations. Our study’s retrospective design offers a descriptive portrait of MiP service provision over a fairly narrow time frame. Continued analysis of MSDQI data over time can demonstrate how MSDQI supportive supervision affects quality of care, and how these data can be used to improve data collection and documentation continuously. Working with secondary data from public-sector facilities limited the types of possible analyses. We assessed service provision as documented in ANC registers. Some MiP care components may have been provided but not documented or, less likely, recorded erroneously but not provided. Without observation to confirm receipt of these services, validity of ANC records cannot be confirmed. In addition, because ANC records did not contain screening and test results, we were unable to assess whether women received care components correctly, at the right time and frequency, and with an appropriate response. For example, we cannot ascertain whether clients with positive mRDT results were prescribed artemisinin-based combination therapy. Similarly, registers did not capture client eligibility for IPTp doses. In addition, MiP services provided by the private sector are not captured; facility readiness to provide ANC and MiP care components is generally lower in private facilities in Tanzania.

Because data were collected during routine supervision, sampling was not as rigorous as in a standalone study. The MSDQI tool sampled the same number of records at all facilities regardless of client load, so our service provision analyses may overrepresent low-volume facilities. Guidelines for MiP call for the same ANC services to be provided at every facility regardless of type; oversampling is unlikely to distort care component coverage estimates. In the client satisfaction analysis, high-volume facilities are likely overrepresented because facilities without clients during supervision were omitted. Low-volume facilities may differ from high-volume facilities in client satisfaction. Future analyses could either sample facilities based on representative shares of clients by facility type and volume of clients, or use weighted analyses. In addition, our study was conducted in just three regions of Tanzania in a fraction of facilities where MSDQI is being implemented. Twenty-three other regions where MSDQI is used do not have implementation support, limiting generalizability of the findings to all of Tanzania.

The logistic regression was based on aggregated service provision data without client identifiers, so stratification by sociodemographic variables of clients was not possible. Some unmeasured demand-side factors such as concealment of pregnancy, opportunity costs, and perceptions about quality or content of care may influence timing of the first ANC visit and, consequently, total doses of IPTp pre-delivery. In addition, women may seek ANC from multiple facilities. Migration into or out of a facility catchment area during pregnancy, which is common in Tanzania, may result in incomplete records of all ANC services a particular client receives.

Last, the MSDQI client satisfaction tool relies primarily on client self-reporting, so social desirability bias could inflate satisfaction estimates. In addition, the MSDQI tool does not assess all dimensions of quality of care, including facility conditions, assurance of privacy, respectful treatment, and cost, which can influence demand for and uptake of services. These would be useful to include in MSDQI, particularly in efforts to increase uptake of ANC and IPTp services.

Recommendations for quality malaria in pregnancy service delivery. In Tanzania, achieving quality improvement for MiP requires attention be paid to ANC provision beyond mere coverage. Multiple strategies to increase IPTp uptake and quality of documentation are underway. Registers can now record up to four doses of IPTp, preservice MiP training curriculum are strengthening provider skills, and IPTp3+ and SP availability are included among indicators used to determine cash incentives for providers and facilities under results-based financing schemes. Implementing partners have promoted IPTp and early and continued ANC attendance, stock status monitoring for MiP commodities, and periodic data review and quality assessment meetings at facilities. These are critical inputs to improve health system readiness to provide quality MiP services.

No single tool, method, or indicator can capture all dimensions of quality of care (e.g., facility readiness, provider performance, number of visits, timing of ANC initiation, coverage, and client satisfaction). Using multiple data sources can paint a more detailed picture of both MiP care components and coverage and quality, and identify issues affecting service delivery (e.g., stock-outs, long wait times, and late initiation of ANC). The MSDQI tool—and OTSS tools for MiP used in other countries—could be adapted to capture more effectively the appropriateness of care provision and other dimensions of quality of care, such as respectful maternity care and costs. Routinizing collection of data that capture both content and experience of MiP services through modalities such as supportive supervision is needed to mark progress toward quality improvement.

CONCLUSION

Our study provides insight on the quality of MiP services delivered during ANC visits in Tanzania, demonstrating how routinely collected data can support quality improvement by...
identifying gaps in service delivery and guiding quality improvement initiatives. Quality of MiP services can be evaluated through several different lenses, including service provision and client experiences of care. Evaluating how supportive supervision approaches affect health service performance helps strengthen the case for MOHs to adopt supportive supervision approaches using tools such as the MSDQI tool to collect data that are useful for monitoring coverage and quality of MiP services.

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Disclosure: This study analyzed secondary data and received a nonresearch determination from the Institutional Review Board (IRB) of the Johns Hopkins Bloomberg School of Public Health (Baltimore, MD; IRB No. 23914) and clearance from the Population Services International Research Ethics Board. In Tanzania, no ethical approval was required because secondary aggregated data were used for the analysis. Permission to conduct the study was sought from all district authorities. Oral consent to participate in the client satisfaction survey was sought during the MSDQI supervisory process from all participating clients. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. President’s Malaria Initiative, the United States Agency for International Development, the U.S. CDC, or other employing organizations or sources of funding.

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Experiences in Improving the Quality of Community-Based Fever Management from Three Malaria-Endemic African Countries

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Abstract. The WHO affirms that trained, supervised, and supported community health workers (CHWs) can deliver high-quality health services effectively and has called for documentation of enabling factors, needs, and implementation strategies of successful CHW programs. In response, the U.S. President’s Malaria Initiative Impact Malaria Project conducted a study to document implementation approaches, best practices, and lessons learned for quality improvement (QI) of community-based fever management in Madagascar, Malawi, and Mali. The team conducted 10 key informant interviews (KII) with individuals at national, regional, and district levels using an open-ended interview guide tailored to each level, and a desk review of documents and materials related to community-based QI. Each country’s community health landscape and QI approaches were summarized into four categories identified during the KII’s training, supervision, coaching/mentoring, and review meetings) and compared. Results found that Madagascar, Malawi, and Mali all had well-defined community health strategies that include QI, but countries could not extend their full package of community-based QI approaches to all CHWs as a result of limited human and financial resources. Vertical funding for health programs limits the scope and coverage of QI approaches, especially at the community level. Recommendations from key informants for strengthening community-based QI included integrating QI approaches to improve cost efficiency, to define roles and responsibilities more clearly, to engage communities and all health system levels in implementation, and to digitize QI tools. Increased financial and skilled human resources are needed for community-based QI activities to achieve their intended effect.

INTRODUCTION

More than 5 million children died before reaching their fifth birthday in 2021.1 Pneumonia, diarrhea, and malaria—all preventable and treatable diseases—remain the main causes of child mortality, accounting collectively for 32% of annual deaths among children younger than 5 years in 2019.2 Globally, 54 countries are not on track to achieve the Sustainable Development Goals (SDGs) for the child survival target of fewer than 25 deaths per 1,000 live births by 2030.3

Reaching the child health-related SDG targets requires strong primary health-care systems, including the institutionalization of high-quality health care delivered at the community level through the work of community health workers (CHWs).3 The WHO has consolidated evidence indicating that properly trained, supervised, and supported CHWs can deliver a range of preventive, promotive, and curative health services effectively.4 Investments in CHWs and the services they provide help fill gaps in facility-based care, improve access to health care, and save lives.

The WHO and UNICEF recommend the integrated community case management (ICCM) strategy to train and supervise CHWs to provide life-saving care for malaria, pneumonia, and diarrhea by targeting hard-to-reach, vulnerable populations through the rational use of medications and the promotion of nutrition, timely care seeking, and referral of severe cases to higher levels of care.5–8

The WHO defines quality improvement (QI) of health service delivery as “an approach to the improvement of service systems and processes through the routine use of health and program data to meet patient and program needs (p. 282).”8 Other definitions in the literature align well with that of the WHO, emphasizing a systematic approach to improving service provision and patient outcomes by strengthening institutional knowledge, skills, and infrastructure.16–18 However, the WHO places additional emphasis on using data to drive QI, which includes measuring impact and changes over time, and understanding the variation in processes and outcomes.11 Community health workers can be supported by digital tools, which have been shown to improve the access, quality, and collection of CHW performance data to inform supervision and allow real-time problem solving and action planning. These digital tools can also provide a platform for CHW training, peer learning and engagement, skills building, and on-demand learning.16–19 In addition, the integration of data from community-based care in surveillance systems creates new opportunities and challenges for tracking the impact of disease control and child survival initiatives.20,21

The WHO has identified a need for comprehensive case studies that document the critical components of successful CHW programs, including enabling contextual factors, health system needs, and the challenges and opportunities of implementing several interventions simultaneously.4 Community health worker programs and policies need to be monitored over time and adapted using context-specific evidence. As such, policymakers and managers are encouraged to share data on the characteristics of CHWs and their performance, and information on program implementation and effectiveness.22,23

As the flagship global malaria service delivery project of the U.S. President’s Malaria Initiative (PMI), the PMI Impact Malaria Project supports national malaria programs (NMPs)
to improve the quality of health service delivery through approaches such as facility-level Outreach Training and Supportive Supervision (OTSS); mentorship; peer-to-peer learning; and targeted classroom training for providers.24 To address the CHW program documentation gap identified by the WHO and to reflect on feasible and effective approaches for measuring and improving the quality of service delivery, PMI Impact Malaria conducted a study to describe the QI approaches used in three malaria-endemic African countries to improve community-based fever management and share experiences from their implementation.

MATERIALS AND METHODS

This study was conducted to document experiences from each country’s implementation of community-based QI. It was not designed to assess program effectiveness or compare country QI approaches and their implementation. The study team conducted country case reviews from September to December 2022 in Madagascar, Malawi, and Mali. Of 19 countries receiving support from the PMI Impact Malaria Project, these three countries met the following study selection criteria: a functioning CHW program in a significant part of the country between 2018 and 2021, linguistic and geographic representation, and ability to secure ethical approval within a defined time frame. The study team completed the analysis in two parts: semistructured qualitative key informant interviews, and a desk review of existing documents and materials. Key informant interviews. Semistructured, qualitative key informant interviews were conducted with national- and subnational-level health authorities in each country to understand more fully the implementation and monitoring of QI activities, program successes and challenges, and lessons learned. Open-ended qualitative interview guides were developed (Supplemental Material 1) for informants at each government health system level (national, regional, and district). Study staff gathered names for shortlists of possible key informants at each level in consultation with PMI Impact Malaria country office ICCM technical advisors. These shortlists were refined to target two to three informants per level in each country based on the following criteria: experience and knowledge of CHW programs in their country, access to an Internet connection, and comfort in either conversational English or French.

Study staff contacted key informants via e-mail to inform them of the study and share the study information sheet. After confirmation of interest, each key informant was sent a preinterview request for information and an informed consent form to be reviewed and signed ahead of their interview. Three attempts were made to contact and schedule interviews with each identified informant. Interviews were conducted using videoconferencing and lasted approximately 45 to 60 minutes. Four study members (J. A., A. N., J. M., and A. C.) conducted key informant interviews in French or English. The interviewers administered the interview guide and took notes. All interviews were recorded and were then reviewed to extract relevant information and to supplement interview notes.

Desk review. The study team also conducted a desk review to obtain information on the implementation and monitoring of each country’s CHW program, establish a framework for analysis, and identify approaches used for improving the quality of community-based fever management in each country. Relevant documents and materials (listed in Supplemental Material 2) were identified through conversations with key informants, including Ministry of Health (MOH), NMP, and PMI Impact Malaria country staff. Documents and materials included national strategic plans, guidelines, reports, and presentations. The Madagascar, Malawi, and Mali malaria digital community health assessment reports developed by Digital Square (Table 1) (an initiative funded by the United States Agency for International Development [USAID], the Bill & Melinda Gates Foundation, and a consortium of other partners) were also reviewed.18,25-27 Data analysis and validation. Desk review and interview data from each country were aggregated into one Microsoft Word document per country. The study team convened to review the aggregated data to ensure the information captured was comprehensive, and to identify common themes across the three countries for analysis. The team then held a series of validation meetings with the PMI Impact Malaria Madagascar, Malawi, and Mali country teams to review preliminary findings from each country.

RESULTS

Of 26 key informants identified, the study team interviewed a total of 10: four from Madagascar (three at the national level and one at the regional level), three from Malawi (one at the national level and two at the district level); and three from Mali (two at the national level and one at the regional level). Seven identified key informants did not respond to an interview request, two declined the invitation to interview, and seven had scheduling conflicts and could not participate. Study results are presented in two parts. We first provide an overview of each country’s community health landscape and QI approaches, then summarize and compare the approaches and their implementation using the four main themes derived from the interviews: training, supervision, coaching/mentoring, and review meetings.

Country community health strategies and quality improvement approaches.

Madagascar. In Madagascar, QI of fever management at the community level is integrated within national policies and guidelines on community health, with oversight from the

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Madagascar</th>
<th>Malawi</th>
<th>Mali</th>
</tr>
</thead>
<tbody>
<tr>
<td>National digital health strategy in place</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>National digital health strategy in place and includes funding</td>
<td>–</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>National digital health and community health strategies aligned and support each other</td>
<td>–</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>At least one digital tool in use to assess and monitor community health worker quality-of-care level</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The national community health strategy includes approaches for QI of community health activities, which include control and surveillance of communicable diseases. However, the strategy does not align with the country’s national digital health strategy as it does not discuss any activities related to digital health apart from mentioning a strategic priority of integrating community health data within national data systems. Neither strategy includes plans for the use of digital tools for community health. Madagascar’s mobile connectivity coverage is only 65%, often with very low bandwidth, and just 5% of rural areas have electricity. 

Multiple informants explained that, according to the national strategy, community health activities are conducted by volunteer CHWs who are chosen by their communities. Oversight of a community’s health activities, as described in Madagascar’s Harmonized Community Health Program Implementation Guide and confirmed by key informants, is provided by comités de santé (health committees), which are led administratively by village chiefs and include health facility in-charges, other community groups, and the two CHWs that serve it. The CHWs are managed by the in-charge of their associated health facility. In general, each community site is supposed to serve approximately 1,500 inhabitants. Each site must be either ≥5 km from a health facility or in a particularly inaccessible area. Actual site catchment area size and location could not be confirmed through this study.

Key informants confirmed that community-based QI approaches implemented in Madagascar include training of health staff and CHWs on iCCM, supervision of CHWs, coaching to provide regions and districts with support for community-based activities, and regular (most often monthly or quarterly) meetings between CHWs and their supervising facilities to review community health data and activity implementation. When asked about the contribution of CHWs, one respondent highlighted the critical importance of CHW services:

Lives are saved with the [CHWs]. We must continue in this direction because for some regions, people [primarily consulted at the level of the [community]. (MOH staff member, Madagascar)

However, one informant noted that financial constraints have left districts in 5 of 23 regions without any support for CHWs or community health activities. In the remaining 18 regions, institutionalization and scale-up of QI efforts have been hampered by constrained resources, such as the lack of dedicated staff to oversee community activities and a disjointed data reporting system. One respondent explained that although a health management information system (HMIS) database exists specifically for community activities, data from paper forms used by CHWs are not regularly digitized or linked to the national HMIS. Furthermore, the community- and facility-level HMIS databases are not linked and must be accessed separately. In some regions, digital data collection by CHWs is being piloted with support from the USAID using the CommCare application v2.53.1 (Dimagi, Inc., Cambridge, MA).

Malawi. In 2017, the Malawi MOH launched its first national community health strategy with the aim of harmonizing community-level health service structures and delivery, building capacity for community health service delivery, and integrating community health commodity management within the national supply chain. The strategy calls for a strengthened feedback loop between CHWs and their communities, and establishes a hierarchy within the community health system whereby community-level supervisors oversee CHW activities. The strategy includes details on the use of digital tools for community-level data collection and is well aligned with the country’s digital health strategy.

The role of CHWs is institutionalized within the Malawi health system through the provision of a regular wage and supervision. The community health strategy describes the different cadres of CHWs operating nationwide: health surveillance assistants (HSAs), senior HSAs (who supervise HSAs), community health nurses, and community midwife assistants. Health surveillance assistants provide health services such as iCCM from their local health posts. These health posts are intended to serve the 16 million people living in rural areas, including more than 4 million people living in hard-to-reach areas >8 km away from a health facility.

To improve the quality of iCCM service delivery by CHWs after their initial training, all Malawian informants noted that the district health office coordinates supportive supervision, mentorship, stock supply monitoring, review meetings, and refresher training. However, although national policy states that QI activities should be driven by need, one respondent cited that not all QI activities are planned this way:

Sometimes, activities are not need driven. [We] have to align activities with partners through district planning committees. Sometimes, partner needs are different from what the district needs. (District staff member, Malawi)

All key informants corroborated the community health strategy by explaining that, in practice, supportive supervision visits are led by the MOH and local district teams that observe CHWs working in their communities and provide feedback and support to improve performance and fill competency gaps. These visits combine supervision, coaching, and action planning. Community health workers also travel quarterly to a local clinic, where they are presented with fever cases to assess and treat in the presence of a facility health provider trained in CHW mentorship. After supportive supervision and mentorship are provided, a review is completed to monitor whether CHWs are restocking and reordering supplies to meet inventory requirements. Last, review meetings are held during which several CHWs from the area gather with a supervisor on a quarterly basis to share lessons learned and to understand gaps more fully in malaria case management at the community level through an exchange of experiences. Community health workers are encouraged to engage with village health committees to analyze QI data, identify problems, and develop ideas for improvement.

One key informant noted that the MOH has developed and rolled out a national community-based health information system to track all community health indicators and provide more insight into CHW performance, allowing for the development of tailored QI interventions. However, another informant noted that the community health strategy’s target of 75% of CHWs collecting data electronically has not yet been
met, possibly as a result of low mobile connectivity coverage (18%) and the fact that just 10% of rural areas have electricity.27

Mali. According to one respondent, in 2010, Mali launched a national community health strategy that aimed to reach underserved populations through the establishment of CHW health-care delivery sites within hard-to-reach villages. The strategy includes a performance-monitoring framework with well-defined indicators (listed in Supplemental Material 3).30 One informant highlighted the importance of using these data to evaluate the performance of QI approaches:

[We] should always try to evaluate the strategies being implemented. We need evidence that it works before moving forward with it. (MOH staff member, Mali)

A CHW site covers, both in policy and practice, approximately 700 inhabitants within 3 km of a CSCOM in southern regions and 100 to 500 inhabitants within 25 km of a CSCOM in the less densely populated northern regions (Mali’s Plan Stratégique National des Soins Essentiels dans la Communauté 2021–2025).30 In addition, CHW sites provide care to populations outside the catchment area of CSCOMs, which are a grouping of villages and/or neighborhoods around a health facility. Two respondents shared that administrative management of CSCOMs is provided by a community health association, and technical oversight is provided by a technical health director recruited and trained on CHW work and supervision. One informant noted that, in 2022, the Malian government formalized the status of CHWs within the health system with a guaranteed salary.

All Malian respondents explained that CHW training is followed by regular CHW supervision visits, which allow for the collection of monthly CHW activity reports and provide insight on the quality of community-based service delivery and data collection. Mali’s CSCOMs also provide mentorship to CHW supervisors, and villages organize regular community steering committee meetings. One informant noted that much of the focus for digital health has been to strengthen the national HMIS and improve monthly reporting by health facilities, notatifable diseases (including malaria), and medication supply management. Community health workers receive 5 to 6 days of training on smartphone use, followed by specific training on data collection using CommCare. Multiple respondents explained that refresher training for CHWs is conducted in all three countries with varying frequency. A key informant in Malawi recalled a successful refresher training during which it was identified that some CHWs were giving the first dose of oral artemisinin-based combination therapy rather than rectal artesunate (RAS) for prereferral treatment of severe malaria. The informant reported that refresher training increased knowledge and confidence among CHWs to administer RAS, which led to documented increases in its use and anecdotal improvements in case referral for severe malaria:

Refresher trainings have been used to discuss and address challenges that arise from the community. [Following refresher training, the] confidence of providers was boosted in providing care to sick children at the community level. (District staff member, Malawi)

Supervision. All three countries have CHW supervision plans documented in their community health strategies (Table 3). Respondents in all three countries noted that the focus and timing of supervision visits often depend on donor priorities and commitments as well as on the availability of supervisory staff. As a result, none of the three countries reported having adequate financial resources to supervise all their CHWs. In Madagascar, one informant noted that just 35% of CHWs (those in 40 of 114 districts) receive any form of supervision. A Malawian informant explained that if a donor-funded partner organization is not present within a district to support supervision, the district must wait for the MOH to organize resources for supervision. Most respondents mentioned the importance of CHW supervision after training and the need for external funding to support this:

The supervisions allow for close monitoring of the case management and how the [CHW] is entering data in their registers. [Supervisors] can check for accuracy and make corrections in real time. (Regional staff member, Madagascar)

Specific activities may depend on partners and funding. Without partners, it’s hard to maintain regularity of trainings and supervisions. (MOH staff member, Mali)
If CHWs are supervised, they often do not receive supervisory visits at the frequency dictated in the national community health strategy because of funding and human resource gaps. As a result, respondents said that CHW supervision in Madagascar and Mali is done quarterly instead of monthly. In Malawi, one informant noted that supervisors can often only conduct supervisory visits quarterly for one to two of the approximately 14 community health clinics in their assigned area.

Informants explained that in Malawi and Mali, supervision is done by dedicated supervisors with no competing professional tasks beyond medicine distribution, whereas in Madagascar, supervisors are health facility in-charges. These in-charges either supervise their CHWs during meetings at

### Table 2

<table>
<thead>
<tr>
<th>Element</th>
<th>Madagascar</th>
<th>Malawi</th>
<th>Mali</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained individuals</td>
<td>Community health volunteers</td>
<td>Health surveillance assistants</td>
<td>CHWs</td>
</tr>
<tr>
<td>Geographic scope</td>
<td>18 of 23 regions</td>
<td>National</td>
<td>National CSCOM technical staff</td>
</tr>
<tr>
<td>Trainers</td>
<td>Health facility in-charges</td>
<td>CHW supervisors and health providers</td>
<td></td>
</tr>
<tr>
<td>Training format and content per community health strategy</td>
<td>Training materials should be adapted to the package of interventions provided in the area</td>
<td>Refresher training (both classroom and practical) include</td>
<td>• Guides, training manuals, and iCCM management and reporting tools are used during training</td>
</tr>
<tr>
<td></td>
<td>• A classroom training phase is to be followed by a practical phase in the community</td>
<td>• Assessing sick children</td>
<td>• Training modalities include presentations, case studies and exercises, plenary discussions, field visits, brainstorming, commentary, discussions, and demonstrations</td>
</tr>
<tr>
<td></td>
<td>• Training modalities include singing, sketches, case studies, face-to-face learning and e-learning, feedback sessions, before-and-after tests, and self-evaluations</td>
<td>• Identifying signs and symptoms of common illnesses and severe malaria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Target duration per community health strategy</td>
<td>Training for CHWs</td>
<td>Training for CHWs</td>
</tr>
<tr>
<td></td>
<td>One-day TOT that cascades to 1-day CHW classroom training</td>
<td>Initial CHW training is 6 weeks; refresher training lasts 4 days</td>
<td>Initial CHW training is 21 days</td>
</tr>
<tr>
<td></td>
<td>Target frequency per community health strategy</td>
<td>Refresher training is conducted three times a year during CHW supervisions</td>
<td>Refresher training is conducted every 2 years or sooner if clinical protocols change</td>
</tr>
<tr>
<td></td>
<td>Refresher training includes assessing sick children</td>
<td>The first refresher training session is conducted 3 months after the initial training. Refresher training is then provided as needed or after a maximum 5 years</td>
<td></td>
</tr>
<tr>
<td>Training locations</td>
<td>Health facilities</td>
<td>Training centers</td>
<td>CSCOM facilities</td>
</tr>
</tbody>
</table>

**CHW** = community health worker; **CSCOM** = Centre de Santé Communautaire (community health center); **iCCM** = integrated community case management; **TOT** = training of trainers.

### Table 3

<table>
<thead>
<tr>
<th>Element</th>
<th>Madagascar</th>
<th>Malawi</th>
<th>Mali</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term used for CHWs</td>
<td>Community health volunteers</td>
<td>Health surveillance assistants</td>
<td>CHWs</td>
</tr>
<tr>
<td>CHW supervisors</td>
<td>Health facility in-charges</td>
<td>Senior health surveillance assistants</td>
<td>National CSCOM-dedicated supervisors</td>
</tr>
<tr>
<td>Geographic scope</td>
<td>40 of 114 districts</td>
<td>National</td>
<td>National</td>
</tr>
<tr>
<td>Target frequency per community health strategy</td>
<td>Monthly</td>
<td>Quarterly</td>
<td>Monthly</td>
</tr>
<tr>
<td>Actual frequency</td>
<td>Quarterly</td>
<td>Quarterly, but only for up to 15% of community health clinics in the supervisor’s assigned area</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Supervision tool</td>
<td>CHW supervision checklist (paper and digital)</td>
<td>CHW supervision checklist (digital)</td>
<td>CHW supervision checklist (digital)</td>
</tr>
<tr>
<td>Supervision data reporting and use</td>
<td>Development and review of CHW action plans, manual data entry and analysis in Excel</td>
<td>Development and review of CHW action plans, manual data entry and analysis in Excel</td>
<td>Development and review of CHW action plans, digital data entry and analysis in Excel, monthly upload to health management information system (forthcoming)</td>
</tr>
</tbody>
</table>

**CHW** = community health worker; **CSCOM** = Centre de Santé Communautaire (community health center).
the facility or during visits to the communities in which the CHWs work. Obtaining approval for supervisory visits is time-consuming and depends on the motivation of the health facility in-charge, who are frequently the only staff at the facility and may find it difficult to leave their post to supervise CHWs in the community. One respondent explained that this has led to an arrangement in a few districts whereby the health facility in-charge identifies and oversees a well-performing CHW to conduct peer supervision:

If the [health facility in-charge] is the only person in the [health facility], it is challenging for them to leave to conduct the supervisions. Their travel [for the supervisions] may also be logistically challenging. Due to lack of funds, not all the [CHWs] are able to receive a supervision visit. (MOH staff member, Madagascar)

One respondent from Malawi explained that the lack of support for supervision staff (senior HSAs) transportation greatly hampers the implementation of the approach because commuting to the CHW’s community can be expensive:

There are issues in relation to where the [supervisor] stays and where the clinic is. Some [supervisors] do not have a house in the catchment area and there is a need to commute to the clinic. This can be expensive for them, especially if they do not have a bike. (MOH staff member, Malawi)

In Mali, one respondent explained that the first CHW supervisory visit is supposed to be completed within 30 days of the CHW starting work, followed by monthly supervisions of 12 to 18 CHWs by CSCOM-dedicated supervisors. Mali’s supervisors are also responsible for on-the-job training and disbursement of supplies and equipment to CHWs. National and regional teams in Mali conduct biannual supervisions, and district and health facility teams conduct quarterly supervisions.

[The supervision at the national and regional levels in Mali] are to evaluate not only the CHW, but also to try and understand the impact of supervision on the quality of the CHW’s work. (MOH staff member, Mali)

In all three countries, key informants described how supervisors use MOH-validated, observation-based checklists to assess CHW performance, including questions to evaluate CHW competency in iCCM and malaria service delivery during a sick child consultation and referral, and reporting through a review of the CHW’s consultation forms and registers. Availability of commodities is also monitored through the checklists. Respondents in Madagascar and Malawi explained that paper-based versions of their CHW checklists (see Supplemental Materials 4 and 5, respectively) are used, except in three districts of Madagascar supported by PMI Impact Malaria, where the checklist has been digitized. The project supports the NMP in the oversight of the tool and its data, which are downloaded and analyzed in Excel. In Mali, a new application is currently being digitized to allow CHWs to collect data electronically, and for supervisors to assign tasks to the CHW, and analyze and visualize activity and performance data. Supervisors will also be able to monitor a CHW’s longitudinal follow-up of patients by accessing these data disaggregated to the level of the patient, which would allow CHWs and their supervisors to identify and track areas for improvement immediately. Community health workers will be expected to send data from the tool to the HMIS server using the cellular network at least twice per month. Community health worker supervisors are currently being trained on the tool and CHW training will follow.

Respondents from all three countries described how the supervisor and the CHW review the supervisory results before developing and agreeing on action plans that will be followed up by the supervisor during subsequent visits. These action plans are considered important to improving CHW performance as well as to sustain gains through community engagement in the implementation of the QI approach. A respondent from Madagascar noted that action plans are also posted on the walls of the CHW’s associated health facility:

Regular supervisions [and] action plans developed after the supervision help reinforce the sustainability of the QI. (Regional staff member, Mali)

The sustainability of an approach that is essentially conducted at the community level, the results must be shared with the community on a regular basis so that the community can understand the approach, express itself, and play its role. (Regional staff member, Mali)

There has been community mobilization as a result of supportive supervision. Each clinic has a committee of 10 members that help in mobilizing people and acts as a bridge between community and chiefs. [They] can discuss [CHW] issues as well, such as building a house for the [CHW] in the catchment area. (MOH staff member, Malawi)

Supplemental Materials 6 and 7 show examples from Madagascar and Mali of how indicators calculated from CHW supervisory data are analyzed routinely and presented.
According to the Malawi MOH, CHW supervisions may have contributed to the improvements recorded in malaria case management and in the reduction of under-five all-cause mortality.31

Coaching/mentoring. Respondents explained that Malawi and Mali organize mentoring for their CHWs and CHW supervisors, respectively. In Malawi, two respondents noted that relatively low-performing CHWs receive mentorship based on supervisory results. These CHWs travel to their local health facility, where they assess and treat three to five fever cases in the presence of a facility health provider who has been trained as a mentor:

This quality of care assessment approach looks at the skills of CHWs at the lower level. … When that is administered, it looks at combining supervision with coaching right at that time. (District staff member, Malawi)

As with supervision, there are often limited funds for CHW travel to health facilities. Mentor attrition is another challenge commonly cited by informants in Malawi, meaning that practice does not always align with mentorship policy:

[For staff] to provide care at the health facility, but also have time to provide community case management mentorship, is a challenge [because] there are only one or two individuals who are doing mentorship to more than 10 [CHWs]. (District staff member, Malawi)

In Mali, per the national guidelines, the CHW supervisor is mentored and coached monthly by the CSCOM technical director through direct observation of supervisory visits and the use of a monitoring checklist. The technical director and supervisor discuss feedback and areas for improvement. In Madagascar, two respondents explained that a nutrition-focused project assigns coaches to motivate and encourage regions and districts within their project scope to coordinate the mobilization and sharing of malaria information and resources, and improve their malaria situations through proper prevention techniques and care seeking.

Review meetings. Key informants corroborated national community health strategy documentation describing how all three countries organize meetings to review community health activities, although each country assembles a different group of stakeholders and reviews different aspects of the work (Table 4). In Madagascar, respondents explained that CHWs are supposed to travel to their associated health facility for monthly meetings with the in-charges to review CHW registers, reports, and forms, and to conduct quality control of their data. However, lack of funding and resources for printing and transport means that CHWs may not have all the forms they need or may not be able to travel to the facility for each month’s meeting. One respondent noted that, in some instances, CHWs request money or nonfinancial incentives before they agree to send their data and attend the meeting:

[CHWs] are only volunteers, but they are now asking for incentives. … There are times where they go on strike—for example, during [insecticide-treated net] distribution campaigns. For example, they don’t send back the data and are requesting money. (MOH staff member, Madagascar)

Groups of CHWs in Malawi meet with a supervisor at a set location to review their data and share best practices and solutions to challenges, according to one respondent. These cluster review meetings are intended to occur every quarter, although they are often held less frequently because of lack of funding for travel:

Resource needs [such as fuel, vehicles, and lunch allowances] are a limitation for conducting cluster review meetings. The key [solution to resource challenges] is integration [of] any of these pieces into other QI tools. (District staff member, Malawi)

In Mali, all community-based interventions are coordinated by the General Directorate of Health and Public Hygiene through steering committees that exist at all levels of the health system. At the community level, each CHW site has its own committee, which is presided over by the site’s village chief and includes CHWs, religious leaders, traditional providers, women’s and youth associations, and other groups. One informant explained that its role is to increase community awareness and mobilization around the health activities provided by the CHWs:

The committees are key to sustaining the community-level work [by helping to] coordinate activities at all levels, and create transparency and accountability for the implementation of the community-level activities. (MOH staff member, Mali)

These steering committees are supposed to meet monthly to review implementation of community health activities, propose solutions to challenges encountered, and plan the following month’s activities. However, two respondents noted that they often do not meet as frequently as planned, and the Directorate is disseminating additional guidance to committees to improve their planning and management.

DISCUSSION

These country case studies provide historical and contextual information and describe approaches currently used in Madagascar, Malawi, and Mali to improve the quality of community-based fever management. Despite the diversity in settings, health system structures, and the level of institutionalization of community health, all three countries have well-defined community health strategies that include QI approaches and tools covering CHW and supervisor training, supervision, coaching/mentoring, and review meetings. Some of the approaches and tools we examined are not integrated within the countries’ community health strategies. In addition, some approaches are for QI of iCCM activities, whereas others focus specifically on QI of malaria case management.

All three countries included in our study face a crucial challenge in implementing their community-based QI approaches: the persistent lack of resources, particularly human and financial. As a result, none of the countries can extend their full QI package at the desired frequency to all CHWs.

Our study highlights key facets of this challenge and shares possible solutions. First, there are not enough QI staff to implement the approaches, and those who are available are often constrained by a lack of time or funds to complete
the work. Health facility staff are often asked to balance running their facilities (where they may be the only health provider) with implementing QI activities, and may see no other option than to prioritize their clinical practice. Even if QI staff do not have competing priorities, they are often unable to visit CHWs at the desired frequency as a result of the lack of transportation funds. Conversely, the CHWs they supervise may not get compensated, incentivized, or reimbursed for travel for training, supervision, mentoring/coaching, or review meetings.

Although country community health strategies in all three countries integrate multiple health areas, in practice, QI activities are often focused on specific health areas that receive vertical donor funding. In some instances, this funding is also tied to specific geographic areas, limiting coverage of QI to only a portion of CHWs in the country. For example, in Madagascar, a nutrition-focused project has dedicated supervisors for the CHWs whose work they fund. The project holds monthly review meetings with these CHWs to ensure sustainability of the QI approaches used. However, CHWs who are not funded by the project are not included in the meetings.

Our study identifies some solutions that countries have used to strengthen the implementation of community-based QI activities, especially those facing resource challenges. As is already the case in the three countries, coupling and streamlining QI activities—such as combining training and supervision or training and group problem solving—can mutually strengthen and sustain them while minimizing their implementation costs. Integrated QI approaches at the health facility level, such as OTSS, have also been shown to contribute to improved competency in fever management. Efficiencies in QI implementation through cascade training for multiple levels of a health system are considered a cost-effective and efficient approach to reach all targeted participants in Madagascar. Having more trained QI staff can strengthen supervisory quality, which has been shown to contribute to stronger CHW performance.

Our study also highlighted that communities and districts may be best placed to implement, monitor, and address challenges to community-based QI approaches. However, they require the human and financial resources as well as the mechanisms to facilitate engagement with the health system for timely and effective QI implementation (such as supply chain management and approvals for logistics or release of funds) to avoid placing further stress on overburdened staff. This arrangement would capitalize on the strong ties and mutual support that CHWs in all three countries have with the communities they serve. Community support for CHW activities has been shown to have a positive effect on improving CHW performance, and the WHO encourages community engagement and feedback on the quality of CHW service delivery to complement supervisory efforts.

Digitizing tools used for the collection, reporting, and analysis of CHW data, as well as CHW supervisory tools, can help mitigate recurring costs associated with printing and transport of paper-based tools. It can also help supervisors with automated calculation of performance indicators, real-time availability of data, user-friendly scoring of performance to tailor feedback, and easy access to previous supervision results, which allows them to monitor progress over time and identify persistent gaps. Studies have demonstrated that digitizing tools can facilitate access, interpretation, and action based on complete and timely data collected at the community level. In Malawi and Mali, where the national digital health strategy is well aligned with the national community health strategy, tools used for the collection, reporting, and analysis of community data are digitized and integrated within an HMIS. Data can also be disaggregated by level, thereby allowing action plans to be tailored to each community. In countries where CHW data are not integrated into the national HMIS, and where use of digital tools at the CHW level is not feasible, disaggregation between facility- and community-based data may be achieved through the addition of a CHW-specific section to the monthly facility health services report, which was noted by informants as a best practice in Mali.

One key informant emphasized that community-based QI activities should be monitored through performance data on a trial basis before being scaled up. This type of routine monitoring can be made more feasible, effective, and efficient if community health programs identify a small number of high-value performance indicators that can be measured and interpreted easily, and are useful to global and national stakeholders as well as health providers.

Our study has some limitations. Study timelines and nonresponses by potential key informants limited data collection efforts. As a result of the smaller number of respondents than initially planned, some caution is warranted in generalizing these findings. Overall, though, there was a balanced mix of national and subnational health authorities interviewed for this study. Although efforts were made to conduct a comprehensive desk review, the study team may not have obtained all the relevant documents and materials for this review.

Quality improvement activities are critical to ensuring febrile patients receive appropriate care at the community level. Strong, integrated, community-based QI strategies and programs must be pragmatic, feasible, and resource conscious to achieve their goals. The overarching goal should be an integrated, country-led QI program with priorities that are driven by country needs to ensure consistent CHW support and sustainability. Through coordination and pragmatic planning, a variety of adaptive QI approaches can support the implementation of successful community programming for fever management and beyond.

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REFERENCES


Impact of the Severe Malaria “Champions Program” on the Management of Severe Malaria Cases in 12 Hospitals of the North and Far North Regions of Cameroon

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Abstract. Malaria remains a main cause of morbidity and mortality in Cameroon. Since 2021, the U.S. President’s Malaria Initiative Impact Malaria Project has supported the National Malaria Control Program to develop the Champions program in two northern regions. We assessed this program’s preliminary effectiveness on the performance of hospitals in the management of severe malaria and reduction of malaria-related deaths. We conducted a secondary analysis of Outreach Training and Supportive Supervision (OTSS) data from four rounds (one round pre-Champions program and three rounds post-Champions program and 2020–2022 malaria-related mortality data for 12 hospitals). Using linear regressions, we measured changes in hospital readiness and competency of health workers in the management of severe malaria between baseline and subsequent rounds. There were statistically significant improvements in overall management of severe malaria scores in post-Champions OTSS rounds, with post-Champions round 3 exhibiting an increase of +14% (P = 0.013) over baseline. Overall health facility readiness scores exhibited an increase of +7% (P = 0.006) from baseline to post-Champions round 3. There were no statistically significant findings associated with providing the right treatment, as nearly all patients hospitalized with severe malaria were treated with a recommended severe malaria treatment. Reported inpatient malaria deaths and case fatality rates trended downward from 2020 to 2022, but these differences were not statistically significant. The Champions program resulted in significant improvements in quality of inpatient care for severe malaria. The downward trends in malaria deaths and case fatality rate will require further monitoring to determine whether the Champions program is having the desired impact of reducing inpatient deaths from malaria.

INTRODUCTION

Despite declines in cases and deaths since 2000, malaria remains one of the main causes of morbidity and mortality in Cameroon. The percentage of hospital admissions that were diagnosed with malaria dropped in the general population from 41% in 2000 to 24.0% in 2014 and 23.6% in 2016 but then increased to 28% in 2019.1–3 In 2020, severe malaria cases accounted for 49% of all malaria cases reported in Cameroon (2020 National Malaria Control Program [NMCP] report, Cameroon Ministry of Health, unpublished), which is far higher than what is reported by the WHO for similar settings (between 3% and 10%). In the same year, the proportion of severe malaria cases reported by the NMCP in the North and the Far North were 56% and 47%, respectively. According to this report, the percentages of deaths attributed to malaria in children under 5 years were 44.8% and 48%, respectively, in the North and Far North regions, compared with 35.5% at the national level.

Since 2019, the U.S. President’s Malaria Initiative (PMI) Impact Malaria project has supported quality improvement for malaria case management in multiple countries, including implementation of Outreach Training and Supportive Supervision (OTSS), by using structured checklists to monitor the readiness of health facilities and competency of health workers in the management of uncomplicated malaria and the performance of malaria microscopy testing and rapid diagnostic tests (RDTs). The OTSS has been expanded under PMI Impact Malaria to include additional checklists for malaria in pregnancy and severe malaria.4 The Cameroon NMCP, with support from PMI Impact Malaria, launched and implemented OTSS to reinforce the quality of facility-based care, including inpatient management of severe malaria in the North and Far North regions, which carry the heaviest burden of malaria in the country. During OTSS visits, the readiness of the facilities as well as the competency of health workers is assessed through chart reviews of severe malaria inpatient cases (see Materials and Methods for more details). The data gathered through initial OTSS rounds identified a very small percentage of inpatient facilities that had health workers that were competent in the overall management of severe malaria (2% in round 1 and 3% in round 2), with poor scores in both initial assessment of patients and management of complications.5

Several studies conducted in similar settings have highlighted the gaps in inpatient care for severe malaria.6–10 A cross-sectional survey of health facilities in 11 districts in Uganda demonstrated that none of the inpatient facilities had all seven components of a basic care package for the management of severe malaria during the 3 months prior to the survey.6 Prompt care was reported for only 29% of patients, whereas severe malaria was correctly diagnosed in 27%. Elrou et al. reported that half of the health care providers (46.7%) in 20 hospitals in Gezira State, Sudan, did not receive training in severe malaria management, with just over half (55.4%) achieving a passing score on knowledge of severe malaria management.7 Overall compliance with severe malaria guidelines was just 2.2%.7

The MalariaCare project that preceded the PMI Impact Malaria project took important steps to address this issue of poor management of severe malaria by elaborating and implementing a series of tools—for mentoring on severe
malaria (including triage, diagnosis, and treatment) and for assessing management of severe malaria— that were important for quality improvement. Based on the poor results documented during OTSS visits and building on the lessons learned from MalariaCare, PMI Impact Malaria worked with the Cameroon NMCP to develop and implement a more tailored quality improvement approach, as a supplement to OTSS, to address the poor performance of hospitals and their providers in severe malaria management. It did this by focusing on internal quality improvement activities to reinforce and sustain the quality of care for severe malaria cases with the goal of reducing malaria-related inpatient deaths. Since 2021, PMI Impact Malaria has worked with the NMCP and stakeholders to develop and implement this new approach, called the Champions program, in the hospitals in the Far North and North regions. The program included training selected clinicians from district hospitals on the management of severe malaria and its complications, equipping the clinicians with the skills to become Champions mentors in the management of severe malaria for other staff in their hospitals, and implementing internal quality assurance activities in their hospitals to improve the management of severe malaria. These activities included creating an internal quality committee to identify challenges in severe case management and solutions to address them and conducting monthly case reviews and death audits.

The U.S. President’s Malaria Initiative Impact Malaria coordinated with the NMCP and health districts, using health management information system (HMIS) data, to select the hospitals that reported the highest number of deaths from malaria to participate in this program. These activities targeted 11 district hospitals and five regional hospitals that serve as referral facilities for the whole population of the North (3,098,009 inhabitants) and the Far North (5,104,209 inhabitants) regions. While implementing the Champions program, the NMCP continued to implement regular OTSS visits as an external quality improvement approach using trained health district supervisors to monitor the quality of care for case management of severe malaria, as well as to monitor HMIS data on malaria-related deaths in the targeted hospitals. The Champions program implementation process.

Training. Thirty clinicians who were providing care to severe malaria cases in outpatient, internal medicine, and pediatric wards were prioritized for this training; 14 hospitals sent two participants each, while two hospitals sent one each. These clinicians were selected to be Champions candidates based on their willingness and interest in sharing the knowledge they acquired during training to mentor their colleagues and support improvements in the management of severe malaria in their respective hospitals. Training was conducted at the University Teaching Hospital (UTH) in Yaoundé to provide the best opportunity to improve the knowledge and skills of these clinicians on the identification and management of each complication through hands-on training supported by expert mentors from UTH. This training was conducted by eight mentors from the teaching hospital who were considered the best teachers, knowledgeable of the subject matter, and willing to contribute to the program. The final list of mentors was determined by the UTH leadership and the NMCP.

The training curriculum was developed based on WHO and national treatment guidelines, as well as the UTH curriculum. The training focused on the following: national and global malaria case management and prevention policies and guidelines, malaria epidemiology, physiology and pathology of malaria in vulnerable groups, and the management of severe febrile illness, including malaria and other conditions. The training also focused on critical care management of the complications of severe malaria, such as hypoglycemia, alteration of consciousness, seizures, and acid-base and fluid imbalances. Training on preparation and dosing of intravenous artesunate- and artemisinin-based combination therapy (ACT) follow-up treatment was also covered. The training lasted 2 weeks, which allowed enough time for both theory sessions and a practicum. For the practicum, participants took part in rotations on the internal medicine, pediatrics, and maternity services, participated in rounds with attending physicians, and discussed cases with mentors.

Posttraining activities. After their training, all 30 trained clinicians became Champions who worked with their hospital and local health staff to create a quality committee, composed of the hospital staff, that coordinated a series of internal quality improvement activities aimed at reinforcing the capacity to manage cases of severe malaria. These activities encompassed the following:

1. A 2-day cascade training on severe malaria facilitated by the Champions for the hospital staff. Overall, 407 health workers participated in this training (hospital reports).
2. Monthly quality meetings during which charts of inpatient severe malaria cases were reviewed to identify and discuss gaps in care and to develop recommendations for the hospital management team. In the hospitals targeted, 119 charts were reviewed during the assessment period (hospital reports).
3. Monthly death audits to validate the appropriateness of the diagnosis of severe malaria, to correct the reporting of deaths, and to review the inpatient management and proposed solutions to gaps in care. A total of 42 deaths had been audited during the intervention period in the hospitals targeted (hospital reports).
4. Quarterly meeting of quality committees with district and regional health authorities to review quality and outcome data and to discuss possible corrective actions, such as the procurement of missing commodities and equipment and improvement in documentation.

The overall aim of this study was to evaluate the effect of the Champions program on the performance of hospitals in the management of severe malaria. More specifically, this study assessed trends in: 1) the readiness of targeted hospitals in the availability of critical tools before and after the implementation of the program; 2) the competency of health workers in these hospitals in the overall management of severe malaria before and after the launch of the program; 3) key subcomponents in the management of severe malaria (patient assessment, providing the right antimalarial treatment according to norms, and correctly treating the different complications from severe malaria); and 4) the number of deaths and the case fatality rate among patients with confirmed malaria in these hospitals since the launch of the Champions program, in comparison with the previous year.

MATERIALS AND METHODS

Study design. This study conducted a secondary analysis of data from four rounds of OTSS in 12 of 16 hospitals.
participating in the Champions program. The remaining four facilities did not receive OTSS visits during the study period because of security concerns in their catchment area. One OTSS round was conducted before implementation of the Champions program (pre-Champions) and three rounds were conducted postimplementation (post-Champions round 1, post-Champions round 2, and post-Champions round 3). The timing for each round can be found in Table 1. The severe malaria checklist was completed by reviewing one or two inpatient records during an OTSS visit. The readiness checklist was completed once for each health facility during each OTSS visit. Specific data elements were extracted from the health facility readiness checklist (Supplemental Table 1) and the OTSS inpatient severe malaria checklist (Supplemental Table 2). In addition, data on malaria-related deaths and the number of malaria cases admitted in the 12 hospitals were extracted from the national HMIS data for 1 year before the implementation of the program (2020) and for 2 years post-Champions program implementation (2021 and 2022).

Measures and variables. The OTSS facility readiness checklist was used to evaluate overall facility readiness and the availability of commodities, documentation, and materials to support the management of severe malaria cases. Facility readiness was defined as achieving an overall score of 90% or more on the health facility readiness checklist. In addition, subcomponents of the health facility readiness checklist, including availability of trained personnel, ACT availability for all age ranges, availability of injectable artemesine/artemether, availability of materials, and availability of documentation, were used in this analysis. The last two subcomponents were analyzed as continuous variables. The remaining subcomponents were analyzed as binary variables. Competency to manage severe malaria was defined as achieving a score of 90% or more on the inpatient severe malaria checklist. Key steps in the management of these cases were also assessed using composite indicators or subsections of the checklist. These included initial patient assessment and laboratory testing (patient assessment score) and prescribing of specific treatments for severe malaria (providing the right treatment) and its complications (hypoglycemia, severe anemia, and alteration of consciousness). These variables were left as continuous variables.

Malaria death and case fatality rates in the 12 hospitals were drawn from the national HMIS data validated by the government and were calculated for all sociodemographic groups combined. The malaria case fatality rate was defined as the number of malaria deaths divided by the total number of malaria cases admitted (by RDT and/or microscopy) to the 12 targeted hospitals.

### Analyses

The team generated descriptive statistics for the overall facility readiness score (i.e., proportion achieving a score of ≥90%) and calculated the proportions for the single-item variables (availability of injectable artesunate/artemether and ACT per age group) and the average facility score for the composite variables (e.g., availability of documentation and materials).

The study team generated descriptive statistics for facility competency in the management of severe malaria (i.e., proportion achieving a score of ≥90%) and averages (sum of the scores divided by the number of records reviewed) for the different subcomponents in the management of severe malaria (patient assessment, providing the right treatment, and management of hypoglycemia, severe anemia, and alteration of consciousness).

Using the scores (dependent variables) for overall management of severe malaria, patient assessment, providing the right treatment, health facility readiness, material availability, and documentation availability, simple linear regressions were performed using Stata (v. 15.1) to assess the percent change between the OTSS pre-Champions round (baseline/reference group) and the post-Champions rounds 1, 2, and 3 (independent variables). Linear regressions were performed as opposed to a nonparametric Wilcoxon signed-rank test because only five facilities consistently received OTSS visits across all four rounds, greatly reducing the sample size for the Wilcoxon test. Regressions were deemed significant when the P value was less than 0.05.

Additionally, the study team performed the $\chi^2$ test to assess the relationship between overall deaths and the nonparametric Wilcoxon rank sum test to assess the difference between the case fatality rates from 2020 (reference), 2021, and 2022. These analyses were performed for 10 of the 12 targeted hospitals, as two of the hospitals were excluded because of missing data for more than 1 month during the period being assessed.

### RESULTS

Across the four rounds of OTSS, not all the facilities received an OTSS visit, which led to differing sample sizes ranging from 9 to 11 health facilities (Table 1). Overall, 46 record reviews were included in the analysis of the four rounds of OTSS data: 10 reviews for pre-Champions (April–May 2021), 14 reviews for post-Champions round 1 (August–November 2021), 11 reviews for post-Champions round 2 (February 2022), and 11 reviews for post-Champions round 3 (September–October 2022) (Table 1).

**Table 1**

<table>
<thead>
<tr>
<th>OTSS rounds</th>
<th>Number of facilities</th>
<th>Number of records reviewed</th>
<th>Records per facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Champions (April–May 2021)</td>
<td>9</td>
<td>10</td>
<td>1–2</td>
</tr>
<tr>
<td>Post-Champions round 1 (August–November 2021)</td>
<td>11</td>
<td>14</td>
<td>1–2</td>
</tr>
<tr>
<td>Post-Champions round 2 (February 2022)</td>
<td>11</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Post-Champions round 3 (September–October 2022)</td>
<td>11</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>

OTSS = Outreach Training and Supportive Supervision.

Across the four rounds of OTSS, there were statistically significant increases in post-Champions scores for the overall management of severe malaria and health facility readiness as well
as for average scores for subcomponents, such as patient assessment and material availability. For the management of severe malaria, regression analysis demonstrated modeled increases of +11% \((P = 0.04)\) and +14% \((P = 0.01)\), respectively, in post-Champions round 2 and post-Champions round 3 in comparison with pre-Champions (Table 3). There also were statistically significant increases in modeled patient assessment scores of +16% \((P = 0.03)\) and +21% \((P = 0.06)\) when post-Champions round 2 and post-Champions round 3, respectively, were compared to pre-Champions scores.

The regression model for health facility readiness scores exhibited an increase for post-Champions rounds 1, 2, and 3 in comparison with pre-Champions of +7% \((P = 0.003)\), +6% \((P = 0.01)\), and +7% \((P = 0.006)\), respectively (Table 3). The model for materials availability for all post-Champions rounds had a statistically significant increase compared with that for pre-Champions, of +14%, +16%, and +15%, respectively \((P < 0.001)\).

There were no statistically significant changes in the model pre-Champions to post-Champions in providing the recommended malaria treatment of severe malaria in national treatment guidelines, as the use of recommended treatments was high prior to the launch of the Champions program.

The associations between pre- and post-Champions program rounds of OTSS for additional variables such as complications (e.g., anemia, hypoglycemia, and conscience), ACT availability, and injectable artesunate/artemether availability could not be assessed because of insufficient sample size. Across all rounds, ACTs and injectable artesunate and/or artemether were available in nearly all facilities, preventing the regression analyses from being conducted.

### Trends in malaria deaths and case fatality rate in targeted hospitals.

For 10 of the participating hospitals, all malaria-related death reports as well as the total number of malaria cases admitted for all age groups were available from the HMIS and were used to calculate the case fatality rate for the January–December period of the years 2020, 2021, and 2022. For the period of the study, we observed that in 2022, the number of deaths was lower than for the years 2021 and 2020 (Table 4). The aggregate malaria case fatality rate across these 10 hospitals trended downward from 3.2% in 2020 to 3.1% in 2021 and 3.0% in 2023, although these reductions were not statistically significant (Table 4).

### DISCUSSION

This analysis of both OTSS and data in a limited sample of hospitals provides encouraging evidence of improvement in the quality of severe malaria management after implementation of the Champions program. Over the 2 years, as the program activities were implemented and reinforced, improvements in the overall management of cases and particularly patient assessment have increased and been sustained in comparison with the period before the launch of this program. Similarly, hospital readiness also improved, particularly the availability of materials, such as guidelines and job aids.

During the same period, hospital deaths decreased and the case fatality rate trended downwards, although these decreases were not statistically significant. The small numbers of recorded hospital deaths in the 10 hospitals where data were available limited the power of these analyses. The
small sample also prevented controlling for other factors that might have impacted the malaria fatality rates, such as age and socioeconomic status of the patients, changes in transmission intensity, delays in care-seeking, changes in the availability of diagnosis and treatment of uncomplicated malaria, and the type of complications diagnosed. As this program is expanded, there will be additional opportunities to assess whether the improvements in the quality of case management for severe malaria can be linked to reductions in inpatient mortality and case fatality rate.

These results reinforce the findings of reports of similar interventions that have demonstrated the positive impact of quality improvement interventions on severe malaria case management.\(^\text{14}\,\text{15}\) For example, in Nigeria, a 2021 project brief for the Support to the National Malaria Program Phase 2 (SuNMaP2) project reported on the improvement of inpatient malaria case management and health system readiness in 62 hospitals in six states where in-service programmatic interventions, like those implemented through the Champions program (such as in-service malaria case management trainings for health workers, distribution of national guidelines and job aids, and integrated supportive supervision), were implemented along with annual quality improvement cycles that include postassessment feedback, the creation of hospital quality improvement teams, and supportive follow-up visits.\(^\text{15}\) These activities produced a positive impact on the quality of care. From two assessment rounds undertaken in 2019 and 2020, injectable artesunate availability increased by +14% to +50% in four states, and its use for severe malaria increased in all states by +6% to +51%.\(^\text{15}\)

Building on the lessons learned from other project experiences in quality improvement for severe malaria, the Champions program package deployed internal quality improvement interventions, including death audits and quarterly case reviews, reinforced by external quality improvement approaches such as mentoring and training and a robust monitoring approach. Other countries could learn from this approach to quality improvement of inpatient care for severe malaria and consider adopting it.

The primary limitation of this analysis was the small number of facilities and patient records and the limited time period assessed. Because the analysis included only 12 health facilities and a small number of records were reviewed, the study team was limited in the robustness of statistical analyses.

<table>
<thead>
<tr>
<th>TABLE 3</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre-Champions</th>
<th>Post-Champions round 1 % change (95% CI)</th>
<th>Post-Champions round 2 % change (95% CI)</th>
<th>Post-Champions round 3 % change (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall management of severe malaria (score)</td>
<td>Ref</td>
<td>3.3 (−7.0 to 13.6)</td>
<td>11.3 (0.4−22.1)</td>
<td>14.3 (3.2−25.4)</td>
</tr>
<tr>
<td>Patient assessment (score)</td>
<td>Ref</td>
<td>8.7 (−4.9 to 22.4)</td>
<td>16.2 (1.8−30.6)</td>
<td>21.0 (6.2−35.8)</td>
</tr>
<tr>
<td>Providing the right treatment (score)</td>
<td>Ref</td>
<td>8.8 (−0.6 to 18.2)</td>
<td>9.7 (−0.2 to 18.6)</td>
<td>8.0 (−2.1 to 18.1)</td>
</tr>
<tr>
<td>Health facility readiness score (score)</td>
<td>Ref</td>
<td>6.9 (2.5−11.3)</td>
<td>5.9 (1.5−10.3)</td>
<td>6.5 (2.0−11.0)</td>
</tr>
<tr>
<td>Material availability (score)</td>
<td>Ref</td>
<td>13.9 (7.6−20.2)</td>
<td>15.9 (9.6−22.2)</td>
<td>14.8 (8.3−21.3)</td>
</tr>
<tr>
<td>Documentation availability (score)</td>
<td>Ref</td>
<td>3.0 (−8.5 to 14.4)</td>
<td>7.5 (−4.0 to 19.0)</td>
<td>10.8 (−1.0 to 22.5)</td>
</tr>
</tbody>
</table>

CI = confidence interval; OTSS = Outreach Training and Supportive Supervision; Ref = reference variable; round 3.

*Regression analysis was not possible for ACT availability by age group as ACTs were available at almost all facilities across all rounds. Regression analysis also was not possible for complications (hypoglycemia, anemia, alteration of consciousness) due to small sample sizes.
Nonetheless, significant improvements in both readiness and competency were documented. Because of the small sample size, though, the effect of the program on the management of complications in these hospitals, which was the major focus of the training of the Champions, could not be assessed. As the Champions program is expanded to other facilities and additional experience is gathered in the existing facilities, future assessment of the program’s effect on management of complications will be warranted.

This analysis also relied on data collected through programmatic activities, which are potentially prone to data quality issues. However, the use of a digital platform to collect OTSS data likely mitigated some data quality issues. Using HMIS data to assess inpatient deaths and case fatality rates also has its limitations, including that malaria cases include all patients admitted who tested positive for malaria, which likely resulted in some patients with comorbidities being misclassified. Case-control studies may be able to better elucidate the link between these quality improvement activities and hospital mortality. Other limitations included nonrandom selection of districts and hospitals participating in the study and the lack of control facilities that were not implementing the Champions program. This analysis also could not control for other factors that might have affected malaria transmission and mortality, including changes in rain patterns, changes in availability of malaria diagnosis and treatment services, civil unrest, and other factors.

As management of the complications of severe malaria has often been neglected as a strategic priority, the Champions program has been an important additional intervention to supplement other quality improvement efforts, such as the OTSS, to address the quality of inpatient care for severe malaria and the high hospital mortality rate of malaria in Cameroon. The combination of training clinicians to become Champions, followed by internal quality improvement activities, and reinforcement by OTSS visits has the potential to make a significant difference in the quality of management of severe malaria cases and may reduce deaths from malaria. Further benefits to the quality of inpatient care of severe malaria and further reductions in inpatient deaths may be achieved if this Champions program is sustained and expanded to hospitals throughout Cameroon and in other countries.

**Table 4**

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of deaths</td>
<td>510</td>
<td>514</td>
<td>332</td>
</tr>
<tr>
<td>Number of malaria cases</td>
<td>16,140</td>
<td>16,337</td>
<td>11,114</td>
</tr>
<tr>
<td><strong>Chi-square test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of deaths</td>
<td>Ref</td>
<td>0.0049</td>
<td>0.6551</td>
</tr>
<tr>
<td>Number of malaria cases</td>
<td>Ref</td>
<td>0.944</td>
<td>0.418</td>
</tr>
</tbody>
</table>

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**REFERENCES**


Outreach Training and Supportive Supervision: A Package of Strategies That Improves the Quality of Malaria Services and Provides a Model for Monitoring and Evaluating Their Effective Implementation

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In this supplement, authors from the U.S. President’s Malaria Initiative (PMI) Impact Malaria Project present their experience with an approach to improving malaria case management and related services in 11 countries. Outreach Training and Supportive Supervision (OTSS) was initially developed to guide improvements in malaria diagnosis and has been adapted as a package of implementation strategies to support malaria case management and prevention interventions over multiple years. In this supplement, Impact Malaria partners demonstrate through an independent evaluation how the approach is adaptable to multiple settings and can enhance service quality in individual countries. They also apply supervisor checklists to create indicators of facility readiness and provider competency that can be a model for transforming information systems to track the impact of the malaria service investments made by countries and their partners more effectively. The results are relevant to malaria control efforts in high-burden contexts, elimination settings, and even countries certified as malaria free.

“Prompt and effective case management is the cornerstone of malaria programs.” Many of us have written that statement dozens of times and spoken it out from the podium at conferences. It remains as true today as it did following a Ministerial Conference in 1992.1 It was enshrined in the Abuja Declaration,2 and it persists in the current Global Technical Strategy.3 It holds for high-burden countries as well as those approaching elimination. Even countries that have been certified malaria free must maintain the ability to detect and treat imported cases with minimal delay, and guard against reintroduction of transmission. This clear and sustained commitment to ensuring that each malaria infection or illness is detected, diagnosed, and completely treated rests on a complex interplay of factors. Individual behaviors, cultural perceptions and practices, health system infrastructure and capacity, human resources, supply chains, health information systems, and financing don’t always converge in ways that make the accomplishment of quality case management a simple or seamless endeavor. Ensuring they do is a daunting challenge and still leaves too many cases undetected, underreported, and incompletely treated.4 In this issue of the Journal, contributors from the U.S. PMI Impact Malaria Project present work on the OTSS approach developed to support frontline health workers and district managers in their efforts to ensure universal access to quality malaria services.

There is considerable evidence of the benefits of prompt and effective malaria case management. It can reduce the duration of illness and disability, forestall progression to severe or fatal disease, shorten the duration of infection and risk of ongoing transmission, mitigate against the selection of drug-resistant parasites, and provide reliable data to track the impact of control and elimination efforts. Over recent decades, several innovations have transformed malaria case management. These include the adoption of artemisinin-based combination treatments (ACTs) as first-line drugs, the introduction and expansion of point-of-care diagnostic testing, and the opportunity to collect and act on meaningful trends in parasitologically confirmed cases through enhanced surveillance and response systems. These developments have improved what health workers and systems can provide. The OTSS represents a different sort of innovation, one that enhances how case management services are provided, monitored, and evaluated. In the language of implementation science, case management is a complex but technologically sound evidence-based intervention, and OTSS can be viewed as a package of implementation strategies that aim to optimize its delivery.

In the first paper of this series, Barat et al.5 characterize OTSS as a quality improvement approach that combines training, supervision, coaching, troubleshooting, action planning, and follow-up, and compile evidence and experience to support how the approach can improve the quality of malaria case management alongside systems supports, supplies, data collection, and use. Rather than stand-alone training workshops or onsite coaching or competency-based supervision, a strength of OTSS is the comprehensive and integrated support it provides health workers and managers. In an earlier systematic review,6 this sort of multifaceted strategy frequently showed better impact on quality of care than the component elements independent of one another. Another key feature of OTSS is its adaptability. It can and has been customized to meet the specific needs of different countries and health systems in the face of evolving challenges. Barat et al.5 describe the evolution of the OTSS strategy and its expansion from an original focus on diagnosis of uncomplicated malaria to a more comprehensive one that includes treatment, data collection, and reporting. They further describe examples of expanded approaches—termed OTSS Plus (OTSS+)—that also address related outcomes and interventions such as client satisfaction, data quality, management of severe malaria, delivery of chemoprevention, routine distribution of insecticide treated nets at antenatal clinic visits, and even management of other conditions such as COVID-19. Another adaptation includes systematically collecting and utilizing information gathered during OTSS visits through a routine Malaria Services and
Reporting on an independent evaluation of OTSS in four countries, Ashton et al. confirmed substantial improvement in health worker competencies to deliver quality malaria services including diagnosis, clinical management, and prevention. Health workers who received more OTSS visits attained the highest level of competence. The independent evaluation also included an 11-country qualitative evaluation of OTSS that established a high level of satisfaction among health providers, supervisors, and other stakeholders. Key features that were especially valued included the adaptability of the strategy package, the amount and quality of interaction between providers and supervisors with a focus on joint problem solving and action planning, and the digitization of checklists to guide the OTSS visits and streamline data collection and use. Participants broadly perceived OTSS to be effective at improving knowledge, skills, and service delivery. These independent findings confirmed evidence collected directly by the Impact Malaria teams and their malaria program colleagues. In Niger, Koko et al. used data collected on OTSS supervisor checklists to demonstrate improvements in both facility readiness predictors and quality service delivery outcomes for managing patients with fever or conducting antenatal consultations. Working across three countries, Bernard et al. demonstrated how facility readiness predicts health worker competence and can improve the quality of care. Other contributions to the supplement examined the impact of the OTSS package for improving malaria services for pregnant women, enhancing the community management of febrile illness, and advocating effectively to improve the management of severe malaria in hospital settings.

Together, these accounts demonstrate how an approach based on multiple integrated implementation strategies can improve facility readiness and health worker competence to deliver quality malaria services. The evolution of the approach, its expansion to address facility-based case management as well as other malaria interventions, and its success across multiple transmission settings and health systems in nearly a dozen countries attest to the adaptability of OTSS based on local needs and priorities. By emphasizing OTSS consistently across multiple funding cycles, PMI, Impact Malaria, and their national malaria program partners have also demonstrated how quality continues to improve over time as health facilities and providers receive additional visits. These are lessons that will inform the scale-up and sustainability of the approach. Although the reports in this supplement stop short of documenting health impact at a population level, they answer critical questions about how to deliver malaria interventions that are well proven and recommended.

Since 2001, scale up of malaria interventions has had a substantial impact, reducing prevalence of infection by 40% across the African continent by 2015. Although the major part of this impact was attributed to massive campaigns distributing bed nets, improved case management still accounted for 19% of this historic progress, and its relative contribution was highly dependent on the coverage of prompt, effective treatment. A major challenge to improving the coverage and quality of malaria services is that information hasn’t regularly been collected to guide or monitor relevant outcomes, apart from national surveys at the household and health facility levels. Even when questions about care seeking or quality-of-care indicators are included in demographic and health surveys, malaria indicator surveys, and service provision assessments, these are limited, occurring at irregular intervals of 3 to 5 years or longer and only in specific geographic areas. In addition, population-based surveys nearly always use childhood fever as a proxy for malaria, an approach that was devised before universal parasitological diagnosis became a standard of care. They have been revised since, only to include limited details about the care those children received, such as whether they received a finger prick or heel stick, and whether they received an ACT. These measures are further limited by patients’ or parents’ recall and reporting. More contemporary standard measures reflecting current malaria case management practice have not been developed to monitor or improve malaria diagnosis and treatment.

The availability of routine parasitological diagnosis is beginning to transform health information systems by providing data on testing rates and confirmed malaria cases. These data are enabling endemic country health officials to track malaria burden at subnational levels and tailor their interventions based on local trends. Global malaria partners have responded by issuing guidance for subnational targeted programs. But these routine systems still fail to capture information on the quality of case management. They also seldom capture information about the age (apart from disaggregating cases among children under 5 years), gender, pregnancy status, or travel history of respondents. Malaria programs interested in cases among school-age children, pregnant women, or young men who may have acquired malaria while migrating for employment have had to devise parallel systems to track trends in these populations. In many malaria surveillance evaluations, only cases that receive a parasitological test are reported as suspected cases, making it difficult for program managers to monitor whether all potential cases have been tested.

The contributions from PMI Impact Malaria partners in this supplement demonstrate one approach to overcoming the limitations of routine surveillance and intermittent national surveys. The checklists that supervisors completed during OTSS visits have been exploited as sources of more continuous data on the fidelity of case management service delivery, collected from all participating health facilities. In doing so, the PMI Impact Malaria experience with OTSS may be much more than a promising quality improvement initiative adapted and applied in settings across multiple countries. It also suggests a model for monitoring the quality and availability of malaria services, something malaria programs across endemic, eliminating, and malaria-free countries can incorporate into their own supervision and support strategies. Individual and composite indicators of readiness and competence derived from supervision checklists allow for comparisons of quality services across settings and over time. Such indicators have been lacking as the nature of malaria case management has evolved over the past few decades. Scaling up OTSS and approaches like it stand to address persisting gaps in service quality as well as malaria...
information systems that incorporate indicators addressing current case management standard practices.

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Annual Meeting
BE AT THE FOREFRONT
The Annual Meeting is a dynamic international forum for the exchange of the latest scientific and clinical advances in tropical medicine and global health. It draws approximately 4,800 professionals representing academia, foundations, government, not-for-profit organizations, non-governmental organizations, the private sector, military and private practice.

Journal
LATEST SCIENCE AT YOUR FINGERTIPS
All members receive free digital access to the American Journal of Tropical Medicine and Hygiene and members-only discounts on author fees.

Education
STRIVING FOR EXCELLENCE
- Clinicians can sit for the Certificate of Knowledge in Clinical Tropical Medicine and Travelers’ Health Examination (CTropMed® Program). The CTropMed® program recognizes individual excellence in training and knowledge in clinical tropical medicine and travelers’ health.
- Applications are limited to members for the FASTMH, recognizing sustained professional excellence in tropical medicine/global health, hygiene and related disciplines.
- CTropMed, the ASTMH Global Online Tropical Medical Education website, is a members-only benefit offering online talks and presentations by world experts in tropical medicine, hygiene and global health.

Networking
BUILD YOUR PROFESSIONAL NETWORK
Connect with respected leaders in the field. Whether in person at the Annual Meeting, through the Society’s five subgroups or social media, members stay in touch to share the latest data, engage in scientific discourse and collaborate on Society activities.

Advocacy
MAKE YOUR VOICE HEARD IN WASHINGTON, DC
ASTMH advocates for strong U.S. funding for and adoption of evidence-based policies that promote tropical medicine and global health.

BE PART OF THE GLOBAL HEALTH COMMUNITY
All members receive reduced rates to attend the Annual Meeting, Pre-Meeting Courses, the Update Course and to sit for the CTropMed® examination.