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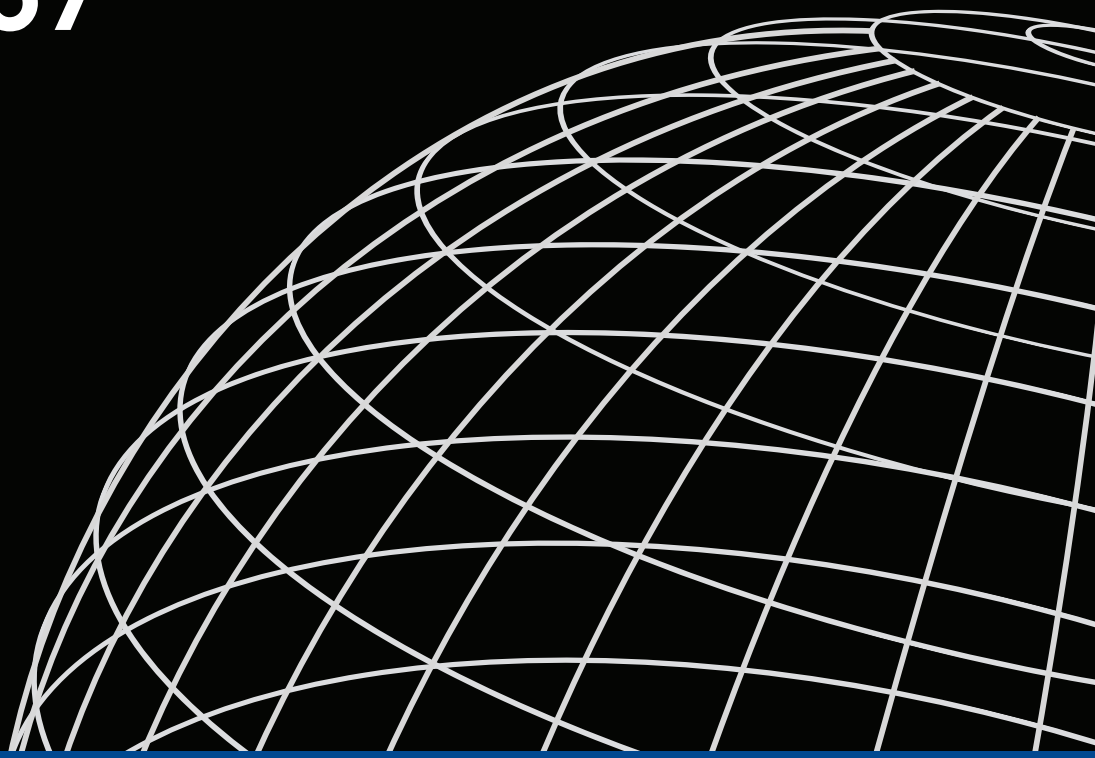

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Gaps in Service Utilization and Service Provision: An Analysis of DHS and SPA Malaria Data from Malawi, Senegal, and Tanzania

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1 INTRODUCTION

Barriers to the prompt and effective diagnosis and treatment of malaria exist at both the community and health facility level. Household surveys measure malaria case management at the population level with standard indicators that assess treatment-seeking behavior, access to diagnostic testing, and access to appropriate treatment. Performance on these indicators varies widely from country to country. Among countries with Demographic and Health Surveys (DHS) or Malaria Indicator Surveys (MIS) completed between 2014 and 2016, advice and treatment was sought for a median of 47% of children under age 5 with fever [1].

Although there are nearly universal policies for the diagnostic confirmation of suspected malaria cases, a median of only 52% of children with fever had blood taken from their finger or heel for testing, which is a proxy for malaria testing. Despite its importance within the case management strategy, access to diagnostic testing has not expanded at the same rate as access to prevention efforts [2]. As malaria cases have increased, the number of malaria rapid diagnostic tests (mRDTs) distributed to National Malaria Control Programs (NMCPs) in Sub-Saharan Africa decreased by 19% between 2015 and 2016. This could be due to the timing of orders, and fewer orders by programs in a year after greater commodities were available [1]. During the same period, countries procured a greater number of artemisinin-based combination therapy (ACT) treatment courses. Among children with fever who received any antimalarial treatment in 2014-2016, 54% received an ACT, the recommended first-line treatment; the percentage had increased from 39% during the 2010-2012 survey period [1].

To achieve universal access to malaria diagnosis and treatment, it is essential to know the types of facilities in endemic countries where the population seeks care and the malaria service readiness of these facilities. To investigate the gaps between the seeking and provision of malaria services, this study examines malaria service utilization data in children under age 5 with fever from the household-based Demographic and Health Survey (DHS) and provision of care data from the facility-based Service Provision Assessment (SPA) from Malawi, Senegal, and Tanzania. Facilities categorized as “malaria service ready” were those with 1) personnel trained in either mRDT, microscopy, or case management and treatment of malaria in children, 2) national guidelines for the diagnosis and treatment of malaria, 3) diagnostic capacity with valid mRDT tests and microscopy equipment, and 4) unexpired ACTs available on the day of the survey. Facility types were harmonized by managing authority and facility level between the DHS and SPA surveys to examine the types of facilities where individuals seek care and the malaria service readiness of the facilities. To explore the variation in malaria service readiness by malaria transmission in each country, geographic coordinate data collected during survey fieldwork were used to stratify the SPA facilities by malaria prevalence. All of this information provides a more detailed description of where malaria specific training and services should be targeted when working in limited resource settings.

Understanding the service readiness and service readiness gaps of facilities is essential, particularly when new policies are introduced, such as the World Health Organization (WHO) policy for the diagnostic confirmation of suspected cases and treatment of cases with ACT [3]. Prior research has identified both progress and gaps in malaria service readiness. For example, innovations in rapid diagnostic testing lead to increased financing and massive increases in the procurement of mRDTs. However, availability of these commodities is only the first step. The procurement of mRDTs without reinforcement of other factors, such

as an efficient delivery system and staff who are trained to perform the tests, interpret the results, and treat the patient accordingly does not result in facilities that are malaria service ready [4].

Service readiness naturally affects the quality of care. Studies across Sub-Saharan Africa after malaria case management policy changes have identified barriers [5] to malaria service readiness. This research has shown that although there have been improvements in case management over time, the quality of care remains inadequate [6,7]. Different interpretations of the new policy for administering Artemether+Lumefantrine (AL) for uncomplicated malaria were found in Angola, where local malaria control staff enhanced training materials to improve understanding of the new policy and to provide more precise directions for health workers who conducted consultations[8]. After the introduction of AL as the first-line antimalarial in Kenya, one study confirmed the widespread availability of AL, and gaps in the availability of age-specific dosages, as well as a shortage of posted guidelines and staff who had received in-service training on the new case management guidelines [9]. In contrast, a malaria health facility survey in Malawi found that most facilities had staff trained in case management but lacked both ACTs and essential equipment such as microscopes and thermometers [10]. A survey of public health facilities in Sudan, conducted 5 years after the transition from chloroquine to ACTs as the recommended first-line antimalarial, found gaps in ACT availability, in-service training, job aids, and supervision [11].

The managing authority plays a definite role in malaria service readiness[5]. Although the private sector in some countries may be more sophisticated than the public sector and may serve as a primary source of fever treatment, mRDT availability was found to be poorer in the private sector in nine of 10 countries in a 10-country survey [12]. This diminished availability was a barrier to the goal of universal diagnosis. Studies in both Uganda and Somalia, where fever treatment is primarily sought through the private sector, found that private sector providers prescribed treatments that did not conform with the national policy [13], although Ugandan facilities had a high availability of ACTs [14].

As this report describes, facility level is also a determinant of malaria service readiness. Historically, lower-level facilities do not have sufficient diagnostic capacity because of lack of microscopes or specialized staff who are trained in microscopy. However, the introduction of mRDTs has removed a barrier for service readiness for lower-level health facilities, because these tests make parasitological diagnosis feasible at lower levels and lead to improved targeting of malaria treatment [15]. In addition, it has been widely shown that low level care providers such as community health workers, when appropriately trained and supervised, are capable of delivering high quality care for uncomplicated malaria cases with mRDTs to diagnose cases [16] and administration ACTs for treatment [17,18]. Twenty-six malaria-affected countries have adopted the WHO policy of integrated community case management (iCCM), through which malaria can be treated at the community level and outside of health facilities[1]. While in some settings, care for fever cases is widely sought through iCCM, this report examines only facility-based care-seeking because the SPA survey is facility-based [19].

In analyzing service readiness by malaria endemicity, this report uses an approach similar to a study that examined health system readiness by malaria endemicity in Kenya, Namibia, and Senegal. This study demonstrated an increase in service readiness with increasing malaria endemicity in rural areas, and no relationship between endemicity and service readiness in the urban areas [5]. A study in the lower endemicity setting of Vanuatu demonstrated the importance of service readiness in countries that are striving to eliminate malaria [20].

This prior research demonstrated the importance of and barriers to malaria service readiness as related to the goals of universal access to diagnosis and treatment, particularly during the period of 2006-2010 when many of the current policies on diagnosis and treatment were initially implemented. Since barriers still exist, this report takes the analysis a step further by using existing data from household and facility surveys to analyze service readiness among the facilities where treatment-seeking for malaria actually occurs. The results will allow for better prioritization of interventions that can improve service readiness in the facilities where, as determined by their utilization, there is the greatest need.

2 COUNTRY PROFILES

2.1 Malawi

2.1.1 Malaria profile

Malaria is hyperendemic in 95% of Malawi. In most of the country, transmission occurs year round, with peaks after the beginning of the annual rains in November. Transmission is highest in lowland areas that are hotter, wetter and more humid, particularly around the lakeshore. In the 2017 Malawi MIS, 24% of children under age 5 tested positive for malaria by microscopy [21]. *P. falciparum* accounts for 98% of malaria infections and all severe cases and malaria deaths [22].

2.1.2 Health system

Care through the public health system in Malawi is delivered at primary, secondary, and tertiary levels. Facilities at the primary level include health posts, dispensaries, maternity facilities, health centers, and community or rural hospitals where primary and preventive care services are provided primarily by community health workers. Secondary level care is provided at district hospitals, which serve as referral facilities that provide inpatient and outpatient services. Central hospitals that provide tertiary level services are referral hospitals for the district hospitals. With decentralization, the health system gave authority to the district health management teams to deliver secondary and primary health services in the district [23].

In addition to the public sector facilities, private sector facilities in Malawi include not-for-profit and for-profit facilities. Private not-for-profit facilities include independent church-affiliated facilities that belong to the Christian Health Association of Malawi (CHAM) and are primarily located in rural areas. These facilities charge user fees for care other than basic preventive and curative care services for which they are contracted by District health officers to provide free of charge. The private for-profit sector also operates health facilities and health programs. The public sector supports private sector facilities and faith-based organizations (FBOs) by providing staff training, public sector staffing for facilities, supervision, medicines, and vaccines [23].

2.1.3 Case management

Malawi's national malaria policy states that mRDTs should be performed on all patients suspected of having uncomplicated malaria in order to obtain parasitological confirmation before beginning treatment [24]. Since the policy was adopted in 2010, mRDTs have been distributed to all facilities. The NMCP's goal is broadening access to testing and treatment services by increasing the number of village clinics.

In 2007, the NMCP implemented a policy that recommended ACT as the treatment for uncomplicated malaria. Artemether+Lumefantrine (AL) is the recommended first-line ACT. For patients with symptoms of severe malaria, pre-referral treatment begins immediately with artesunate, followed by microscopy testing (if possible) or mRDT, and then referral to a hospital for treatment with parenteral artesunate. In areas more than 5 km from a health facility, health surveillance assistants (HSAs) conduct integrated community case management (iCCM), in which they conduct mRDTs, treat children under age 5 with ACT, and administer pre-referral artesunate to children with symptoms of severe malaria [24].

2.2 Senegal

2.2.1 Malaria profile

Malaria is endemic throughout Senegal with the country divided into two epidemiological zones. In the tropical zone, transmission is year-round, with peaks during the rainy months. In the Sahelian zone, transmission is lower, with the highest transmission during October and November, which are at the end of the rainy season, and small outbreaks in the low transmission season [25]. Malaria testing with microscopy in the Continuous DHS, 2016 among children age 6-59 months found malaria prevalence to be 1% [26]. Ninety-nine percent of infections are due to *P. falciparum* [27].

2.2.2 Health system

The operations of Senegal's health system are implemented at the district level. Each of the 76 health districts has at least one health center, which is a secondary health facility with a medical team that provides direct care and oversees the district's prevention efforts. Health centers are attached to the district's health posts, staffed by a nurse or midwife, which generally serve as the first level of contact with the population. Health posts are responsible for a number of health huts, which have trained community health workers and the necessary structure and equipment for providing basic services that include the diagnosis and treatment of uncomplicated malaria. Since 2008, community case management of malaria can be provided by home care providers, who are lower-level community health workers who work from their own homes rather than in a specific health facility.

Tertiary facilities include hospital centers that provide specialized care. These hospitals, which are found at the regional, departmental or communal level, typically provide care coverage for approximately 150,000 residents. There are also seven national hospital centers in Dakar. The health system has a network of regional pharmacies that supply the facilities and care providers of the corresponding regions. These regional pharmacies receive supplies from the national pharmacy. In addition to public sector facilities, there are also a number of private clinics and health posts throughout the country [27].

2.2.3 Case management

Case management guidelines in Senegal specify that all suspected malaria cases should be confirmed with mRDTs, and that all uncomplicated cases be treated with ACT [19]. The algorithm became slightly more complicated during 2015 and 2016, when it was specified that all children under age 5 with fever should be tested for malaria (irrespective of symptoms of other illness), and that febrile patients over age 5 should be tested only if they showed no symptoms of other illness. In 2017, the policy required testing all febrile patients with mRDT, regardless of other symptoms [25].

In 2006, AL became the first-line treatment [28]. The mRDTs and ACTs are provided free-of-charge by the public health system. For severe cases, patients identified at the community or health post level are given pre-referral rectal artesunate and then referred to a health center or hospital. At the health center or hospital level, patients with severe malaria should be treated with injectable artesunate, which is then followed with oral ACT.

The goal of the NMCP is to reach pre-elimination, which is defined as an annual incidence of fewer than 5 cases per 1,000 by 2020. Since the incidence varies throughout the country, all interventions are targeted

by incidence. In districts with higher incidence, a proactive community case management strategy, in which a community health worker conducts a weekly door-to-door sweep of the village to seek out fever cases, is used to detect symptomatic cases early and to provide prompt case management [29]. The districts with the lowest incidence districts use focal screen and treat, focal test and treat, and focal drug administration strategies.

In addition, the strategy in pre-elimination areas involves the training of laboratory technicians on the Loop-Mediated Isothermal Amplification (LAMP) technique for molecular-level diagnosis, and the Real-Time Quantitative Reverse Transcription Polymerase Chain Reaction (qrt-RTPCR) at the central level [27].

2.3 Tanzania

2.3.1 Malaria profile

In the Tanzania Mainland, 95% of the population lives in high-risk malaria areas. The Tanzanian population is the third largest population at risk of stable malaria in Africa, with 59% of the population living in hypo-endemic areas (where parasitemia is <10%), and 41% in meso, holo, or hyper-endemic areas (where parasitemia is >10%) [30]. Transmission peaks seasonally at the end of the rainy season, which is in March and April in the Central and Southern areas of the country with a single rainy season and in November and again in April in the Eastern, Northern, and Western areas that have bimodal rainfall that is spread over a long period [30]. The 2017 Tanzania MIS performed mRDT testing and found the malaria prevalence among children age 6-59 months to be 7%.

The Zanzibar Malaria Elimination Program (ZAMEP) began focusing on malaria elimination after a 2009 assessment found that local transmission could be reduced to zero through universal coverage of vector control and the establishment of a case surveillance system [31]. The prevalence of malaria from the 2017 Tanzania MIS in both Unguja and Pemba is <1%, which is similar to findings from the DHS, MIS, and other ZAMEP surveys, which determined that prevalence has remained stable since 2007 with no epidemics occurring during that time.

In both Tanzania Mainland and Zanzibar, more than 95% of malaria cases are *P. falciparum.*

2.3.2 Health system

A central district government structure is the basis of Mainland Tanzania's National Health System. In this structure, the Ministry of Health and Social Welfare (MoHSW), the President's Office of Regional Administration, and the local government share the responsibility for the delivery of public health services. The central level develops policies and guidelines, which are implemented by the regional health teams. Health facilities include dispensaries, health centers, and hospitals, which operate in a hierarchical manner. The health facilities may be administered by the government, faith-based voluntary organizations, or other private organizations, and may be parastatal in nature. Dispensaries at the primary level in villages serve between 6,000 and 10,000 residents, secondary level health centers serve between 50,000-80,000 in a ward, and district hospitals provide tertiary level care for more than 250,000 residents and refer cases to the regional and consultant hospitals.

In Zanzibar, health services are delivered through public, private (both for-profit and non-profit), and government health facilities, some of which are administered by military or defense forces. In the

hierarchical system in Zanzibar, primary level care is provided at primary health care units (PHCUs) and primary health care cottages (PHCCs) that also provide inpatient care and x-ray services. At the secondary level, the district and regional hospitals provide care. Specialized hospitals provide care at the tertiary level. Under the policy of devolution, the provision of public health services, particularly preventive services, has been delegated to district health management teams in Zanzibar's 11 districts.

2.3.3 Case management

As malaria prevalence decreases, the malaria strategic plan for Mainland Tanzania aims to "ensure that symptoms and signs of malaria in the general population are recognized early and that appropriate management is provided promptly at the individual, family, community, and facility levels." All individuals with signs and symptoms of malaria should have access to appropriate, timely malaria diagnosis and treatment, with special emphasis on biologically and socioeconomically vulnerable populations. To ensure universal access, the government policy requires that all suspected cases in both the public and private sectors are confirmed by a diagnostic test. The government seeks to provide "high-standard, accessible, affordable, equitable, and quality assured testing" through the public sector, ensuring that diagnostics are affordable to public sector patients through a global partnership mechanism. At the same time, the government aims to facilitate this kind of testing through the establishment of alternative malaria testing points outside of facilities, which include accredited dispensing drug outlets (ADDOs) and community-based services like iCCM which provide subsidized malaria diagnostics that are regulated by the government.

For treatment, the government seeks to provide "highly efficacious, accessible, affordable, equitable, and quality-assured antimalarials" through the public sector, and to facilitate their provision in the private sector. The ACTs (with AL as the first-line treatment) are the recommended treatment for uncomplicated malaria cases and are provided free in public facilities for vulnerable groups [32]. Private sector facilities are encouraged to offer ACTs at the lowest possible price. Private markets provide presumptive treatment and sell ineffective antimalarials, which violate national policy. The establishment of ADDOs and the subsidization of ACTs attempt to address both these issues. Injectable artesunate is the recommended treatment for severe malaria.

In Zanzibar, the policies of diagnostic confirmation and treatment with ACT concur with those of the Mainland. Instead of AL, Artesunate+Amodiaquine (ASAQ) is the first-line antimalarial, with the addition of Primaquine as a gametocytocidal drug. A surveillance system established to pursue elimination rapidly detects a high proportion of all new malaria infections. In addition, the passive case detection system, which is treatment-seeking at health facilities, must detect and treat imported infections. To accomplish this, there has been an additional focus on improving prompt health-seeking behavior. The malaria epidemic early detection system has been expanded to include an existing mobile phone case reporting system that includes all public and private facilities through which malaria has become a notifiable disease. With these systems, each parasitologically confirmed case is evaluated through a case investigation to determine the source of the malaria infection and the possibility of onward transmission. For locally acquired infections, active case detection activities and investigation of vector control activities are pursued. For imported cases, neighboring households are alerted and asked to report any suspected malaria cases. To address asymptomatic cases in the case of active foci for transmission, mass drug administration campaigns are also implemented.

3 METHODS

3.1 Overview of SPA and DHS surveys

3.1.1 Service Provision Assessment surveys

Service Provision Assessment (SPA) surveys are sample surveys of formal-sector health facilities. Pharmacies and individual doctors' offices are usually not included in SPA surveys. Typically, the SPA surveys collect data from 400-700 facilities, which have been selected from a comprehensive list of health facilities in a country (sampling frame), categorized by facility type, managing authority (public and non-public), and region. The sample provides indicators at the national level for the different facility types and managing authority, as well as aggregate indicators at the regional level. The SPA surveys can also be conducted in a census of facilities, depending on the total number of facilities in the country.

Hospitals are oversampled because of their small numbers in a country. Subsequently, the data are weighted during analysis to ensure that the data are proportionally representative. To do this, the sample weight is applied to the data to ensure that the contribution of facilities to the total is proportionate to their share in the country.

The SPA surveys utilize four main questionnaires: 1) inventory questionnaires, 2) health worker or provider questionnaires 3) observation protocols and 4) exit interview questionnaires.

The SPA surveys are typically administered by 10 to 15 teams, with each including three to four interviewers, who are usually health workers. The interviewers collect data from the most knowledgeable person(s) available for each service with the inventory questionnaire. Specific sections of the inventory questionnaire assess the laboratories and pharmacies in these health facilities. A key feature of the inventory questionnaire is that interviewers verify the existence of specific items such as medicines and commodities.

Within a facility, the team interviews health providers with the health worker or provider interview questionnaire. The sample of health providers is taken from the providers who are present in the facility on the day of the survey. In each facility, the aim is to interview seven to eight providers about the range of services they provide, in-service training or training updates, and working conditions at the facility.

Using observation protocols, the interviewers observe client-provider consultations for three priority services: antenatal care (ANC), family planning, and the curative care of sick children. The number of consultations observed depends on the number of providers and clients in the facility that day. Interviewers also use the client exit interview questionnaire to interview clients who were observed and are leaving the facility.

3.1.2 Demographic and Health Surveys

The Demographic and Health Surveys (DHS) are nationally representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. The DHS surveys have large sample sizes (usually between 5,000 and 30,000 households) and are conducted about every 5 years to allow comparisons over time.

The sample is generally representative at the national, residential (urban or rural), and regional level. The survey utilizes a stratified two-stage cluster design. During the first stage, enumeration areas (EA) are drawn from a census file. In each EA selected, the second stage involves drawing a sample of households from an updated list of households. The DHS surveys are typically implemented by the national statistical office in a country with data collection typically lasting between 5 to 6 months.

In malaria-endemic countries, many DHS surveys include questions about malaria that are included in the Household and Women's Questionnaires. These questions generate data that can be used to assess progress in the core household malaria indicators that are detailed in the Roll Back Malaria Partnership to End Malaria (RBM) Household Survey Indicators for Malaria Control guidance document [33].

The Household Questionnaire lists all household members and determines their eligibility for interviews and biomarker testing. Questions about household characteristics, such as ownership and the use of mosquito nets, are included in the Household Questionnaire.

The Women's Questionnaire is used for interviewing women of reproductive age about a recent birth history, pregnancy status, and use of intermittent preventive treatment of malaria during pregnancy. The Women's Questionnaire also collects information about each woman's children under age 5, such as care-seeking, diagnostic testing, and access to prompt treatment with antimalarials for children with reported fever.

3.1.3 Harmonization of health facilities between DHS and SPA

Facilities listed in the Women's Questionnaire as a source for care-seeking for recent fever in the DHS and facilities sampled in the SPA were harmonized to allow for comparisons between seeking and the provision of malaria services at specific facility types. Generally, the DHS questionnaire groups facilities by public, religious, private, and other sources, while the SPA categorizes facilities by managing authority (government, private, NGO, religious) and facility level (hospital, health center, dispensary, clinic). The facility types were harmonized (considering managing authority and facility level) between the DHS and SPA surveys in order to examine the types of facilities where individuals seek care and the malaria service readiness of those facilities. Efforts were made to group facilities by facility level, although this was not possible in all cases due to sample size. This is more apparent in the groupings of facilities at the lower district or village level.

One disadvantage of the SPA surveys is that the data do not provide a complete picture of the health service environment. The SPA surveys do not include private health care providers (individual doctors, private pharmacies), community-based care (CHWs who provide iCCM), or those in the informal health care sector such as traditional healers, markets, and shops. Since the DHS includes options for private healthcare providers and informal healthcare providers in the questionnaire options for antimalarial treatment, it is impossible to compare these facilities to the data in the SPA. In this report, private healthcare providers and those in the informal healthcare sectors are identified as "any other source" in the analysis tables.

3.2 Data

To investigate the gaps between the seeking and provision of malaria services, we examined malaria service utilization data in children under age 5 with fever from the household-based DHS surveys and provision of

care data from the facility-based SPA surveys conducted in Malawi, Senegal, and Tanzania. These countries were included in the analysis because the fieldwork for each country's DHS and SPA surveys was completed within 1 year of each other. Surveys included the 2013-14 Malawi SPA and 2015-16 Malawi DHS, 2016 Senegal Continuous SPA and 2016 Senegal Continuous DHS, and the 2014-15 Tanzania SPA and 2015-16 Tanzania DHS-MIS.

To explore if malaria service readiness varies by level of malaria transmission in each country, geographic coordinate data collected during fieldwork were used to stratify SPA facilities by malaria prevalence. Facilities in each country were stratified into two equal frequency groups (low and high malaria risk categories) based on *Plasmodium falciparum (Pf)* parasite prevalence rates among children age 2-10 ($PfPR_{2-10}$) from the Malaria Atlas Project (MAP). The MAP provides a spatial data layer that describes the estimated proportion of children age 2-10 in the general population infected with *Pf* at any one time, and then averaged over the 12 months of 2015. The SPA data include geospatial locations for the actual location of the healthcare facility, which permits linkage of MAP data with the SPA data.

3.2.1 Malawi

The 2015-16 Malawi DHS, which was conducted between October 19, 2015 and February 17, 2016, is a population-based household survey that provides representative estimates for the country as a whole, for urban and rural areas, and for each of the three regions and 28 districts of Malawi. All women age 15-49 in the selected households were eligible for an individual interview, in which information was collected about care-seeking for their children under age 5 with recent fever. A total of 4,774 children under age 5 had a reported fever in the 2 weeks before the survey.

Although most SPA surveys select a representative sample of health facilities, the 2013-14 Malawi SPA was a census of all formal-sector health facilities in Malawi. The Central Monitoring and Evaluation Division (CMED) of the Malawi Ministry of Health (MoH) provided a master list of 1,060 such facilities. Data were collected from 977 facilities, due to the non-response of some health facilities. The results are representative at the national level, by facility type and managing authority, and for three regions. The fieldwork was conducted in two phases between June 11 to August 20, 2013 and November 13, 2013 to February 7, 2014.

Facility categories were harmonized between the DHS and SPA, as shown in Table 1. The facilities were classified as government hospital, government health center, government health post or mobile clinic, private facility, Christian Health Association or mission and faith-based, and other sources. Informal providers reported in the DHS were grouped into "any other sources." There is no equivalent category in the SPA because it focused on formal-sector facilities.

Table 1 Malawi standardized health facilities

Standardized Name	2015-16 Malawi DHS Facilities	2013-14 Malawi SPA Facilities
Government hospital	Government hospital	Government/public: central hospital Government/public: district hospital Government/public: rural/community hospital Government/public: other hospital
Government health center	Government health center	Government/public: health center
Government health post or mobile clinic	Government health post/outreach Government has Government mobile clinic	Government/public: maternity Government/public: dispensary Government/public: clinic Government/public: health post
Private facility	Private hospital/clinic Private pharmacy Private doctor Private mobile clinic Private fieldworker/chw Other private medical sector	Private for profit: other hospital Private for profit: health center Private for profit: maternity Private for profit: dispensary Private for profit: clinic NGO: other hospital NGO: health center NGO: clinic Company: health center Company: dispensary Company: clinic
Christian health association/ mission/faith-based[1]	CHAM/mission hospital CHAM/mission health center	CHAM: rural/community hospital CHAM: other hospital CHAM: health center CHAM: maternity CHAM: dispensary CHAM: clinic CHAM: health post Mission/faith-based (other than CHAM): Other hospital Mission/faith-based (other than CHAM): Clinic
Any other source	BLM Shop Traditional practitioner Market Itinerant drug seller Youth drop-in center Other	No SPA equivalent

[1]CHAM= Christian Health Association of Malawi.
[2]BLM= Banja La Mtsogolo (program established by Marie Stopes International).

In Malawi, the malaria prevalence (*Pf*PR$_{2-10}$ rate) for the geographic locations of SPA facilities ranged from <1% to 37%. Facilities were stratified at the median prevalence of 10.2%, which resulted in 471 facilities in the low-risk group and 506 facilities in the high-risk group.

3.2.2 Senegal

In 2012, the Senegal Continuous DHS and Senegal Continuous SPA were launched to respond to the ongoing need for more frequent data for planning, monitoring, and evaluating health and population programs, and to serve as a pilot of the continuous model in an African country. For both the Senegal Continuous DHS and SPA, data were collected each year from 2012 through 2017 with reduced standard questionnaires. Fieldwork for the two surveys was conducted in two waves of 4 months each during the

course of each year, for a total of 8 months each year. For this report, we analyzed the 2016 Senegal Continuous DHS and 2016 Senegal Continuous SPA data.

The 2016 Senegal Continuous DHS is a population-based household survey that provides representative estimates for the country as a whole, for urban and rural areas, and for each four aggregated geographic "grand regions." Fieldwork was conducted between March 1 and November 25, 2016. All women age 15 to 49 in the selected households were eligible for individual interviews, in which information was collected about the care-seeking of their children under age 5 with recent fever. A total of 740 children under age 5 had a reported fever in the 2 weeks before the survey.

The Senegal Continuous SPA was a census of all formal-sector health facilities in Senegal over the five-year period of the continuous survey. Each year, the results are representative at the national level, and for facility type, managing authority, and the country's 14 administrative regions. In 2016, the sample included 50% of all hospitals and health centers and 20% of all health posts, along with their associated health huts. Given the limited nature of services provided by health huts, they are not included in the national totals in the Senegal Continuous SPA final report. However, health huts are included in this analysis in order to develop a complete picture of malaria service readiness in Senegal. Similar to the 2016 Senegal Continuous DHS, fieldwork for the 2016 Senegal Continuous SPA was conducted between March and October, 2016.

Facility categories were harmonized between the DHS and SPA, as shown in Table 2. Facilities were classified as government hospital or health center, government health post or mobile clinic, government health hut, private facility, and any other source. Informal providers reported in the DHS were grouped into "any other sources." There is no equivalent category in the SPA because it focused on formal-sector facilities. Due to low numbers of individuals seeking care for fever at government hospitals, government hospitals and health centers were combined to generate an adequate sample size for analysis.

Table 2 Senegal standardized health facilities

Standardized name	2016 Senegal Continuous DHS Facilities	2016 Senegal Continuous SPA Facilities
Government hospital or health center	Government hospital Government health center	Government/public: hospital Government/public: health center
Government health post or mobile clinic	Government health post Government mobile team	Government/public: clinic
Government health hut	Other public sector Country specific public sector	Government/public: case de santé
Private facility	Private hospital/clinic Private pharmacy Private community health worker Other private medical	NGO/private not for profit: hospital NGO/private not for profit: health center NGO/private not for profit: clinic Private for profit: hospital Private for profit: health center Private for profit: clinic
Any other source	Shop Traditional practitioner Country specific other sector Other	No SPA equivalent

In Senegal, the malaria prevalence (*Pf*PR_{2-10} rate) for the geographic locations of SPA facilities ranged from <1% to 24%. Facilities were stratified at the median prevalence of 2.4%, which resulted in 211 facilities in the low-risk group and 238 in the high-risk group.

3.2.3 Tanzania

The 2015-16 Tanzania DHS-MIS is a population-based household survey that provides representative estimates at the national level, for urban and rural areas in the country as a whole and the mainland, at the zonal level, and for some, but not all indicators, estimates at the regional level. The 2015-16 Tanzania DHS was conducted between August 22, 2015 through February 14, 2016. All women age 15-49 in the selected households were eligible for individual interviews, in which information was collected about the care-seeking of their children under age 5 with recent fever. In total 1,706 children under age 5 had a reported fever in the 2 weeks before the survey.

The 2014-15 Tanzania SPA was designed to be a sample of all formal-sector health facilities in Tanzania. A master list of health facilities with 7,102 verified (active) health facilities in Tanzania was obtained from the Ministry of Health and Social Welfare (MoHSW) in Tanzania Mainland and the Ministry of Health (MoH) in Zanzibar. Of the 7,102 active health facilities, a sample of 1,200 facilities was selected for the survey, which was designed to provide nationally representative results by facility type, managing authority, and regionally representative results for the 25 Tanzania Mainland regions and the 5 Zanzibar regions, for a total of 30 survey regions. Fieldwork was conducted between October 20, 2014 through February 21, 2015. Some facilities were revisited because they were not included in Dar es Salaam from March 2 to 13, 2015.

Facility categories were harmonized between the DHS and SPA as shown in Table 3. Facilities were classified into government hospital, government health center, government clinic/dispensary, private facility, mission or faith-based, and other sources. Informal providers reported in the DHS were grouped into “any other sources.” There is no equivalent category in the SPA because it focused on formal-sector facilities.

Table 3 Tanzania Standardized Health Facilities

Standardized Name	2015-16 Tanzania DHS-MIS Facilities	2014-15 Tanzania SPA Facilities
Government hospital	National/zonal referral/specialized hospital Referral regional hospital Regional hospital District hospital	Government/public: national referral hospital Government/public: regional hospital Government/public: district hospital Government/public: district-designated hospital Government/public: other hospital Parastatal: regional hospital Parastatal: other hospital
Government health center	Public health center	Government/public: health center Parastatal: health center
Government Clinic/dispensary	Public clinic Public dispensary Public chw	Government/public: clinic Government/public: dispensary Parastatal: dispensary
Private facility	Private hospital Private specialized hospital Private health center Private clinic Private dispensary	Private: other hospital Private: health center Private: clinic Private: dispensary
Mission/faith-based	Religious/voluntary referral spec. hospital religious/voluntary hospital religious/voluntary district hospital religious/voluntary health center religious/voluntary clinic religious/voluntary dispensary	Mission/faith-based: national referral Mission/faith-based: regional hospital Mission/faith-based: district hospital Mission/faith-based: district-designated hospital Mission/faith-based: other hospital Mission/faith-based: health center Mission/faith-based: clinic Mission/faith-based: dispensary
Any other source	Pharmacy ADDO[1] NGO Other	No SPA equivalent

[1]ADDO: Accredited Drug Dispensing Outlet.

In Tanzania, the malaria prevalence (*Pf*PR$_{2-10}$ rate) for the geographic locations of SPA facilities ranged from <1% to 23%. Facilities were stratified at the median prevalence of 5%, which resulted in 589 facilities in the low-risk group and 599 in the high-risk group.

3.3 Definition of Key Variables

Indicators in the Service Provision Assessment Survey (SPA)

The SPA indicators included in this analysis examine the following: availability of malaria-related services, trained personnel, national malaria diagnosis and treatment guidelines, mRDT protocol, and relevant supplies, along with malaria diagnostic capacity, antimalarial availability, and malaria service readiness. For a more detailed description of the indicator construction, see Appendix A.

3.3.1 Service availability

The availability of a basic package of malaria health services is an essential component of malaria control and prevention at the facility level. In the SPA survey, health facility supervisors at all facilities were asked about the availability of client services. These services can include the diagnosis and treatment of malaria, curative care for sick children, and preventive services offered through ANC, all of which are relevant for malaria. However, this report focuses on the diagnosis and treatment services and the curative care for sick

children. For the remainder of this report, unless otherwise specified, the term facilities refer to those that offer malaria diagnosis/treatment or sick child curative services.

In high transmission settings, children under age 5 are one of the groups that are most vulnerable to malaria. The SPA is a useful tool for assessing the capacity of institutions to provide malaria diagnosis and treatment services, and curative care for sick children in malarious areas. Curative care includes performing diagnostic tests for malaria according to WHO recommendations in order to provide timely and effective treatment to those with positive test results [3]. In the case of severe malaria, the SPA is limited in its ability to provide a complete picture of a facility's capacity to provide proper pre-referral treatment. While information is collected on facilities with artesunate injections, little is known about the training of providers on the treatment of severe malaria.

In addition to the reported availability of services, interviewers observe a select number of client-provider interactions. For example, an interviewer observes a provider using a mRDT as part of the observation protocol that classifies the facility as offering malaria diagnosis and treatment services. This process allows for cross checks that validate the self-reported data. In this report, the proportion of facilities that offer malaria diagnosis and treatment services, and curative child care services includes those identified through provider reports and the services identified during client observation.

Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
Facilities offering malaria diagnosis/treatment services	Proportion of all facilities offering malaria diagnosis/treatment services	Number facilities offering malaria diagnosis or treatment services	Total number of facilities	Table A.1
Facilities offering curative care for sick children	Proportion of all facilities offering curative sick child care services	Number facilities offering curative sick child care services	Total number of facilities	Table A.2
Facilities offering malaria diagnosis/treatment services or curative child care services	Proportion of all facilities offering malaria diagnosis/treatment services or curative child care services	Number facilities offering malaria diagnosis/treatment services or curative sick child care services	Total number of facilities	

3.3.2 Trained personnel

An essential component of the proper diagnosis and treatment of malaria is the appropriate training of the facility staff. Ongoing training for service providers ensures that providers continue to learn about the most recent developments about the services they provide. Within the SPA, adequate training is defined as a facility having at least one provider of malaria services who reports receiving in-service training during the 24 months before the survey. The training must have involved structured sessions, and does not include individual instruction a provider might have received during routine supervision. The Health Worker Questionnaire includes questions about the training of the health service providers.

Providers were asked if the following topics were included in their in-service training, training updates, or refresher trainings:

- Diagnosis of malaria in children
- Case management and treatment of malaria in children
- Performance of malaria microscopy
- Performance of malaria rapid diagnostic tests (mRDT)

Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
Personnel trained in mRDT	Proportion of facilities with personnel trained in mRDT among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in malaria mRDT in the past 24 months	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.3
Personnel trained in microscopy	Proportion of facilities with personnel trained in malaria microscopy among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in malaria microscopy in the past 24 months	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.4
Personnel trained in case management/treatment of malaria in children	Proportion of facilities with personnel trained in case management/treatment of malaria in children among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in case management and treatment of malaria in children in the past 24 months	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.5
Personnel trained in mRDT, microscopy, or case management/treatment of malaria in children	Proportion of facilities with personnel trained in in mRDT, malaria microscopy, or case management and treatment of malaria in children among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in mRDT, malaria microscopy, or case management/treatment of malaria in children in the past 24 months	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	

3.3.3 National malaria diagnosis/treatment guidelines and mRDT protocol

National guidelines for the diagnosis and treatment of malaria, as well as treatment job aids and wall charts, are essential components of malaria care in a facility setting. These guidelines serve as visual reminders and references for healthcare providers. A facility is categorized as having guidelines for diagnosis and treatment of malaria only if the interviewer is shown the guidelines at the facility. This indicator is not based on self-report. The Inventory Questionnaire contains the questions asked of the health service providers about the availability of national guidelines for diagnosis and treatment of malaria.

The mRDT protocol refers to the written instructions for performing mRDT. Facilities with an mRDT protocol must have a training manual, poster, or job aid for using malaria RDT observed in the facility.

Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
National guidelines for diagnosis and treatment of malaria	Proportion of facilities that have national guidelines for diagnosis and treatment of malaria among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with national guidelines for diagnosis and treatment of malaria	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table Appendix Table A.6
Malaria mRDT Protocol	Proportion of facilities that have protocol for malaria mRDT among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with protocol for malaria mRDT	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.7

3.3.4 Supplies

For the proper diagnosis of malaria, health facilities must have adequate supplies available for use. The gold standard of laboratory malaria diagnosis is an examination by microscope of blood smears for malaria parasites (microscopy). The mRDTs are an alternative to microscopy in situations where high quality microscopy services cannot be readily provided.

A facility that is defined as having adequate microscopy supplies must have a functioning microscope with glass slides and the relevant stains for malaria microscopy available somewhere in the facility on the day of the survey. Appropriate stains for malaria microscopy include Giemsa, field, or acridine orange stain. A facility considered to have with adequate mRDT supplies must have unexpired malaria mRDT kits available in the facility.

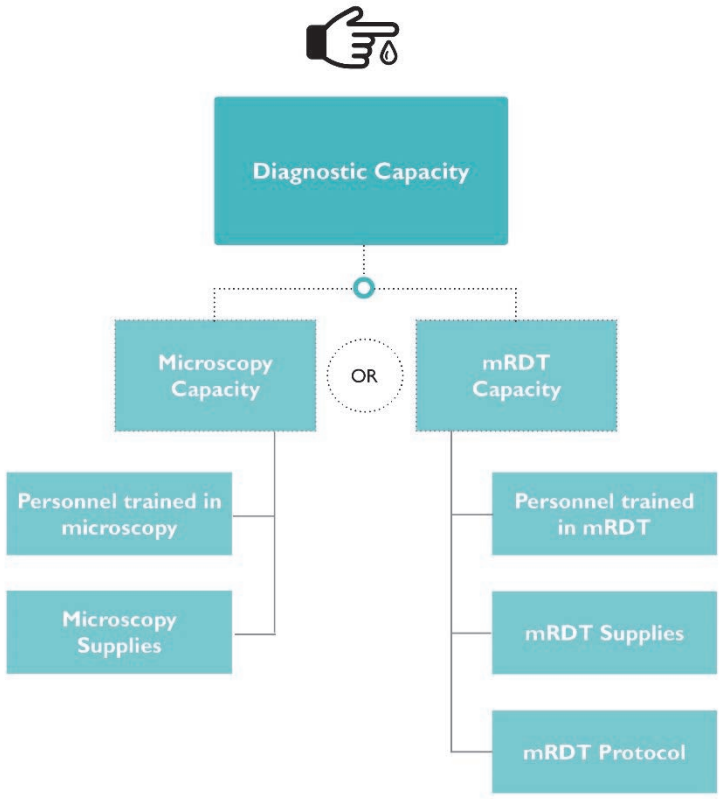
Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
Malaria mRDT supplies	Proportion of facilities that have malaria mRDTs supplies among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with malaria mRDT supplies	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.8
Malaria microscopy supplies	Proportion of facilities that have malaria microscopy supplies among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with malaria microscopy supplies	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.9
Any malaria diagnostics supplies	Proportion of facilities that have malaria microscopy supplies or mRDT supplies among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with malaria microscopy or mRDT supplies	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	

3.3.5 Diagnostic capacity

Malaria diagnostic capacity for a facility is defined as having the capacity for microscopy or mRDT (Figure 1). Microscopy capacity is defined as a facility having a functioning microscope with glass slides and relevant stains, in addition to at least one health provider who has received training on microscopy during the 24 months before the survey. Similarly, RDT capacity is defined as a facility having unexpired malaria mRDT kits, at least one health provider who received mRDT training in the 24 months before the survey, and the facility has an instructional protocol for performing a mRDT.

Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
Microscopy diagnostic capacity	Proportion of facilities that have microscopy diagnostic capacity among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with microscopy diagnostic capacity	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.10
mRDT diagnostic capacity	Proportion of facilities that have mRDT diagnostic capacity among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with mRDT diagnostic capacity	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.11
Diagnostic capacity	Proportion of facilities that have diagnostic capacity (microscopy diagnostic capacity or mRDT diagnostic capacity) among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with diagnostic capacity (microscopy diagnostic capacity or mRDT diagnostic capacity)	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.12

Figure 1 Components of diagnostic capacity[1]



[1]'Blood' icon by Adrien Coquet of the Noun Project.

3.3.6 Antimalarial availability

The universal and continuous availability of antimalarial drugs is a critical component for the delivery of malaria treatment in health facilities. In the SPA survey, the person most knowledgeable about storage and management of medicines and supplies at the health facilities was asked to show the interviewer the following medicines:

- Artemether Lumefantrine (AL) in (6,12,18, and 24 packs)
- Injectable Artesunate
- Artesunate Suppositories/Rectal Artesunate
- Quinine Tablets
- Quinine Injection

Antimalarial medicines must be observed in the health facility, and there needed to be at least one valid dose of each medicine available on the day of the interview. The Inventory Questionnaire contains the questions asked of the health service providers about the availability of antimalarial drugs in the health facility.

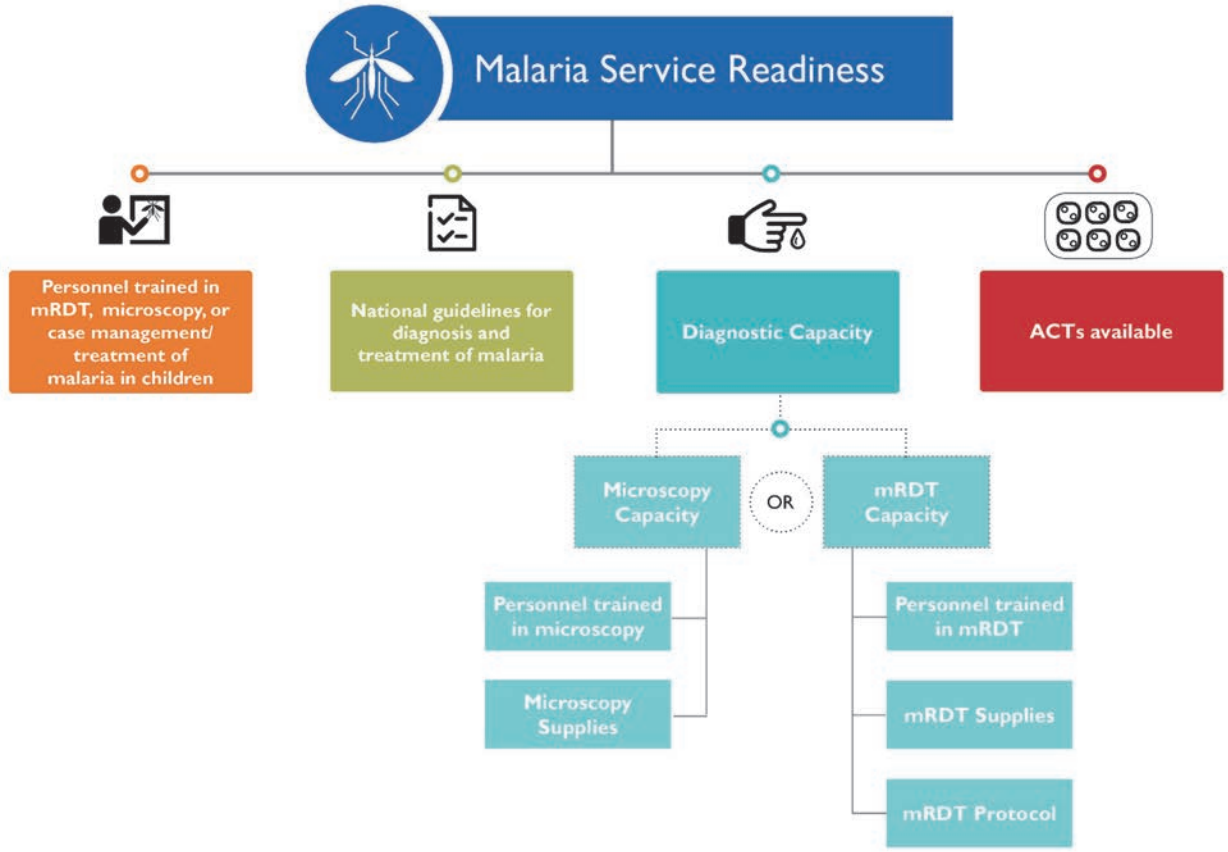
Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
ACT availability	Proportion of facilities with ACTs among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities that have ACTs available	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.13

3.3.7 Malaria service readiness index

The malaria service readiness index is an indicator that assesses the ability of a facility to provide the best care for the diagnosis and treatment of malaria. The facility must have personnel trained in either mRDT, microscopy, or case management and treatment of malaria in children; national guidelines for the diagnosis and treatment of malaria; diagnostic capacity (microscopy or mRDT capacity); and unexpired ACTs to be classified as malaria service ready (Figure 2).

Variable	Indicator	Numerator	Denominator	Appendix A Indicator Construction
Malaria service readiness	Proportion of facilities who are malaria service ready among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities that are malaria service ready	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services	Table A.14

Figure 2 Components of malaria service readiness[1]



[1]Mosquito icon by Yanti Anis, training icon by Yuvika Koul, guideline icon by Mahdi Ehsaei, and blood icon by Adrien Coquet of the Noun Project.

3.4 Indicators from the Demographic and Health Survey (DHS)

The DHS indicators included in this analysis examine care-seeking, diagnostic testing, and appropriate treatment for children with recent fever.

3.4.1 Care-seeking for fever in children

The proportion of children under age 5 with fever in the previous 2 weeks for whom advice or treatment was sought is an indicator that captures care-seeking behavior for febrile illness in children. Most cases of malaria include symptoms of fever, which is a proxy for national-level care-seeking for malaria. In the Individual Questionnaire, mothers are asked if their child under age 5 has had a fever in the previous 2 weeks. If so, they are asked, "*Did you seek advice or treatment for the illness from any source?*" If yes, they are asked, "*Where did you seek advice or treatment?*" The mother is then asked to list the specific type of facilities where they sought care for their child with a fever. Multiple responses for sources of care are allowed. Interviewers are instructed to ask "*Anywhere else?*" after recording the first facility listed to make sure that all facilities where treatment was sought are captured.

Variable	Indicator	Numerator	Denominator
Care-seeking for fever in children	Proportion of children under age 5 years with fever in the previous 2 weeks for whom advice and treatment was sought	Number of children under age 5 with fever in the previous 2 weeks for whom advice and treatment was sought	Total number of children under age 5 with fever in the previous 2 weeks

3.4.2 Diagnostic testing for children with fever

The proportion of children under age 5 with fever in the previous 2 weeks who had a finger or heel stick is an indicator that measures the extent to which children with fever obtain a malaria diagnostic test. Only a minority of fever cases that present to a health facility have evidence of malaria parasitemia when tested and should be treated with antimalarial medicines. Adherence to this policy cannot be directly measured through household surveys. However, interviewed women with children under age 5 who had a fever in the previous 2 weeks before the survey are asked: "*At any time during the illness, did the child have blood taken from his/her finger or heel for testing?*" This information serves as a proxy measure for adherence to the policy of conducting diagnostic testing for all suspected malaria cases. Since most malaria-endemic countries now have policies that require universal diagnostic testing for malaria before treatment, this is an important measure of the appropriateness of care.

In this report, the denominator for the diagnostic testing for children with fever indicator varies slightly from the standard RBM MERG indicator (which is also the standard in the DHS and MIS reports) that examines children under age 5 with fever in the previous 2 weeks who have had a finger or heel stick [33]. The RBM MERG indicator denominator is defined as the "Total number of children under age 5 who had a fever in the previous 2 weeks." In this report, the denominator is defined as "Total number of children under age 5 who had a fever in the previous 2 weeks *who sought advice or treatment*" which includes formal and non-formal sources. Adding the specification that the child must have sought advice and treatment for fever allows the indicator to be more comparable to the indicator from the SPA data (those who sought care at a facility and received a diagnostic test). In addition, the indicator in this report does not exclude traditional healers, shops, or other non-formal places for seeking care.

Variable	Indicator	Numerator	Denominator
Diagnostic testing for children with fever	Proportion of children under age 5 with fever in the previous 2 weeks who had a finger or heel stick	Number of children under age 5 with fever in the previous 2 weeks who had a finger or heel stick	Total number of children under age 5 who had a fever in the previous 2 weeks who sought advice and treatment

3.4.3 Appropriate treatment with ACT

The proportion receiving artemisinin-based combination therapy (ACT) treatment among children under age 5 with fever in the previous 2 weeks who received any antimalarial drug is an indicator that assesses the proportion of antimalarial treatment received by children under age 5 that is in accordance with the national malaria treatment policy. ACT is the WHO-recommended first-line antimalarial drug for the

treatment of uncomplicated malaria. This policy has been recommended in most countries in Sub-Saharan Africa since 2006. Understanding which antimalarial drugs are available and prescribed to children is an important component for monitoring access to effective treatment.

For each child who had a fever or cough in the 2 weeks before the survey, mothers are asked in the Individual Questionnaire: "*At any time during the illness, did the child take any drugs for the illness?*" and, if yes, "*What drugs did the child take?*" Respondents are asked the question "*Any other drugs?*" to identify all drugs given to the child.

Similar to the previous indicator, for this report the denominator for ACT treatment for fever in children indicator varies slightly from the standard RBM MERG indicator (which is also the standard in the DHS and MIS reports) [33]. The RBM MERG indicator denominator is defined as the "Total number of children under age 5 with fever in the previous 2 weeks who received any antimalarial drug" while for this report, the denominator is defined as "Total number of children under age 5 with fever in the previous 2 weeks *who sought treatment* and took an antimalarial drug." Adding the specification that the child must have sought advice and treatment for fever allows the indicator to be more comparable to the indicator from the SPA data (those who sought care at a facility and received an antimalarial drug).

Variable	Indicator	Numerator	Denominator
ACT treatment for fever in children	Proportion receiving ACT treatment among children under age 5 with fever in the previous 2 weeks who received any antimalarial drug	Number of children under age 5 with fever in the previous 2 weeks who received an ACT	Total number of children under age 5 with fever in the previous 2 weeks who *received any antimalarial drug*

4 RESULTS

4.1 Malawi

4.1.1 Service availability

In the 2015-16 Malawi DHS, advice and treatment was sought for 67% of the children with fever in the 2 weeks before the survey (Table 4). Most children with recent fever for whom care was sought received advice and treatment from a formal health provider (61%). Among those seeking advice and treatment, 39% of children were taken to a government health center, 8% to a government hospital, 7% to a government health post or mobile clinic, 5% to a private facility, and 4% to a faith-based facility. Only 6% sought advice or treatment from a source not sampled in the SPA (Table 4).

In the 2013-14 Malawi SPA, 97% of facilities in Malawi offered malaria diagnosis/treatment services or curative care for sick children. Among the facilities sampled, 100% of government hospitals and health centers, 99% of faith-based facilities, 96% of private facilities, and 81% of government health posts or mobile clinics offered malaria diagnosis/treatment services or curative care for sick children (Table 4).

Comparison of the DHS data on the source of advice or treatment for children with fever with SPA data on availability of malaria services by facility type in Malawi shows that government health centers had the highest utilization for seeking advice and treatment for fever in Malawi (39%) and that 100% of the government health centers offer malaria diagnosis/treatment services or curative care for sick children (Table 4).

Table 4 Source of advice or treatment for children with fever and availability of malaria services by facilities in Malawi

Facility type	2015-16 Malawi DHS		2013-14 Malawi SPA			
	Percentage for whom advice or treatment was sought	Number of children under age 5 with a fever	Facilities offering malaria diagnosis/treatment services	Facilities offering curative care for sick children	Facilities offering malaria diagnosis/treatment services or curative care for sick children	Total number of facilities
Government hospital	8	4,774	100	100	100	48
Government health center	39	4,774	99	100	100	339
Government health post or mobile clinic	7	4,774	76	74	81	85
Private facility	5	4,774	96	90	96	342
Christian health association/mission/ faith-based	4	4,774	99	99	99	163
Any other source	6	4,774	n/a	n/a	n/a	n/a
Total	67	4,774	96	94	97	977

4.1.2 Trained personnel

In the 2015-16 Malawi DHS, 69% of children with a recent fever for whom treatment was sought had blood taken from a finger or heel, presumably for malaria testing (Table 5). After disaggregating for facility type, 87% of children who went to a faith-based organization, 84% of children to a government hospital, 76% of children to a government health center, 68% to a private facility, and 57% to a government health post or mobile clinic had blood taken from a finger or heel for testing. Only 11% of children who went to a source not sampled in the SPA survey had blood taken from a finger or heel for testing.

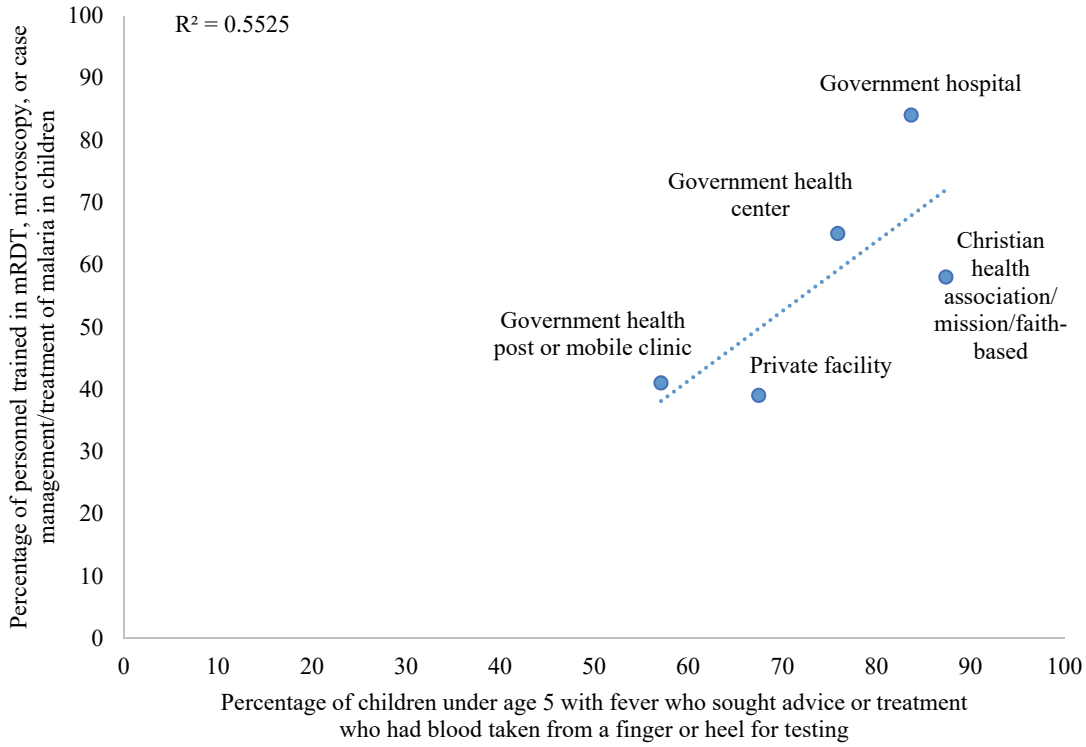
The 2013-14 Malawi SPA found that 50% of facilities had at least one staff member trained in mRDT, 40% in microscopy, 38% in case management and treatment of malaria in children, and 54% trained in mRDT, microscopy, and case management and treatment of malaria in children (Table 5). By facility type, the percentage of facilities with at least one staff member trained in mRDT ranges from 82% of government hospitals to 34% of private facilities. Personnel trained in microscopy ranges from 72% of government hospitals to 26% of government health posts or mobile clinics. Similarly, the percentage of facilities with staff trained in case management and treatment of malaria in children ranges from 54% of government hospitals to 25% of government health posts or mobile clinics. The composite indicator that examined personnel trained in mRDT, microscopy, and case management and treatment of malaria in children ranged from 84% of government hospitals to 39% of private facilities (Table 5).

A comparison of diagnostic testing data from the DHS and malaria training of personnel by facility type from the SPA shows that 84% of children in Malawi who went to a government hospital had blood taken from a finger or heel for testing. Likewise, 84% of government hospitals had at least one person trained in mRDT, microscopy, or case management and treatment of malaria in children (Figure 3). Febrile children were most likely to have blood taken from a finger or heel for testing if they were taken to faith-based facilities for care (87%), although only slightly more than half of these facilities (58%) had at least one person trained in mRDT, microscopy, or case management and treatment of malaria in children (Figure 3). A scatterplot of children who had blood taken from a finger or heel for testing and personnel trained in mRDT, microscopy, or case management and treatment of malaria in children by facility type shows a positive association between the two measures with an R^2 of 0.55 (Figure 3).

Table 5 Diagnosis of fever and malaria training of personnel by facilities in Malawi

	2015-16 Malawi DHS		2013-14 Malawi SPA				
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services				
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Personnel trained in mRDT	Personnel trained in microscopy	Personnel trained in case management/ treatment of malaria in children	Personnel trained in mRDT, microscopy, or case management and treatment of malaria in children	Total number of facilities
Government hospital	84	372	82	72	54	84	48
Government health center	76	1,843	60	48	46	65	338
Government health post or mobile clinic	57	330	36	26	25	41	68
Private facility	68	232	34	28	29	39	330
Christian health association/ mission/faith-based	87	188	55	44	40	58	162
Any other source	11	278	n/a	n/a	n/a	n/a	n/a
Total	69	3,200	50	40	38	54	947

Figure 3 Diagnosis of fever by malaria training of personnel in Malawi



4.1.3 National guidelines

In the 2013-14 Malawi SPA, 64% of facilities had national guidelines for the diagnosis and treatment of malaria and 60% of facilities had a malaria mRDT protocol available. By facility type, the percentage of facilities with national guidelines for the diagnosis and treatment of malaria ranged from 82% of government hospitals to 51% of private facilities. Similarly, facilities with a malaria mRDT protocol ranged from 88% of government hospitals to 46% of private facilities (Table 6).

Comparing diagnostic testing of children from the DHS and availability of national malaria guidelines or a mRDT protocol by facility type in Malawi from the SPA, 84% of children who went to a government hospital had blood taken from a finger or heel for testing, while 88% of government hospitals had a malaria mRDT protocol and 82% had national guidelines for the diagnosis and treatment of malaria. Febrile children were most likely to have blood taken from a finger or heel for testing if they were taken to faith-based facilities for care (87%). However, 70% of the facilities had national guidelines for the diagnosis and treatment of malaria and 68% of the facilities had a malaria mRDT protocol. Private facilities were least likely to have national guidelines for the diagnosis and treatment of malaria (51%) and malaria mRDT protocol (46%), although 68% of children who sought care at a private facility had blood taken from a finger or heel for testing. The coefficient of determination (R^2) of percentage of febrile children who had blood taken from a finger or heel for testing and percentage of facilities that had national guidelines for diagnosis and treatment of malaria by facility type shows a positive association between the two measures with an R^2 of 0.52 (Figure 4). Similarly, children who had blood taken from a finger or heel for testing and a malaria mRDT protocol by facility type shows a positive association between the two measures with an R^2 of 0.56 (Figure 5).

Table 6 Diagnosis of fever and availability of national malaria guidelines/protocol by facilities in Malawi

	2015-16 Malawi DHS		2013-14 Malawi SPA		
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services		
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	National guidelines for diagnosis and treatment of malaria	Malaria mRDT Protocol	Total number of facilities
Government hospital	84	372	82	88	48
Government health center	76	1,843	71	69	338
Government health post or mobile clinic	57	330	60	53	68
Private facility	68	232	51	46	330
Christian health association/mission/faith-based	87	188	70	68	162
Any other source	11	278	n/a	n/a	n/a
Total	69	3,200	64	60	947

Figure 4 Diagnosis of fever by availability of national malaria guidelines for diagnosis/treatment in Malawi

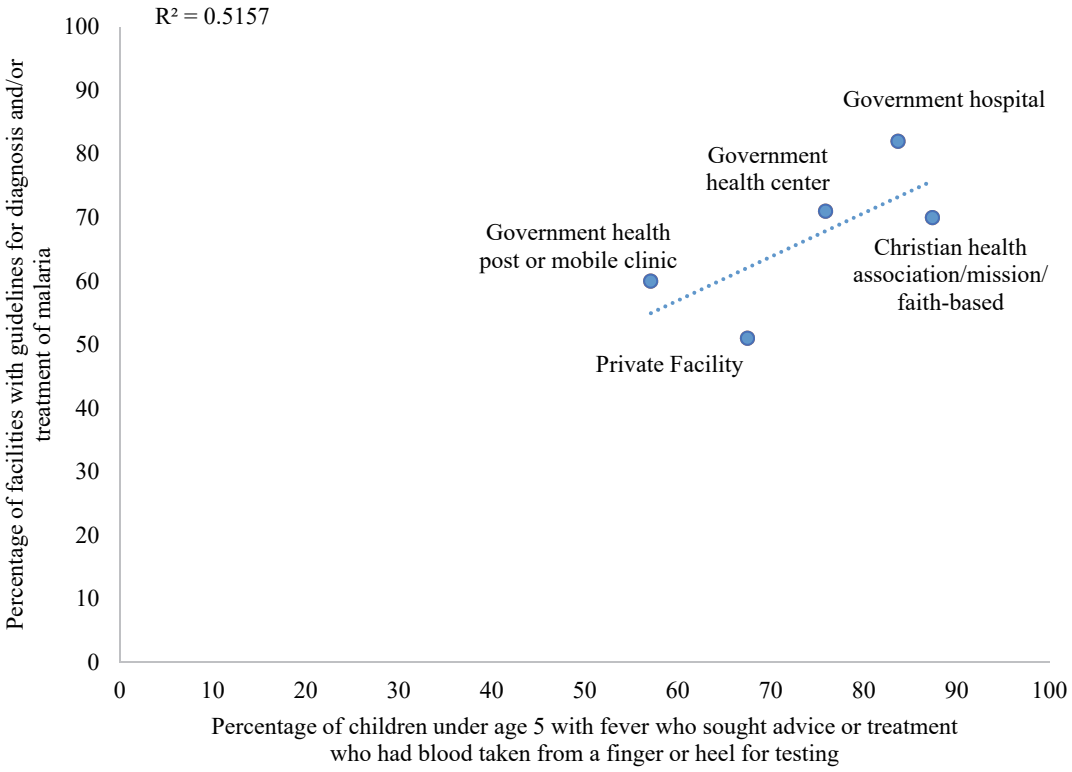
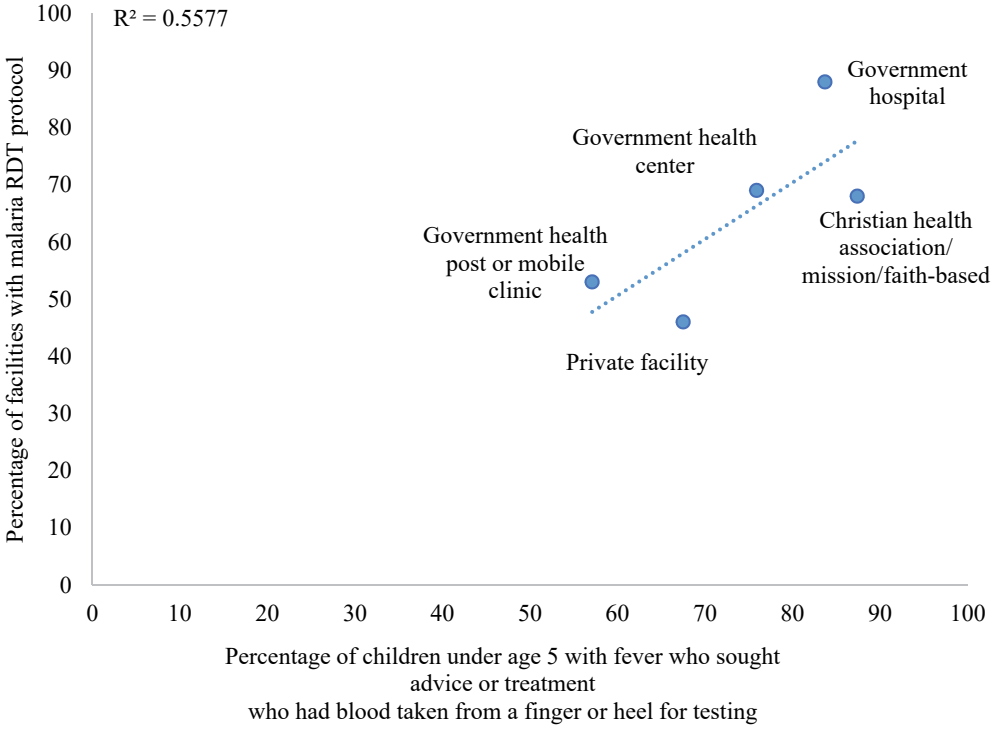


Figure 5 Diagnosis of fever by availability of malaria RDT protocol in Malawi



4.1.4 Supplies

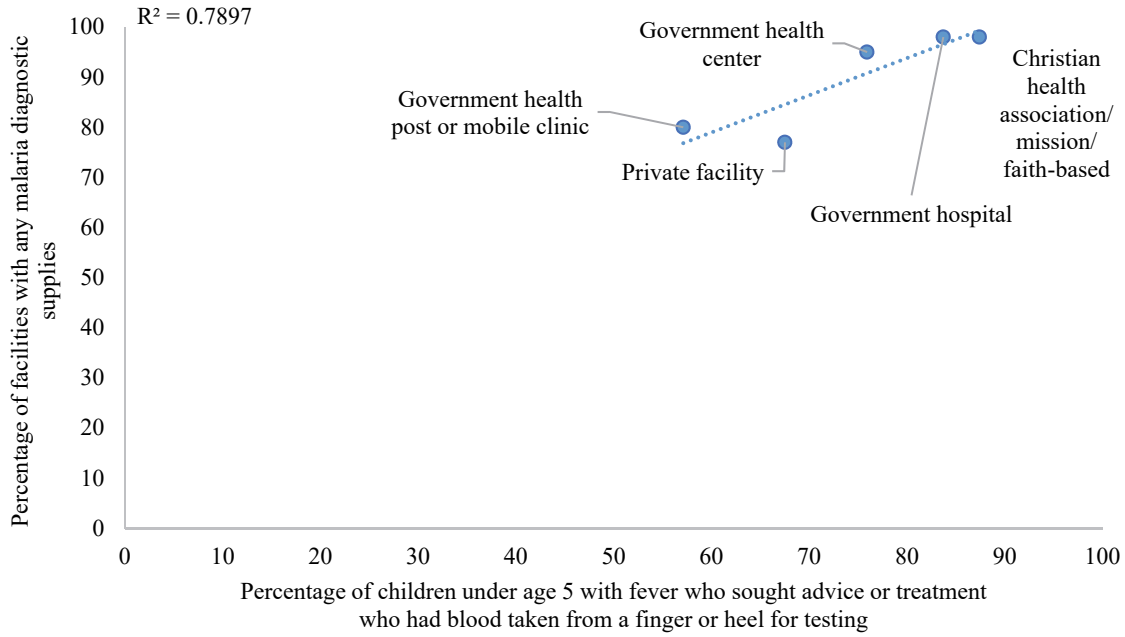
In Malawi, 88% of facilities had mRDT supplies, 14% had malaria microscopy supplies, and 88% had any malaria diagnostic supplies (mRDT and/or microscopy) (Table 7). By facility type, the percentage of facilities with malaria mRDT supplies ranged from 98% in government hospital and faith-based facilities to 76% of private facilities. The percentage of facilities with malaria microscopy supplies ranged from 60% of government hospitals to 3% of government health posts or mobile clinics. The percentage of facilities with any malaria diagnostic supplies ranged from 98% of government hospitals and faith-based facilities to 77% of private facilities (Table 7).

Comparing diagnostic testing and availability of malaria diagnostic supplies by facility type in Malawi, 87% of children who went to a faith-based facility had blood taken from a finger or heel for testing. Among faith-based facilities, 98% had adequate mRDT supplies while only 25% had adequate microscopy supplies. A total of 84% of children who attended government hospitals had blood taken from a finger or heel for testing. Among government hospitals, 98% had adequate mRDT supplies and 60% had adequate microscopy supplies. Few government health centers or government health posts or mobile clinics had adequate malaria microscopy supplies (5% and 3%, respectively), although malaria mRDT supplies were available at 95% of government health centers and 80% of government health posts or mobile clinics. Malaria diagnostic supplies were the least frequently available in private facilities (77%), although 68% of children attending a private facility reported having blood taken from a finger or heel for testing. As expected, there is a strong association (R^2=0.79) between diagnostic testing among febrile children seeking treatment at specific facility types and malaria diagnostic supplies available at the facility type (Figure 6).

Table 7 Diagnosis of fever and availability of malaria diagnostic supplies by facilities in Malawi

	2015-16 Malawi DHS		2013-14 Malawi SPA			
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services			
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Malaria mRDT supplies	Malaria microscopy supplies	Any malaria diagnostic supplies	Total number of facilities
Government hospital	84	372	98	60	98	48
Government health center	76	1,843	95	5	95	338
Government health post or mobile clinic	57	330	80	3	80	68
Private facility	68	232	76	13	77	330
Christian health association/mission/ faith-based	87	188	98	25	98	162
Any other source	11	278	n/a	n/a	n/a	n/a
Total	69	3,200	88	14	88	947

Figure 6 Diagnosis of fever by availability of malaria diagnostic supplies in Malawi



4.1.5 Diagnostic capacity

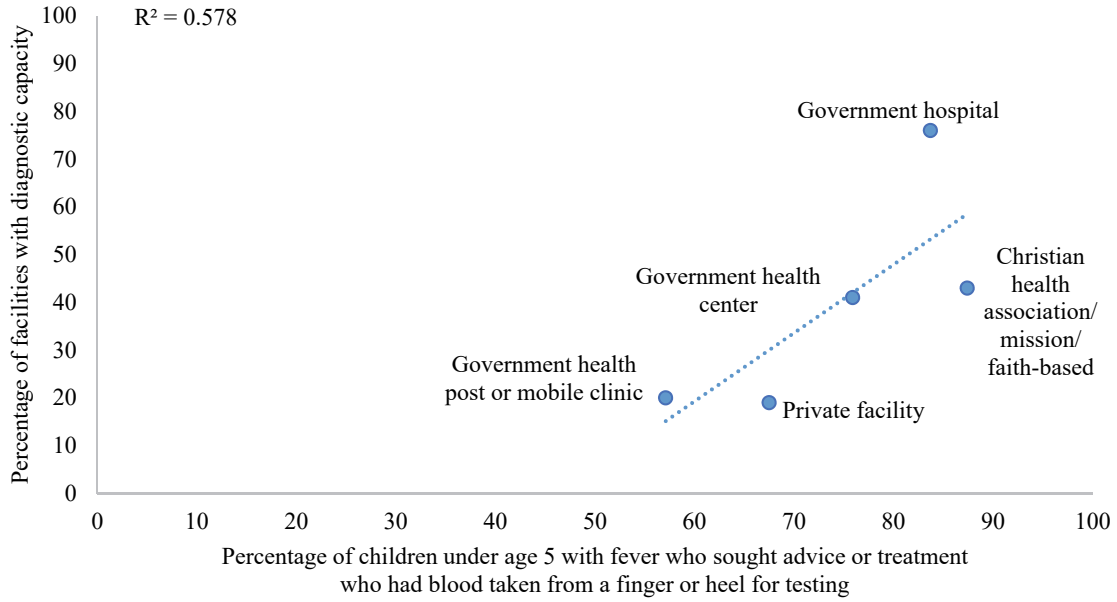
In Malawi, 7% of facilities had microscopy diagnostic capacity, 32% of facilities had mRDT diagnostic capacity, and 34% had malaria diagnostic capacity (microscopy diagnostic capacity and mRDT diagnostic capacity) (Table 8). By facility type, microscopy diagnostic capacity ranges from 40% of government hospitals to 1% of government health post or mobile clinics. The mRDT diagnostic capacity ranges from 72% of government hospitals to 17% of private facilities. Overall diagnostic capacity by facility ranges from 76% of government hospitals to 19% of private facilities (Table 8).

When comparing diagnosis of fever and malaria diagnostic capacity by facility type in Malawi, 87% of children who visited a faith-based facility had blood taken from a finger or heel for testing, although only 43% of faith-based facilities have full diagnostic capacity. Among children for whom treatment was sought at government hospitals, 84% had blood taken from a finger or heel for testing, although only 40% of government hospitals had microscopy capacity and 72% had mRDT diagnostic capacity. No facility had a greater microscopy diagnostic capacity than mRDT diagnostic capacity. Government health posts or mobile clinics and private facilities had the lowest diagnostic capacity (20% and 19% respectively). There is a positive association (R^2=0.58) between diagnostic testing among febrile children seeking treatment at specific facility types and facilities that have diagnostic capacity (Figure 7).

Table 8 Diagnosis of fever and malaria diagnostic capacity by facilities in Malawi

	2015-16 Malawi DHS		2013-14 Malawi SPA			
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services			
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Microscopy diagnostic capacity	mRDT diagnostic capacity	Diagnostic capacity	Total number of facilities
Government hospital	84	372	40	72	76	48
Government health center	76	1,843	3	41	41	338
Government health post or mobile clinic	57	330	1	20	20	68
Private facility	68	232	4	17	19	330
Christian health association/mission/ faith-based	87	188	15	38	43	162
Any other source	11	278	n/a	n/a	n/a	n/a
Total	69	3,200	7	32	34	947

Figure 7 Diagnosis of fever by malaria diagnostic capacity in Malawi



4.1.6 ACT availability

Among children under age 5 with a fever who sought treatment and took an antimalarial drug, 93% of children received an ACT. By facility type, receipt of ACT varies from 97% of children for whom treatment was sought and an antimalarial was prescribed at a government health post/mobile clinic, 95% at a government hospital, 94% at a government health center, 91% at a faith-based clinic, 85% at a source not sampled in the SPA, to 75% at a private facility. Other less frequently prescribed drugs for children who sought treatment for fever included injectable quinine (4%), followed by oral quinine (2%), injectable artesunate (1%), and artesunate suppository (0.2%).

In an examination of the 2013-14 Malawi SPA, 92% of facilities had an ACT drug in stock on the day of the survey (Table 9). This means that the ACT drug was observed in the health facility, and there was at least one valid dose available on the day of the interview. By facility type, 100% of government hospitals and 99% of government health centers and faith-based organizations had ACTs available in stock. However, only 82% of private facilities and 81% of government health posts or mobile clinics had ACT in stock. (Table 9).

In a comparison of the type of antimalarial drug used and availability of antimalarial drugs by facilities in Malawi, more than 90% of children who went to a government hospital, government health center, or a faith-based facility who took an antimalarial drug received an ACT. This concurs with the data from the facility level in that greater than 99% of these facilities had availability of ACTs on the day of the survey. Data from the DHS showed that 97% of children who went to a government health post who took an antimalarial drug received an ACT. However, according to the 2013-14 SPA, 81% of government health posts had ACT in stock on the day of the survey. Injectable quinine and oral quinine were well stocked in facilities, although they are rarely used because they are not the recommended first-line treatment drugs for children under age 5.

Table 9 Type of antimalarial drug used and availability of antimalarial drugs by facilities in Malawi

	2015-16 Malawi DHS						2013-14 Malawi SPA					
							Among facilities offering malaria diagnosis/treatment services or curative sick child care services					
Facility type	ACT	Injectable artesunate	Artesunate suppository (rectal)	Oral quinine	Injectable quinine	Number of children with fever who sought treatment and took an antimalarial drugs	Any ACT	Injectable artesunate	Artesunate suppository (rectal)	Oral quinine	Injectable quinine	Total number of facilities
Government hospital	95	2	0	0	4	194	100	4	0	86	98	48
Government health center	94	0	0	2	4	942	99	1	0	67	99	338
Government health post or mobile clinic	97	1	0	1	1	196	81	0	0	49	69	68
Private facility	77	8	0	9	9	105	82	6	3	74	79	330
Christian health association/mission/ faith-based	91	1	1	5	13	123	99	4	1	83	95	162
Any other source	85	0	2	3	2	44	n/a	n/a	n/a	n/a	n/a	n/a
Total	93	1	0	2	4	1,583	92	3	1	72	89	947

4.1.7 Service readiness

The components of the malaria service readiness index include facility personnel trained in mRDT, microscopy, case management and treatment of malaria in children, national guidelines for diagnosis and treatment, proper supplies for diagnosing malaria, and ACTs available on site. Among facilities in Malawi that offer malaria diagnosis/treatment services or curative care for sick children, 25% have all the components to be considered malaria service ready (Table 10). By facility type, the percentage of facilities considered malaria service ready ranges from 60% for government hospitals to 12% for private facilities. Across all facilities, the lowest component of the malaria service readiness index was the diagnostic capacity.

In comparisons of the source of advice or treatment for children with fever to the components of the malaria service readiness index, 39% of children with a fever were taken to a government health center, although only 32% of government health centers are considered malaria service ready. Among government health centers, 99% have ACTs available and 71% have national guidelines for the diagnosis and treatment of malaria available at the facility, which are components of service readiness. The major barrier to service readiness in Malawi appears to be the low diagnostic capacity (41%). Among government hospitals, 60% are malaria service ready, although only 8% of children sought care for a fever at a government hospital.

Table 10 Source of advice or treatment for children with fever and components of malaria service readiness by facilities in Malawi

	2015-16 Malawi DHS		2013-14 Malawi SPA					
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services					
Facility type	Percentage for whom advice or treatment was sought	Number of children under age 5 with a fever	Personnel trained in mRDT, microscopy or case management treatment of malaria in children	National guidelines for diagnosis and treatment of malaria	Diagnostic capacity	ACTs available	Malaria service readiness index	Total number of facilities
Government hospital	8	4,774	84	82	76	100	60	48
Government health center	39	4,774	65	71	41	99	32	338
Government health post or mobile clinic	7	4,774	41	61	20	71	15	68
Private facility	5	4,774	39	51	19	82	12	330
Christian health association/mission/ faith-based	4	4,774	58	70	43	99	33	162
Any other source	6	4,774	n/a	n/a	n/a	n/a	n/a	n/a
Total	67	4,774	54	64	34	92	25	947

4.1.8 Malaria endemicity

To explore if malaria service readiness varies by the level of malaria transmission, the components of malaria service readiness were examined by endemicity level in Malawi. Facilities were stratified into two equal frequency groups (lower and higher malaria risk categories). The lower malaria risk category for Malawi included facilities with a *Pf*PR≤10.2% while facilities with a higher malaria risk had a *Pf*PR≥10.3%. All components of malaria service readiness (trained personnel, guidelines, diagnostic capacity, and

available ACTs) were higher in areas of higher malaria transmission as compared to the lower malaria transmission areas. When examining malaria service readiness by facilities and malaria endemicity, government hospitals, government health centers, government health posts or mobile clinics, and private facilities had greater malaria service readiness in locations with higher malaria endemicity, while only faith-based organizations had higher malaria service readiness in locations with lower malaria endemicity (Table 11).

Table 11 Malaria service readiness by malaria endemicity and facility in Malawi

	2013-14 Malawi SPA					
Facility type	Personnel trained in mRDT, microscopy, or case management/ treatment of malaria in children	National guidelines for diagnosis and treatment of malaria	Diagnostic capacity	ACTs available	Malaria service readiness index	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services
Government hospital						
PfPR≤ 10.2%	78	78	78	100	56	33
PfPR≥10.3%	89	85	74	100	63	26
Government health center						
PfPR≤ 10.2%	61	68	41	100	27	150
PfPR≥10.3%	69	74	42	99	36	188
Government health post or mobile clinic						
PfPR≤ 10.2%	35	55	7	74	3	30
PfPR≥10.3%	46	65	30	86	24	39
Private facility						
PfPR≤ 10.2%	35	51	18	81	10	177
PfPR≥10.3%	43	51	21	83	13	153
Christian health association/ mission/faith-based						
PfPR≤ 10.2%	57	75	48	99	40	71
PfPR≥10.3%	58	67	40	99	27	90
Total						
PfPR≤ 10.2%	49	62	33	90	22	451
PfPR≥10.3%	58	65	36	93	28	497

4.2 Senegal

4.2.1 Service availability

In the 2016 Senegal Continuous DHS, advice or treatment was sought for 50% of the children with fever in the 2 weeks before the survey (Table 12). Most children with recent fever for whom care was sought, received advice or treatment from a formal health provider (47%). Among those seeking advice or treatment, 32% of children were taken to a government health post or mobile clinic, 9% to a private facility,

5% to a government hospital or health center, and 3% to a government health hut. Only 3% sought advice or treatment from a source not sampled in the SPA survey (Table 12).

In the 2016 Senegal Continuous SPA, 99% of facilities in Senegal offered malaria diagnosis/treatment services or curative care for sick children. Among the facilities sampled, 100% of government hospitals, health centers, government health posts or mobile clinics offer malaria diagnosis/treatment services or curative care for sick children. Similarly, 98% of government health huts and private facilities offered malaria diagnosis/treatment services or curative care for sick children (Table 12).

Comparison of DHS data on the source of advice or treatment for children with fever with SPA data on the availability of malaria services by facility type in Senegal shows that government health posts or mobile clinics had the highest utilization for seeking advice or treatment for fever in Senegal (32%) and that 100% of government health posts or mobile clinics offer malaria diagnosis/treatment services or curative care for sick children (Table 12).

Table 12 Source of advice or treatment for children with fever and availability of malaria services by facilities in Senegal

	2016 Senegal Continuous DHS		2016 Senegal Continuous SPA			
Facility type	Percentage for whom advice or treatment was sought	Number of children under age 5 with a fever	Facilities offering malaria diagnosis/treatment services	Facilities offering curative care for sick children	Facilities offering malaria diagnosis/treatment services or curative care for sick children	Total number of facilities
Government hospital or health center	5	692	100	96	100	29
Government health post or mobile clinic	32	692	100	100	100	252
Government health hut	3	692	91	94	98	87
Private facility	9	692	97	80	98	72
Any other source	3	692	n/a	n/a	n/a	n/a
Total	50	692	98	95	99	439

4.2.2 Trained personnel

In the 2016 Senegal Continuous DHS, 26% of children with a recent fever for whom treatment was sought had blood taken from a finger or heel, presumably for malaria testing (Table 13). Disaggregating by facility type, 36% of children who visited a government health hut, 34% of children who went to a government hospital or health center, 29% of children who went to a government health post, and 11% who went to a private facility had blood taken from a finger or heel for testing. The percentage of children who went to a source not sampled in the SPA had blood taken from a finger or heel for testing is not shown due to the low number of children who visited another type of provider.

The 2016 Senegal Continuous SPA found that 65% of facilities had at least one person trained in mRDT, 88% in microscopy, 63% in case management and treatment of malaria in children, and 88% trained in mRDT, microscopy, or case management and treatment of malaria in children (Table 13). By facility type, the percentage of facilities with at least one person trained in mRDT ranges from 80% of government health posts or mobile clinics to 36% of the private facilities. Having at least one person trained in microscopy

ranges from 96% in government health posts or mobile clinics to 64% in private clinics. Similarly, the percentage of facilities with at least one staff member trained in case management and treatment of malaria in children ranges from 79% of government health posts or mobile clinics to 34% of health huts. The composite indicator that examines personnel trained in mRDT, microscopy, or case management and treatment of malaria in children ranges from 96% in government health posts or mobile clinics to 64% in the private facilities (Table 13).

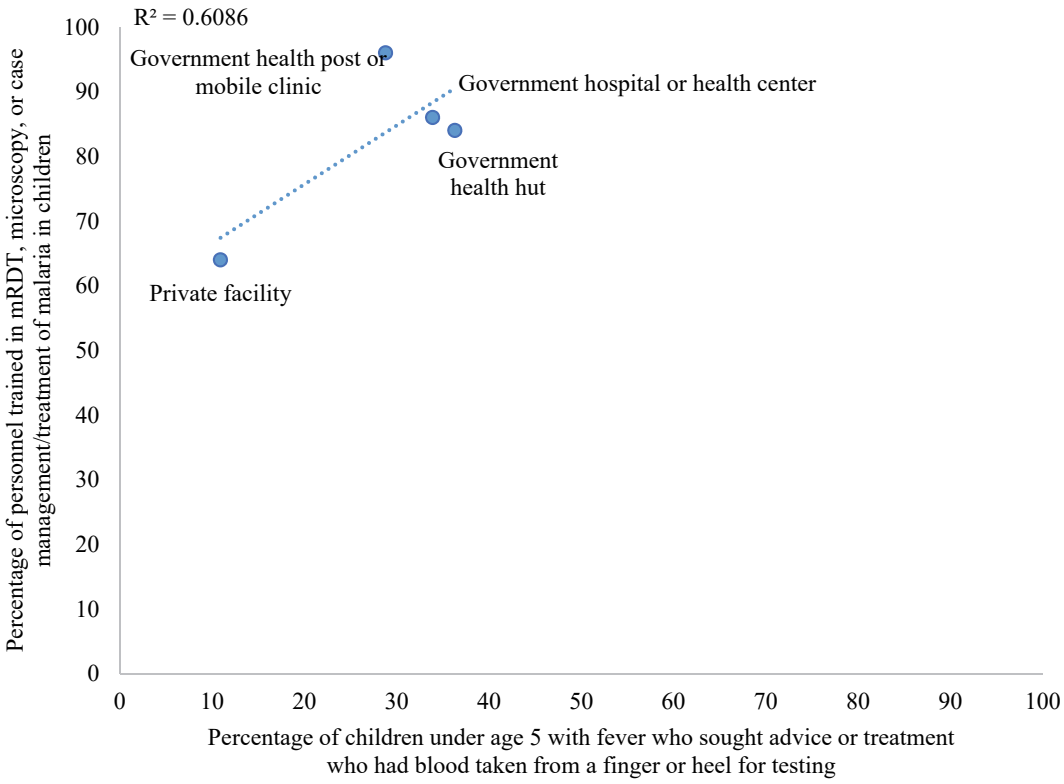
A comparison of diagnostic testing data from the DHS and malaria training of personnel by facility type from the SPA shows that 36% of children in Senegal who went to a government health hut had blood taken from a finger or heel for testing while 84% of government health huts had at least one person trained in mRDT, microscopy, or case management and treatment of malaria in children (Figure 8). Ninety-six percent of government health posts or mobile clinics had at least one individual trained in mRDT, microscopy, or case management and treatment of malaria in children, while only 29% of children who sought care at government health post had blood taken from a finger or heel for testing. A scatterplot of the percentage of febrile children who had blood taken from a finger or heel for testing and percentage of facilities with personnel trained in mRDT, microscopy, or case management and treatment of malaria in children by facility type shows a positive association between the two measures with an R^2 of 0.61 (Figure 8).

Table 13 Diagnosis of fever and malaria training of personnel by facilities in Senegal

Facility type	2016 Senegal Continuous DHS		2016 Senegal Continuous SPA				
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services				
	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Personnel trained in mRDT	Personnel trained in microscopy	Personnel trained in case management and treatment of malaria in children	Personnel trained in mRDT, microscopy, or case management/treatment of malaria in children	Total number of facilities
Government hospital	34	32	62	86	63	86	29
Government health post or mobile clinic	29	223	80	96	79	96	252
Government health hut	36	23	42	84	34	84	85
Private facility	11	60	36	64	36	64	70
Any other source	*	10	n/a	n/a	n/a	n/a	n/a
Total	26	345	65	88	63	88	436

Note: An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

Figure 8 Diagnosis of fever by malaria training of personnel in Senegal



4.2.3 National guidelines

In the 2016 Senegal Continuous SPA, 87% of facilities had national guidelines for the diagnosis and treatment of malaria, and 82% of facilities had a malaria mRDT protocol available. By facility type, the percentage of facilities with national guidelines for diagnosis and treatment of malaria ranged from 94% at government health post or mobile clinics to 72% at private facilities. Facilities with a malaria mRDT protocol ranged from 93% of government hospitals or health centers to 61% of government health posts (Table 14).

Comparing diagnostic testing of children from the DHS and availability of national malaria guidelines or a mRDT protocol by facility type in Senegal from the SPA, 36% of febrile children taken to a government health hut had blood taken from a finger or heel for testing, although only 76% of government health huts had national guidelines for diagnosis and treatment of malaria and 61% had malaria RDT protocol. The coefficient of determination (R^2) of percentage of febrile children who had blood taken from a finger or heel for testing and percentage of facilities that had national guidelines for diagnosis and treatment of malaria by facility type shows a weak positive association between the two measures with an R^2 of 0.25 (Figure 9). Similarly, the percentage of children who had blood taken from a finger or heel for testing and percentage of facilities with malaria RDT protocol by facility type shows a weak positive association between the two measures with an R^2 of 0.04 (Figure 10).

Table 14 Diagnosis of fever and availability of national malaria guidelines/protocol by facilities in Senegal

Facility type	2016 Senegal Continuous DHS		2016 Senegal Continuous SPA		
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services		
	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	National guidelines for diagnosis and treatment of malaria	Malaria mRDT Protocol	Total number of facilities
Government hospital or health center	34	32	91	93	29
Government health post or mobile clinic	39	223	94	91	252
Government health hut	36	23	76	61	85
Private facility	11	60	72	69	70
Any other source	*	10	n/a	n/a	n/a
Total	26	345	87	82	436

Note: An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

Figure 9 Diagnosis of fever by availability of national malaria guidelines for diagnosis/treatment in Senegal

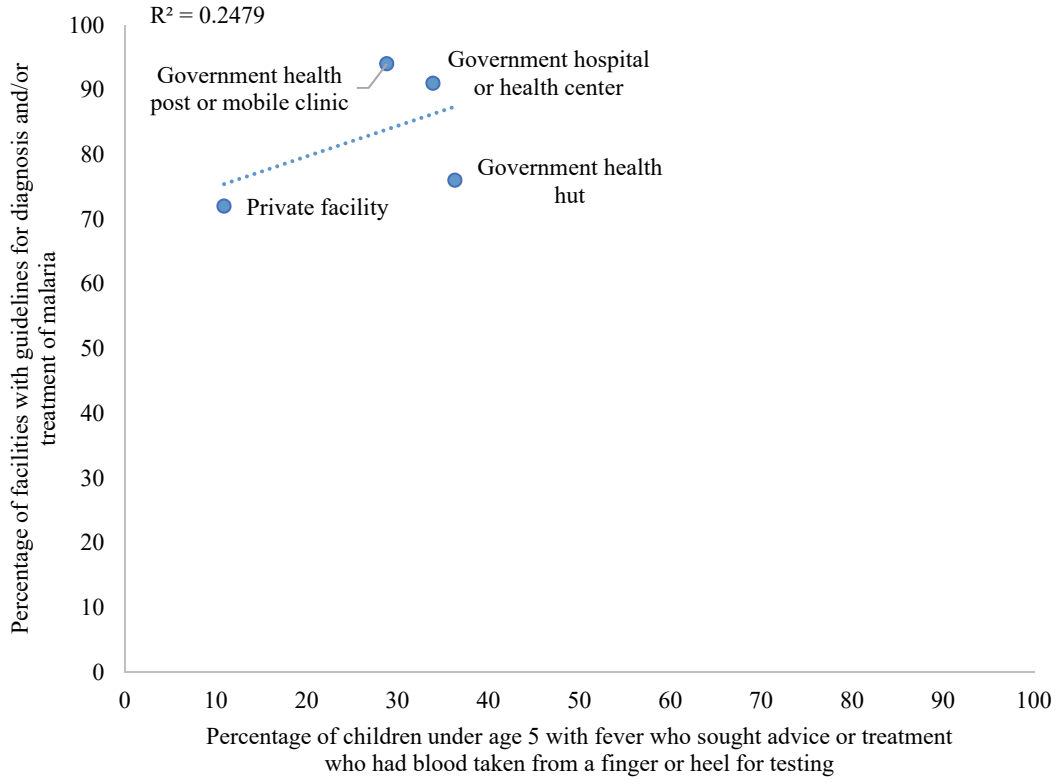
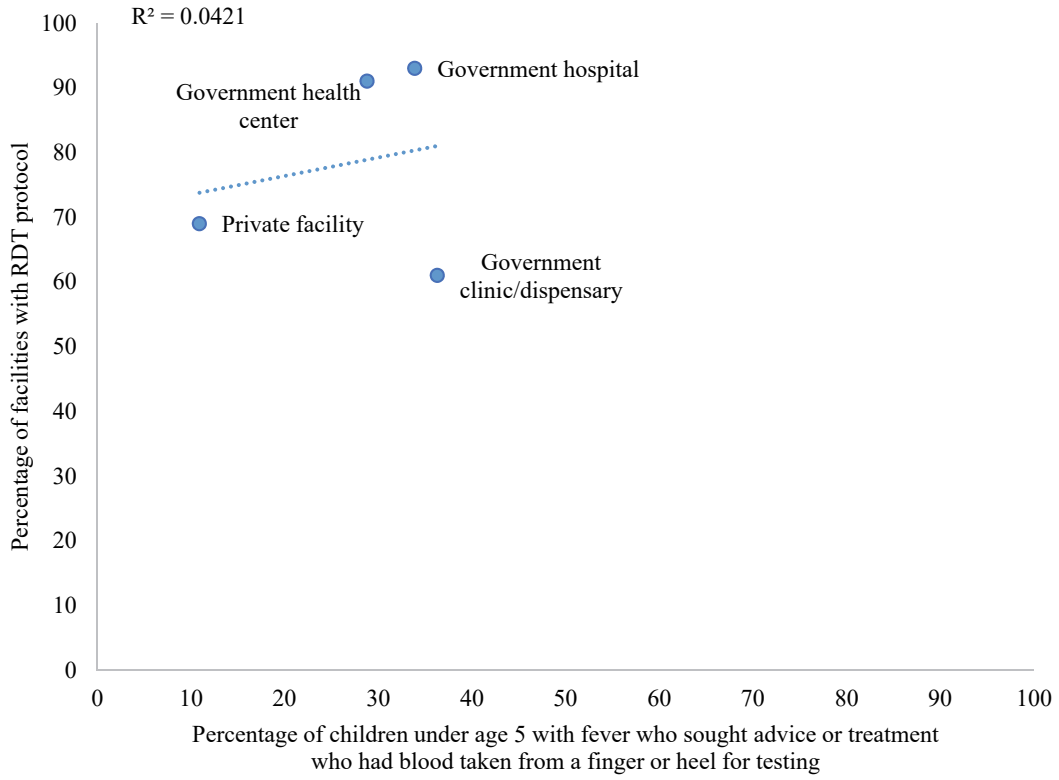


Figure 10 Diagnosis of fever by availability of malaria RDT protocol in Senegal



4.2.4 Supplies

In Senegal, 90% of facilities had mRDT supplies, 10% had malaria microscopy supplies, and 91% had any malaria diagnostic supplies (mRDT and/or microscopy) (Table 15). By facility type, the percentage of facilities with malaria mRDT supplies ranges from 98% in government hospital, health centers, health posts, or mobile clinics to 75% in government health huts and private facilities. The percentage of facilities with malaria microscopy supplies ranges from 81% of government hospitals or health centers to 0% of government health huts. The percentage of facilities with any malaria diagnostic supplies ranges from 98% of government hospitals and faith-based facilities, to 100% of government hospitals or health centers to 75% of government health huts (Table 15).

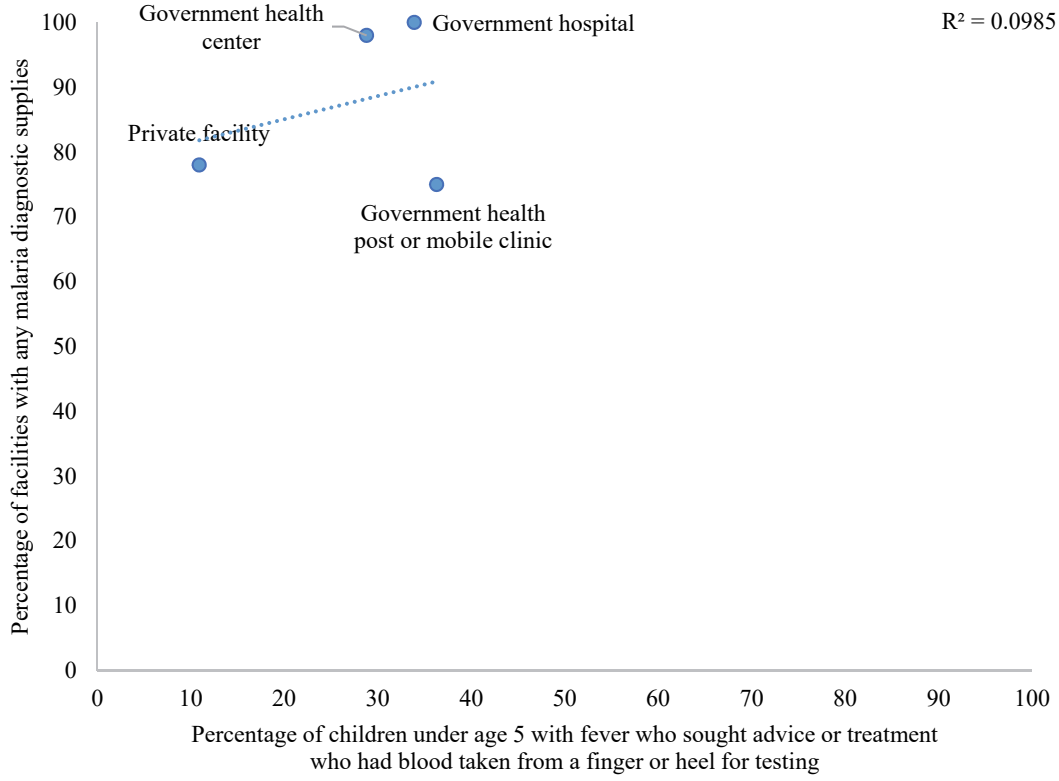
In comparisons of diagnostic testing and availability of malaria diagnostic supplies by facility type in Senegal, 36% of children who went to a government health hut had blood taken from a finger or heel for testing. Among the government health huts, 75% had adequate mRDT supplies while none had adequate microscopy supplies. Government hospitals, health centers, health posts, or mobile clinics had a very high percentage of facilities with an availability of diagnostic supplies, although few children had blood taken from a finger or heel for testing when going to these facilities. In Senegal there is a weak association (R^2=0.1) between diagnostic testing among febrile children seeking treatment at specific facility types and malaria diagnostic supplies available at the facility type (Figure 11).

Table 15 Diagnosis of fever and availability of malaria diagnostic supplies by facilities in Senegal

Facility type	2016 Senegal Continuous DHS		2016 Senegal Continuous SPA			
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services			
	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Malaria mRDT supplies	Malaria microscopy supplies	Any malaria diagnostic supplies	Total number of facilities
Government hospital or health center	34	32	98	81	100	29
Government health post or mobile clinic	39	223	98	3	98	252
Government health hut	36	23	75	0	75	85
Private facility	11	60	75	27	78	70
Any other source	*	10	n/a	n/a	n/a	n/a
Total	26	345	90	10	91	436

Note: An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

Figure 11 Diagnosis of fever by availability of malaria diagnostic supplies in Senegal



4.2.5 Diagnostic capacity

In Senegal, 9% of facilities had microscopy diagnostic capacity, 56% had mRDT diagnostic capacity, and 60% had malaria diagnostic capacity (microscopy diagnostic capacity and mRDT diagnostic capacity) (Table 16). By facility type, microscopy diagnostic capacity ranges from 74% of government hospitals and

health centers to 0% of government health huts. The mRDT diagnostic capacity ranges from 73% of government health posts or mobile clinics to 28% of government health huts and private facilities. Overall diagnostic capacity by facility ranges from 82% of government hospitals and health centers to 28% of government health huts (Table 16).

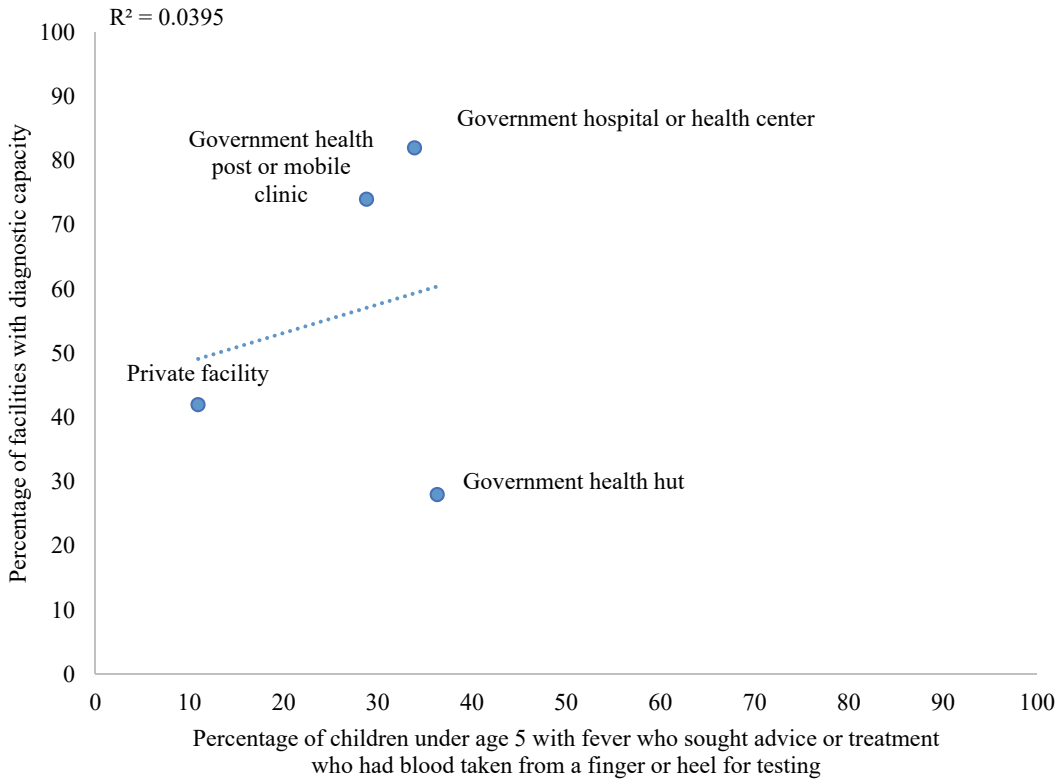
When comparing the diagnosis of fever and malaria diagnostic capacity by facility type in Senegal, 36% of children who went to a government health hut had blood taken from a finger or heel for testing, although only 28% of government health huts have full diagnostic capacity. Among children for whom treatment was sought at government hospitals or health centers, 34% had blood taken from a finger or heel for testing Government hospitals or health centers also had a high percentage of facilities with both microscopy (74%) and mRDT diagnostic capacity (60%). All facilities (except government hospitals or health centers) had higher mRDT diagnostic capacity than microscopy diagnostic capacity. There is a weak positive association (R^2=0.04) between diagnostic testing among febrile children seeking treatment at specific facility types and facilities with diagnostic capacity (Figure 12).

Table 16 Diagnosis of fever and malaria diagnostic capacity by facilities in Senegal

	2016 Senegal Continuous DHS		2016 Senegal Continuous DHS			
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services			
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Microscopy diagnostic capacity	mRDT diagnostic capacity	Diagnostic capacity	Total number of facilities
Government hospital or health center	34	32	74	60	82	29
Government health post or mobile clinic	39	223	1	73	74	252
Government health hut	36	23	0	28	28	85
Private facility	11	60	20	28	42	70
Any other source	*	10	n/a	n/a	n/a	n/a
Total	26	345	9	56	60	436

Note: An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

Figure 12 Diagnosis of fever by malaria diagnostic capacity in Senegal



4.2.6 ACT availability

Among children under age 5 with a fever who sought treatment and took an antimalarial drug, 30% of children received an ACT. The percentage of children who received an injectable artesunate, artesunate suppository, oral quinine, and injectable quinine are not shown due to fewer than 25 unweighted cases of children who attended the specific health facilities among children with fever who took an antimalarial drug.

In examining the 2016 Senegal Continuous SPA, 69% of facilities had an ACT drug in stock on the day of the survey (Table 17). This means that the ACT drug was observed in the health facility, and there was at least one valid dose available at the day of the interview. By facility type, 96% of government health posts or mobile clinics, and 90% of government hospitals or health centers had ACTs available in stock. However, only 63% of government health huts and 48% of private facilities had ACTs available in stock. In Senegal, 66% of facilities had injectable quinine available on the day of the survey. Less common drugs available included oral quinine and injectable artesunate (1%) (Table 17).

Due to low numbers of children with fever who sought treatment and took an antimalarial drug, it is not possible to compare the type of antimalarial drug used and the availability of antimalarial drugs by facilities in Senegal.

Table 17 Type of antimalarial drug used and availability of antimalarial drugs by facilities in Senegal

	2016 Senegal Continuous DHS						2016 Senegal Continuous SPA					
							Among facilities offering malaria diagnosis/treatment services or curative sick child care services					
Facility type	ACT	Injectable artesunate	Artesunate suppository (rectal)	Oral quinine	Injectable quinine	Number of children with fever who took an antimalarial drugs	Any ACT	Injectable artesunate	Artesunate suppository (rectal)	Oral quinine	Injectable quinine	Total number of facilities
Government hospital or health center	*	*	*	*	*	5	90	5	0	5	91	29
Government health post or mobile clinic	*	*	*	*	*	18	96	1	0	1	88	252
Government health hut	*	*	*	*	*	1	63	0	0	0	0	85
Private facility	*	*	*	*	*	9	48	2	0	0	54	70
Any other source	*	*	*	*	*	0	n/a	n/a	n/a	n/a	n/a	n/a
Total	30	0	0	0	0	33	69	1	0	1	66	435

Note: An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

4.2.7 Service readiness

Components of the malaria service readiness index include the facilities having personnel trained in mRDT, microscopy, or case management and treatment of malaria in children, national guidelines for diagnosis and treatment, proper supplies to diagnosis malaria, and ACTs available on site. Among facilities in Malawi that offer malaria diagnosis/treatment services or curative care for sick children, 49% have all the components to be considered malaria service ready (Table 18). By facility type, the percentage of facilities considered malaria service ready ranges from 77% of government hospitals or health centers to 21% of government health huts. Across all facilities, the lowest component of the malaria service readiness index was the diagnostic capacity.

Comparing the source of advice or treatment for children with fever to the components of the malaria service readiness index, 32% of children with a fever were taken to a government health post or mobile clinic, although only 69% of government health centers are considered malaria service ready. Among government health posts or mobile clinics, 96% have ACTs available and personnel trained in mRDT, microscopy, or case management and treatment of malaria in children in the past 24 months, and 94% have national guidelines for diagnosis and treatment of malaria. Although the government health posts or mobile clinics in Senegal are performing poorly, only 74% of facilities have diagnostic capacity. Among government hospitals or health centers, 77% are malaria service ready, but only 5% of children are seeking care at a government hospital or health center for fever.

Table 18 Source of advice or treatment for children with fever and components of malaria service readiness by facilities in Senegal

	2016 Senegal Continuous DHS		2016 Senegal Continuous SPA					
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services					
Facility type	Percentage for whom advice or treatment was sought	Number of children under age 5 with a fever	Personnel trained in mRDT, microscopy, or case management and treatment of malaria in children	National guidelines for diagnosis/treatment of malaria	Diagnostic capacity	ACTs available	Malaria service readiness index	Total number of facilities
Government hospital or health center	5	692	86	91	82	90	77	29
Government health post or mobile clinic	32	692	96	94	74	96	69	252
Government health hut	3	692	84	76	28	63	21	85
Private facility	9	692	64	72	42	48	26	70
Any other source	3	692	n/a	n/a	n/a	n/a	n/a	n/a
Total	50	692	88	87	60	69	49	436

4.2.8 Malaria endemicity

To explore if malaria service readiness varies by level of malaria transmission, the components of malaria service readiness were examined by endemicity level in Senegal. Facilities were stratified into two equal frequency groups (lower and higher malaria risk categories). The lower malaria risk category for Senegal

included facilities with a *Pf*PR≤ 2.4% and those with a higher malaria risk had a *Pf*PR≥2.5%. Across all components of malaria service readiness (trained personnel, guidelines, diagnostic capacity, and availability of ACTs), malaria service readiness components are slightly higher in areas of lower malaria transmission as compared to the higher malaria transmission areas. When examining malaria service readiness by facilities and malaria endemicity, government hospitals, health centers, and health huts had a higher malaria service readiness in locations with higher malaria endemicity, while only private facilities had higher malaria service readiness in locations with lower malaria endemicity (Table 19).

Table 19 Malaria service readiness by malaria endemicity and facility in Senegal

	2016 Senegal Continuous SPA					
Facility type	Personnel trained in mRDT, microscopy, or case management and treatment of malaria in children	National guidelines for diagnosis and treatment of malaria	Diagnostic capacity	ACTs available	Malaria service readiness index	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services
Government hospital						
PfPR≤ 2.4%	83	89	77	92	71	16
PfPR≥2.5%	90	94	87	87	84	13
Government health center						
PfPR≤ 2.4%	96	94	74	94	68	134
PfPR≥2.5%	97	94	73	98	70	118
Government health hut						
PfPR≤ 2.4%	80	74	23	69	19	41
PfPR≥2.5%	88	77	32	57	22	45
Private facility						
PfPR≤ 2.4%	80	77	45	64	35	28
PfPR≥2.5%	54	68	39	38	20	42
Total						
PfPR≤ 2.4%	90	88	61	85	55	219
PfPR≥2.5%	86	86	59	78	52	217

4.3 Tanzania

4.3.1 Service availability

In the 2015-16 Tanzania DHS-MIS, advice or treatment was sought for 81% of the children with fever in the 2 weeks before the survey (Table 20). Among children with recent fever for whom care was sought, 41% received advice or treatment from a formal health provider. Among febrile children seeking advice or treatment, 19% were taken to a government clinic or dispensary, 8% to a private facility, 6% to a government health center, 4% to a government hospital, and 4% to a mission or faith-based facility. The majority (54%) of children who sought advice or treatment were taken to a non-health facility provider such as an ADDO or a pharmacy (Table 20).

In the 2014-15 Tanzania SPA, 99% of facilities in Tanzania offered malaria diagnosis/treatment services or curative care for sick children. Among the facilities sampled, 100% of government health centers, government clinic or dispensaries, and mission or faith-based facilities, 99% of government hospitals, and 96% of private facilities offered malaria diagnosis/treatment services or curative care for sick children (Table 20).

Comparison DHS data on the source of advice or treatment for children with fever with SPA data on availability of malaria services by facility type in Tanzania shows that government clinic or dispensaries had the highest utilization for seeking advice or treatment for fever in Tanzania (19%), and that 100% of these same government clinic or dispensaries offer malaria diagnosis/treatment services or curative care for sick children (Table 20).

Table 20 Source of advice or treatment for children with fever and availability of malaria services by facilities in Tanzania

Facility type	2015-16 Tanzania DHS-MIS		2014-15 Tanzania SPA			
	Percentage for whom advice or treatment was sought	Number of children under age 5 with a fever	Facilities offering malaria diagnosis/treatment services	Facilities offering curative care for sick children	Facilities offering malaria diagnosis/treatment services or curative care for sick children	Total number of facilities
Government hospital	4	1,706	99	98	99	25
Government health center	6	1,706	100	100	100	88
Government clinic/dispensary	19	1,706	100	99	100	764
Private facility	8	1,706	96	91	96	162
Mission/faith-based	4	1,706	100	97	100	148
Any other source	54	1,706	n/a	n/a	n/a	n/a
Total	81	1,706	99	98	99	1,187

4.3.2 Trained personnel

In the 2015-16 Tanzania DHS-MIS, 42% of children with a recent fever for whom treatment was sought had blood taken from a finger or heel, presumably for malaria testing (Table 21). Disaggregating by facility type, blood from a finger was taken from 80% of children who went to a faith-based organization, 79% of children in a private facility, 73% of children in a government hospital, 62% in a government health center, and 54% in a government clinic or dispensary. Only 25% of children who went to an informal source not sampled in the SPA survey had blood taken from a finger or heel for testing.

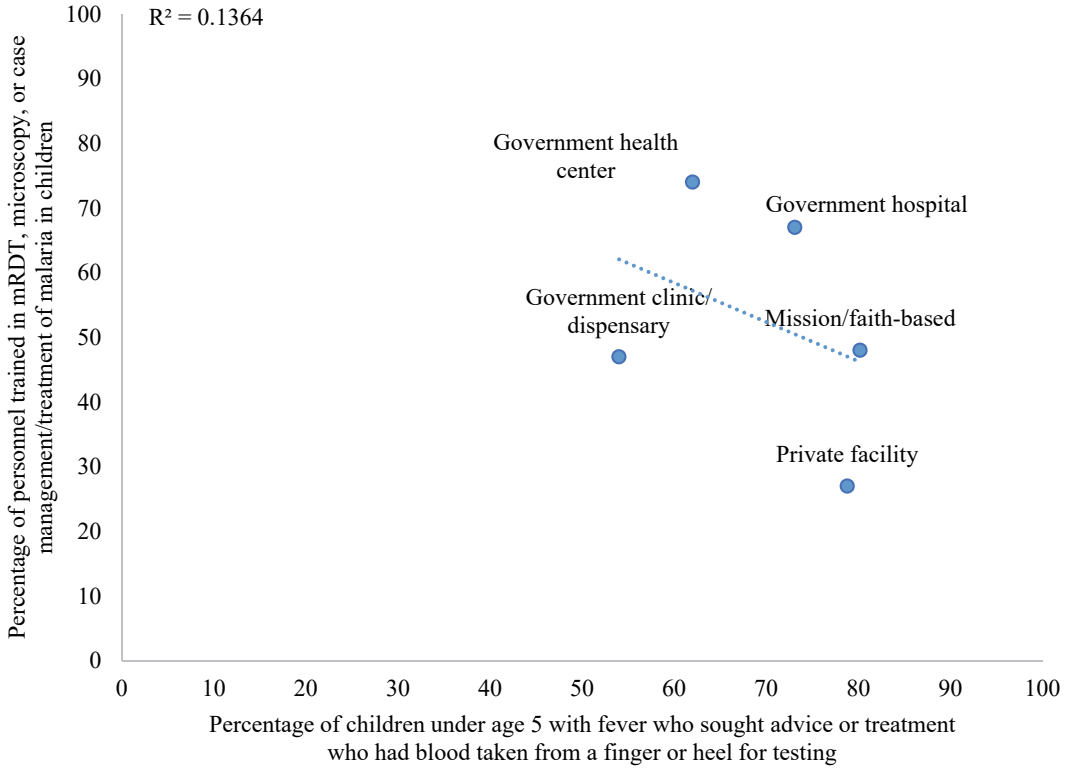
The 2014-15 Tanzania SPA found that 40% of facilities had at least one personnel trained in mRDT, 36% in microscopy, and 47% in mRDT, microscopy, and case management and treatment of malaria in children (Table 21). By facility type, the percentage of facilities with at least one personnel trained in mRDT ranges from 66% of government health centers to 26% of private facilities. At least one personnel trained in microscopy ranges from 66% of government health centers to 25% of private facilities. Similarly, the percentage of facilities with staff trained in case management and treatment of malaria in children ranges from 64% of government health centers to 24% of private facilities. The composite indicator that examined at least one personnel trained in mRDT, microscopy, and case management and treatment of malaria in children ranges from 74% of government health centers to 27% of private facilities (Table 21).

A comparison of diagnostic testing data from the DHS and malaria training of personnel by facility type from the SPA shows that 73% of children in Tanzania who went to a government hospital had blood taken from a finger or heel for testing, while 67% of government hospitals had at least one personnel trained in mRDT, microscopy, or case management and treatment of malaria in children (Figure 13). Faith-based facilities had the highest percentage of children who had blood taken from a finger or heel for testing (80%), although only slightly less than half of the facilities (47%) had at least one personnel trained in mRDT, microscopy, or case management and treatment of malaria in children (Figure 13). A scatterplot of children who had blood taken from a finger or heel for testing and personnel trained in mRDT, microscopy, or case management/treatment of malaria in children by facility type shows a weak negative association between the two measures with an R^2 of 0.14 (Figure 13).

Table 21 Diagnosis of fever and malaria training of personnel by facilities in Tanzania

	2015-16 Tanzania DHS-MIS		2014-15 Tanzania SPA				
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services				
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Personnel trained in mRDT	Personnel trained in microscopy	Personnel trained in case management and treatment of malaria in children	Personnel trained in mRDT, microscopy, or case management and treatment of malaria in children	Total number of facilities
Government hospital	73	61	56	62	59	67	24
Government health center	62	95	66	66	64	74	88
Government clinic/ dispensary	54	312	41	34	34	47	761
Private facility	79	130	26	25	24	27	156
Mission/faith-based	80	64	36	38	39	48	147
Any other source	25	738	n/a	n/a	n/a	n/a	n/a
Total	42	1,385	40	36	36	47	1,177

Figure 13 Diagnosis of fever by malaria training of personnel in Tanzania



4.3.3 National guidelines

In the 2014-15 Tanzania SPA, 62% of facilities had national guidelines for diagnosis and treatment of malaria and 64% of facilities had a malaria mRDT protocol available. By facility type, the percentage of facilities with national guidelines for diagnosis and treatment of malaria ranged from 65% of government clinics or dispensaries to 43% of private facilities. Facilities with a malaria mRDT protocol ranged from 90% of government hospitals to 54% of mission or faith-based facilities (Table 22).

In a comparison of diagnostic testing of children from the DHS and the availability of national malaria guidelines and an mRDT protocol by facility type in Tanzania from the SPA, 80% of children who went to a mission or faith-based facility had blood taken from a finger or heel for testing, while only 60% of mission or faith-based facilities had national guidelines for the diagnosis and treatment of malaria and 54% had an mRDT protocol. The coefficient of determination (R^2) of the percentage of febrile children who had blood taken from a finger or heel for testing and the percentage of facilities that had national guidelines for diagnosis and treatment of malaria by facility type shows a moderate negative association between the two measures with an R^2 of 0.45 (Figure 14). Similarly, children who had blood taken from a finger or heel for testing and mRDT protocol by facility type shows a weak negative association between the two measures with an R^2 of 0.11 (Figure 15).

Table 22 Diagnosis of fever and availability of national malaria guidelines/protocol by facilities in Tanzania

	2015-16 Tanzania DHS-MIS		2014-15 Tanzania SPA		
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services		
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	National guidelines for diagnosis and treatment of malaria	Malaria mRDT Protocol	Total number of facilities
Government hospital	73	61	48	90	24
Government health center	62	95	61	80	88
Government clinic/dispensary	54	312	65	65	761
Private facility	79	130	43	55	156
Mission/faith-based	80	64	60	54	147
Any other source	25	738	n/a	n/a	n/a
Total	42	1,385	62	64	1,177

Figure 14 Diagnosis of fever by availability of national malaria guidelines for diagnosis/treatment in Tanzania

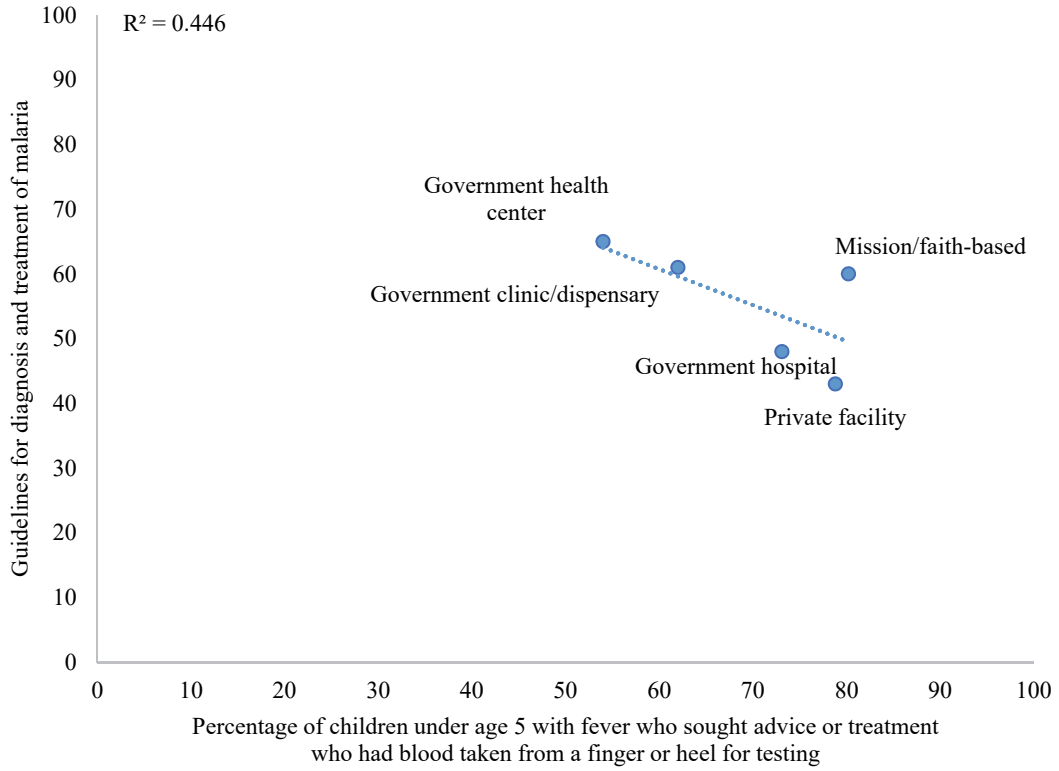
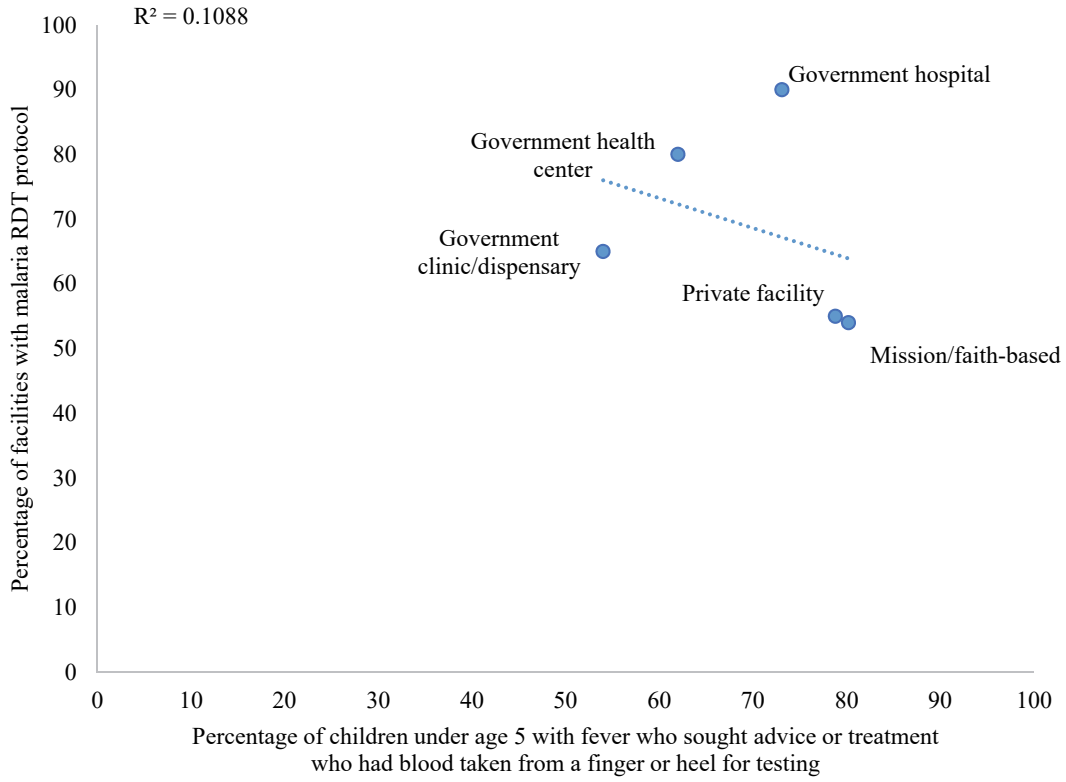


Figure 15 Diagnosis of fever by availability of malaria RDT protocol in Tanzania



4.3.4 Supplies

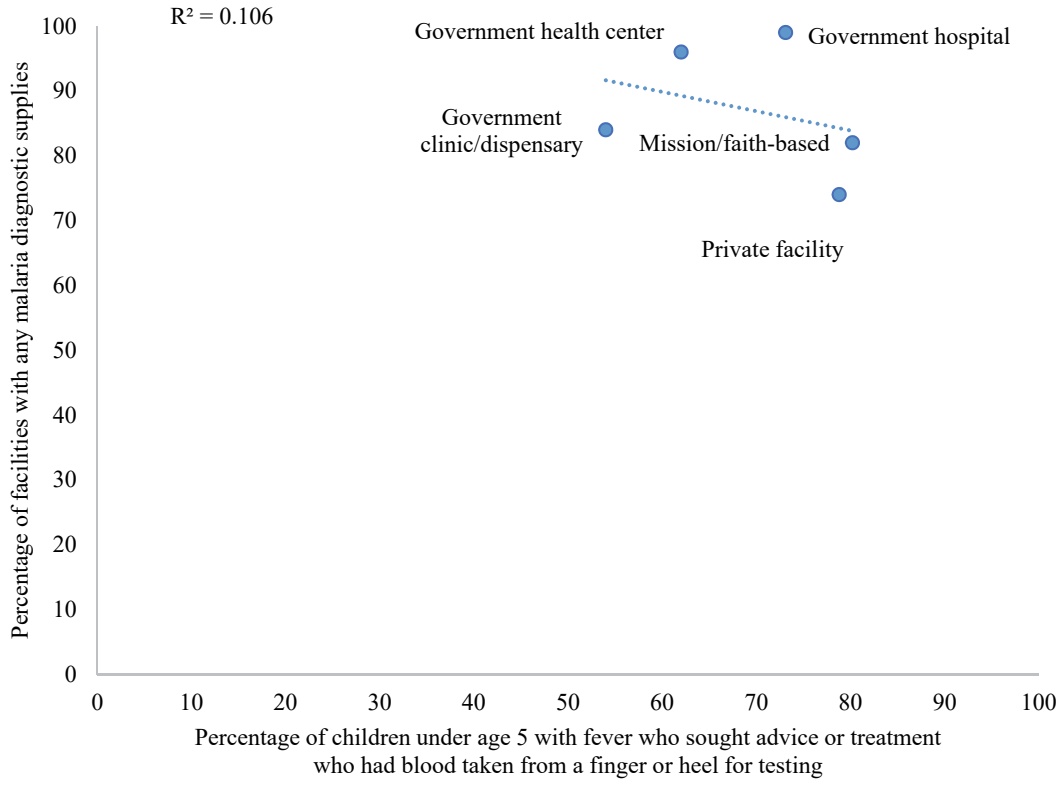
In Tanzania, 81% of facilities had mRDT supplies, 17% had malaria microscopy supplies, and 84% had any malaria diagnostic supplies (mRDT and/or microscopy) (Table 23). By facility type, the percentage of facilities with mRDT supplies ranges from 94% for government hospitals to 63% for the private facilities. The percentage of facilities with malaria microscopy supplies ranges from 55% of government hospitals to 5% of government clinics or dispensaries. The percentage of facilities with any malaria diagnostic supplies ranges from 99% of government hospitals to 100% of government hospitals and 74% of private facilities (Table 23).

Comparing diagnostic testing and availability of malaria diagnostic supplies by facility type in Tanzania, 80% of children who went to a mission or faith-based facility had blood taken from a finger or heel for testing. Among the mission or faith-based facilities, 72% had adequate mRDT supplies, while 38% had adequate microscopy supplies. Government hospitals had a very high percentage of facilities with an availability of diagnostic supplies, although a smaller percentage of children had blood taken from a finger or heel for testing when being seen at these facilities. In Tanzania, there is a weak negative association (R^2=0.11) between diagnostic testing among febrile children seeking treatment at specific facility types and the malaria diagnostic supplies available at the facility type (Figure 16).

Table 23 Diagnosis of fever and availability of malaria diagnostic supplies by facilities in Tanzania

Facility type	2015-16 Tanzania DHS-MIS		2014-15 Tanzania SPA			
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services			
	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Malaria mRDT supplies	Malaria microscopy supplies	Any malaria diagnostic supplies	Total number of facilities
Government hospital	73	61	94	55	99	24
Government health center	62	95	93	45	96	88
Government clinic/dispensary	54	312	84	5	84	761
Private facility	79	130	63	38	74	156
Mission/faith-based	80	64	72	39	82	147
Any other source	25	738	n/a	n/a	n/a	n/a
Total	42	1,385	81	17	84	1,177

Figure 16 Diagnosis of fever by availability of malaria diagnostic supplies in Tanzania



4.3.5 Diagnostic capacity

In Tanzania, 7% of facilities had microscopy diagnostic capacity, 26% had mRDT diagnostic capacity, and 28% had malaria diagnostic capacity (microscopy diagnostic capacity and mRDT diagnostic capacity) (Table 24). By facility type, microscopy diagnostic capacity ranges from 43% of government hospitals to

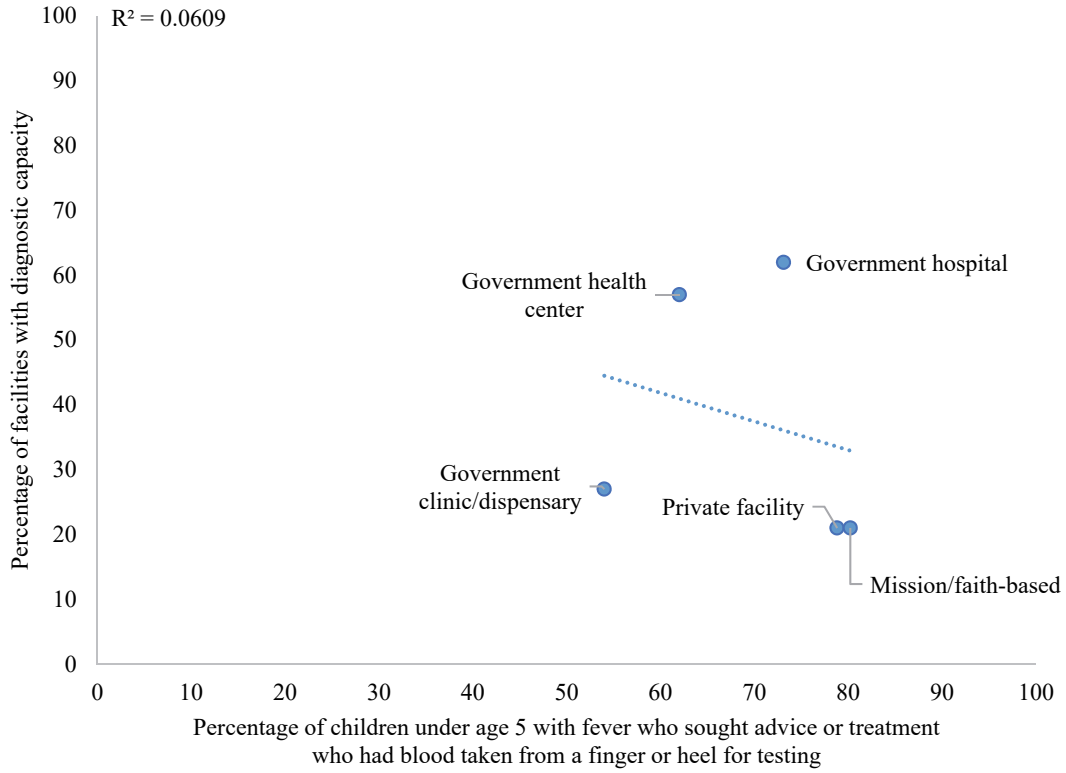
1% of government clinics or dispensaries. The percentage of facilities that have mRDT diagnostic capacity ranges from 51% of government hospitals to 17% of the mission or faith-based facilities. Overall diagnostic capacity by facility ranges from 62% of government hospitals to 21% of private facilities and mission or faith-based facilities (Table 24).

When comparing diagnosis of fever and malaria diagnostic capacity by facilities in Tanzania, 80% of children who went to a mission or faith-based facility had blood taken from a finger or heel for testing, while only 21% of mission or faith-based facilities have full diagnostic capacity. Among children for whom treatment was sought at government hospitals, 73% had blood taken from a finger or heel for testing. Government hospitals also had the highest percentage of facilities with both microscopy (43%) and mRDT diagnostic capacity (51%). All facilities had higher mRDT diagnostic capacity than microscopy diagnostic capacity. There is a weak negative association (R^2=0.06) with diagnostic testing among febrile children seeking treatment at specific facility types and facilities with diagnostic capacity (Figure 17).

Table 24 Diagnosis of fever and malaria diagnostic capacity by facilities in Tanzania

	2015-16 Tanzania DHS-MIS		2014-15 Tanzania SPA			
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services			
Facility type	Percentage who had blood taken from a finger or heel for testing	Number of children under age 5 with a fever who sought treatment	Microscopy Diagnostic capacity	mRDT Diagnostic capacity	Diagnostic capacity	Total number of facilities
Government hospital	73	61	43	51	62	24
Government health center	62	95	33	50	57	88
Government clinic/dispensary	54	312	1	26	27	761
Private facility	79	130	8	18	21	156
Mission/faith-based	80	64	13	17	21	147
Any other source	25	738	n/a	n/a	n/a	n/a
Total	42	1,385	7	26	28	1,177

Figure 17 Diagnosis of fever by malaria diagnostic capacity in Tanzania



4.3.6 ACT availability

Among children under age 5 with a fever who sought treatment and took an antimalarial drug, 85% of children received an ACT. By facility type, receipt of ACT varies from 96% of children for whom treatment was sought and an antimalarial was prescribed at a government clinic or dispensary, 84% at a non-health facility, 81% at government health centers, 80% at a government hospital, 75% at a private facility, and 75% at a mission or faith-based facility.

In examining the 2014-15 Tanzania SPA, 90% of facilities had an ACT drug in stock on the day of the survey (Table 25). This means that the ACT drug was observed in the health facility, and there was at least one valid dose available on the day of the interview. By facility type, 94% of government health centers, 94% of government dispensaries, and 91% of government hospitals had ACTs available in stock. However, only 84% of mission or faith-based facilities and 74% of private facilities organizations had ACTs available in stock. In Tanzania, 80% of facilities had injectable quinine available on the day of the survey, while 67% of facilities had oral quinine. Less common drugs available included injectable artesunate (27% of facilities) and artesunate suppository (2%) (Table 25).

When comparing the type of antimalarial drug used and the availability of antimalarial drugs by facilities in Tanzania, more than 96% of children who visited a government clinic or dispensary with a fever received an ACT. This concurs with the data from the facility level in that greater than 94% of government clinics or dispensaries had availability of ACTs on the day of the survey.

Table 25 Type of antimalarial drug used and availability of antimalarial drugs by facilities in Tanzania

	2015-16 Tanzania DHS-MIS						2014-15 Tanzania SPA					
							Among facilities offering malaria diagnosis/treatment services or curative sick child care services					
Facility type	ACT	Injectable artesunate	Artesunate suppository (rectal)	Oral quinine	Injectable quinine	Number of children with fever who took an antimalarial drugs	Any ACT	Injectable artesunate	Artesunate suppository (rectal)	Oral quinine	Injectable quinine	Total number of facilities
Government hospital	80	2	0	4	7	38	91	52	2	73	88	24
Government health center	81	0	0	11	12	58	94	45	3	66	83	88
Government clinic/dispensary	96	0	0	0	2	194	94	24	1	70	83	761
Private facility	75	7	0	2	5	73	74	34	5	52	67	156
Mission/faith-based	75	0	0	7	13	43	84	25	4	64	77	147
Any other source	84	0	0	5	1	447	n/a	n/a	n/a	n/a	n/a	n/a
Total	85	1	0	4	3	811	90	27	2	67	80	1,177

4.3.7 Service readiness

Components of the malaria service readiness index include the facilities having personnel trained in mRDT, microscopy, or case management and treatment of malaria in children, national guidelines for diagnosis and treatment, proper supplies to diagnosis malaria, and ACTs available on site. Among facilities in Tanzania that offer malaria diagnosis/treatment services or curative care for sick children, 18% have all the components to be considered malaria service ready (Table 26). By facility type, the percentage of facilities that are considered malaria service ready ranges from 35% of government health centers to 11% of private facilities. Across all facilities (except government hospitals), the lowest component of the malaria service readiness index that was diagnostic capacity.

Comparing the source of advice or treatment for children with fever to the components of the malaria service readiness index, 19% of children with a fever were taken to a government clinic or dispensary, although only 19% of government clinics or dispensaries are considered malaria service ready. Among government clinics or dispensaries, 94% have ACTs available and 65% have national guidelines for diagnosis and treatment of malaria, two components of service readiness. At the government health centers in Tanzania that are performing poorly, only 47% of facilities have personnel trained in mRDT, microscopy, or case management and treatment of malaria in children, and 27% have diagnostic capacity. In Tanzania, 35% of government health centers are malaria service ready, but only 6% of children seek care at a government health centers for fever.

Table 26 Source of advice or treatment for children with fever and components of malaria service readiness by facilities in Tanzania

	2015-16 Tanzania DHS-MIS		2014-15 Tanzania SPA					
			Among facilities offering malaria diagnosis/treatment services or curative sick child care services					
Facility type	Percentage for whom advice or treatment was sought	Number of children under age 5 with a fever	Personnel trained in mRDT, microscopy, or case management and treatment of malaria in children	National guidelines for diagnosis and treatment of malaria	Diagnostic capacity	ACTs available	Malaria service readiness index	Total number of facilities
Government hospital	4	1,706	67	48	62	91	33	24
Government health center	6	1,706	74	61	57	94	35	88
Government clinic/dispensary	19	1,706	47	65	27	94	19	761
Private facility	8	1,706	27	43	21	74	11	156
Mission/faith-based	4	1,706	48	60	21	84	12	147
Any other source	54	1,706	n/a	n/a	n/a	n/a	n/a	n/a
Total	81	1,706	47	61	28	90	18	1,177

4.3.8 Malaria endemicity

We also examined malaria service readiness by endemicity level for each type of facility. The lower malaria risk category for Tanzania included facilities with a PfPR≤ 5%, while facilities with a higher malaria risk had a PfPR≥5.1%. In general, across all components of malaria service readiness (trained personnel,

guidelines, diagnostic capacity, and available ACTs), the malaria service component is higher in areas of higher malaria transmission when compared to lower malaria transmission areas. When examining malaria service readiness by facilities and malaria endemicity, government hospitals, government health centers, and government clinics or dispensaries had a higher malaria service readiness in locations with higher malaria endemicity, while private facilities and mission or faith-based facilities had higher malaria service readiness in locations with lower malaria endemicity (Table 27).

Table 27 Malaria service readiness by malaria endemicity and facility in Tanzania

	2014-15 Tanzania SPA					
Facility type	Personnel trained in mRDT, microscopy, or case management/treatment of malaria in children	National guidelines for diagnosis and treatment of malaria	Diagnostic capacity	ACTs available	Malaria service readiness index	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services
Government hospital						
PfPR≤ 5%	70	44	63	88	28	12
PfPR≥5.1%	63	51	61	95	39	12
Government health center						
PfPR≤ 5%	79	59	62	94	34	39
PfPR≥5.1%	69	63	54	95	37	50
Government clinic/dispensary						
PfPR≤ 5%	44	63	26	95	16	312
PfPR≥5.1%	49	67	27	94	20	449
Private facility						
PfPR≤ 5%	30	35	25	75	11	94
PfPR≥5.1%	24	55	14	72	10	62
Mission/faith-based						
PfPR≤ 5%	47	73	25	74	14	69
PfPR≥5.1%	48	49	17	93	10	78
Total						
PfPR≤ 5%	45	58	29	88	16	526
PfPR≥5.1%	48	63	27	92	20	651

5 DISCUSSION AND CONCLUSIONS

To investigate the gaps between the seeking and provision of malaria services, we examined malaria service utilization data in children under age 5 with fever from the household-based DHS surveys and provision of care data from the facility-based SPA surveys from Malawi, Senegal, and Tanzania. Here we summarize the key results for each component of malaria service readiness by facility and malaria service readiness by malaria endemicity, discuss the study limitations, and provide overall conclusions.

5.1 Key Findings of Malaria Service Readiness Components by Facility

5.1.1 Trained personnel

An essential component of the proper diagnosis and treatment of malaria is the adequate training of facility staff to provide the required services. Ongoing training for service providers ensures that providers continue to learn the latest information about the services they provide. The percentage of facilities with at least one personnel member trained in mRDT, microscopy, or case management and treatment of malaria in children in the 24 months before the survey ranges from 47% of all facilities in Tanzania to 88% of all facilities in Senegal. In all three countries, the lowest level facilities (health center/health post/health clinic) were the most commonly utilized facilities for advice and treatment- seeking among children with fever. In Senegal, 96% of health centers or health post facilities had at least one personnel member trained in the diagnosis and treatment of malaria in children in the 24 months before the survey. However, Malawi (65%) and Tanzania (74%) had far fewer health centers or health post facilities with at least one person trained in malaria diagnosis and treatment. These findings suggest that Malawi and Tanzania should increase the number of malaria-specific trainings offered to personnel, especially focusing on the facilities, such as the government health centers, where care-seeking for children with fever is most prevalent. Although the personnel might have received training in the past (>24 months prior to the survey), malaria policies are continually changing. There can be repercussions on the quality of diagnosis and treatment in facilities that do not have at least one personnel member trained in updated policies.

5.1.2 National guidelines

National guidelines for the diagnosis and treatment of malaria are essential components of malaria care in the facility setting. National guidelines serve as references for health care providers on the proper diagnosis and treatment of malaria in their country. The percentage of facilities with national guidelines for diagnosis and treatment of malaria ranges from 62% of all facilities in Tanzania to 87% of all facilities in Senegal. When compared to other facility types, the health posts/health clinics/dispensaries in Senegal and Tanzania had the highest percentage of facilities with national guidelines for diagnosis and treatment of malaria. In Malawi, however, a higher percentage of hospitals (82%) had national guidelines available than the government health centers (71%).

Similar to the percentage of facilities with at least one trained personnel member, Senegal is performing well with almost all health posts (94%) having national guidelines for diagnosis and treatment of malaria available at the facility. Unfortunately, the lack of available national guidelines is prevalent across all facility types in Malawi and Tanzania. The availability of national guidelines within the health facility is essential for staff to be knowledgeable about the guidelines for the diagnosis and treatment of malaria in

their country. It is imperative for countries to disseminate regular guidelines across all levels of the health facility system so that all staff are informed. In addition, across all three countries, private facilities had the lowest percentage of facilities with national guidelines available on the day of the interview. Since private facilities play a key role in the diagnosis and treatment of malaria, it is vital that they are also aware of the national guidelines.

5.1.3 Diagnostic capacity

Malaria diagnostic capacity in a facility is defined as having microscopy or mRDT capacity. The percentage of facilities with diagnostic capacity ranges from 28% for all facilities in Tanzania to 60% for the facilities in Senegal. Across the three countries, government hospitals had the highest percentage of facilities with diagnostic capacity. Government hospitals provide a wide array of services and are expected to have strong diagnostic capacity. However, most care for children is sought at government health centers/health posts/clinics in Malawi and Tanzania, where the diagnostic capacity of these facilities is less than 50%. In all three countries, the malaria service readiness indicator was most influenced by a low diagnostic capacity. Within the components of microscopy capacity, countries in this analysis had a low percentage of facilities with adequate microscopy supplies (a functioning microscope with glass slides and relevant stains). Within the components of mRDT capacity, countries had a low percentage of facilities with at least one personnel member trained in mRDT.

Having adequate diagnostic capacity within facilities is a key component to the *T3: Test, Treat, and Track* policy implemented by WHO in 2012 [34]. This policy mandates that every suspected malaria case should be tested, every confirmed case should be treated with a quality-assured antimalarial medicine, and the disease should be tracked through a timely and accurate surveillance system [34]. However, if adequate diagnostic supplies are not available in the facility or if personnel are not adequately trained in mRDT or microscopy testing, the T3 policy cannot be properly implemented.

5.1.4 ACT availability

The universal and continuous availability of antimalarial drugs is a critical component in the delivery of malaria treatment in health facilities. The percentage of facilities with unexpired ACTs available on the day of the survey ranges from 69% of all facilities in Senegal to 92% of all facilities in Malawi. Examination of the most frequently reported source for advice or treatment for fever across all three countries (health center or health post) showed that more than 90% of facilities had ACTs available on the day of the survey. This is an encouraging finding because children who are positive for malaria can be treated with ACTs within the facility where treatment is sought. According to the World Malaria Report, an estimated 409 million treatment courses of artemisinin-based combination therapy (ACT) were procured by countries in 2016, which represents an increase from 311 million in 2015 [1]. Of these procurements, 69% were reported in the public sector. This is evident in the results of this analysis. Regardless of the source of care, the majority of children who are treated with antimalarials are receiving ACTs in comparison to the less efficacious monotherapy antimalarial drugs, although these drugs are available in the facility. Across all three countries, the private facilities had the lowest percentage of facilities with ACTs available on the day of the survey. While many governments do not have control of the stocks of ACTs in the private facilities, these facilities play a crucial role in the overall health system and make a significant contribution to the treatment of malaria.

5.1.5 Malaria service readiness

The malaria service readiness index is an indicator that measures the ability of a facility to provide the best care for the diagnosis and treatment of malaria. The facility must have personnel trained in either mRDT, microscopy, or case management and treatment of malaria in children, national guidelines for diagnosis and treatment of malaria, diagnostic capacity (microscopy or mRDT capacity), and unexpired ACTs to be classified as malaria service ready. The percentage of facilities classified as malaria service ready ranges from 49% of the facilities in Senegal to 18% of the facilities in Tanzania. Despite some countries performing well in the individual components of malaria service readiness, a facility must have all four required components to be classified as malaria service ready. Overall, among the four components of readiness, the diagnostic capacity is the weakest area, followed by personnel training. All three countries perform well in the availability of ACTs. Analysis of the most utilized provider type for malaria services revealed that in Senegal, 69% of health centers or health posts were classified as malaria service ready, compared with a much lower level in Malawi and Tanzania at 32% and 20%, respectively. Across the three countries, government hospitals had the highest percentage of facilities classified as malaria service ready, although only 10% of children under age 5 with a fever sought advice at a government hospital.

5.2 Key Findings of Malaria Service Readiness by Endemicity

Previous research has shown a link between health facility readiness to deliver malaria services and malaria endemicity [5]. To examine this relationship, we stratified each facility type by high and low endemicity (within the country) and compared the malaria service readiness. In general, across all three countries, there was higher malaria service readiness in facilities located in the higher malaria endemicity areas of the country. The exception was private and faith-based facilities where a higher degree of readiness was observed in locations with low malaria endemicity. In all three countries, the greatest difference in malaria service readiness by endemicity is seen in government facilities versus private or faith-based organizations. Government hospitals, health posts, and health huts all had higher malaria service readiness in areas of higher malaria endemicity. This may be due to the targeting of limited resources to facilities that have a higher demand for malaria services, although the private and faith-based organizations had higher malaria service readiness in places of lower malaria endemicity. This finding could be related to the ease of providing supplies to urban settings that also have lower malaria endemicity. This report did not test for significant differences between the endemicity of facility types, but this could be explored in an additional analysis.

5.2.1 Study limitations

One important limitation of this study is the lack of linkages between the facilities in the DHS and SPA surveys. Without this linkage, we do not know the service readiness of the exact facilities where the caregiver sought advice and treatment for their child with a fever. In this report, the SPA surveys provided information on the malaria service readiness of facilities, while the DHS surveys provided information on population-level utilization of malaria services in children under age 5 with fever. However, linking these two types of data sources can be challenging because the SPA and DHS are independent surveys and were not designed to be linked. In addition, DHS clusters are geographically displaced to protect confidentiality of the participants [35]. Since linkage of DHS and SPA surveys is not possible with these limitations, this report provides a general overview of service readiness of facilities (according to SPA surveys) by specific categories of facilities where caregivers sought care for children under age 5 with fever (according to the

DHS surveys). While harmonizing facility types between DHS and SPA, several types (private hospitals, clinics, dispensaries) are sometimes classified into one category, and this suggests that variability in service readiness among these facilities may exist.

Another limitation is that the service readiness of informal health services or private health care providers who operate outside a formal facility are not included in this report because the SPA includes only formal-sector health facilities. There is evidence of increased use of private healthcare providers and informal health care providers, such as pharmacies, for the disbursement of antimalarial drugs. For example, in the 2015-16 Tanzania DHS-MIS, 54% of children who sought advice or treatment for fever were taken to a location categorized as an "other source." The primary reason that smaller private providers, informal health care providers, or CHWs who provide iCCM, are not included in a SPA survey is the absence of an accurate sampling frame for these providers. Since many of these providers are not well documented or do not have the proper accreditation, the MoH does not have a complete listing that could serve as the basis for a sampling frame. In addition, including these types of health care providers in SPA surveys has the potential to substantially increase the cost of the survey. Nevertheless, these providers are valuable sources of antimalarial drugs for many individuals.

The SPA has limits with the assessment of case management of severe malaria, because it does not provide a complete analysis of a facility's ability to provide proper pre-referral treatment [29]. Although information is collected on availability of artesunate injections, the training of providers on the treatment of severe malaria is not assessed. For Tanzania and Malawi, it should also be noted that the survey periods did not overlap, and this limited the direct comparability of the SPA and DHS surveys. In Malawi, there was a gap of 20 months between the field work of the two surveys, while the surveys in Tanzania were fielded six months apart.

Household survey questions and indicators are also limited. For example, the DHS survey asked questions about finger or heel stick, which is a proxy indicator for examination of a malaria diagnosis. In addition, the questions about where caregivers sought treatment and those about the drugs taken for treatment are multiple response questions, which means that a caregiver could have taken a child to two types of facilities for treatment and that both facilities would be captured in the percent distribution of sites visited for advice and treatment.

Finally, there are limitations in terms of sample size. The R^2 values in the analysis are limited to four or five data points because the facilities had to be grouped to allow for comparability between the DHS and SPA. In addition, with low malaria parasitemia, Senegal has very few cases of febrile children. The problem of small sample size emerges when the data are further stratified to examine febrile children for whom care was sought by health facility type. This should be noted in interpretation of the results.

5.2.2 Conclusions

This report investigated the gaps between the seeking and provision of malaria services through the examination of malaria service utilization data in children under age 5 with fever from the household-based DHS surveys and provision of care data from the facility-based SPA surveys from Malawi, Senegal, and Tanzania. By using existing data sources, we are able to further examine health system performance with the goal of better targeting of interventions. Further research is needed on the readiness and quality of

services provided by informal providers in settings where the informal sector is widely used for malaria diagnosis and treatment.

In all three countries, the health center/health post/health clinic was the most utilized type of facility for care-seeking among children with fever. However, only 69% of these facilities in Senegal, 32% in Malawi, and 19% in Tanzania were classified as malaria service ready (Figure 18). Malaria endemicity appears to be a driver of service readiness of health facilities. Overall, facilities located in high endemicity areas were found to be better prepared to provide malaria diagnostic and treatment services.

This report highlights the need for improving the malaria service readiness of facilities in all three countries. More effort should be focused on facilities that are commonly used for care, especially in the areas of malaria diagnostic capacity and provider training. It is essential for policy makers to consider the malaria service readiness of secondary health care facilities when allocating resources and trainings. This is particularly important in limited resource settings to ensure that the points of care that are most utilized are properly equipped to provide diagnosis and treatment for malaria.

Figure 18 Summary table of results

	Malawi	Senegal	Tanzania
Most visited facility by febrile children (according to DHS results of percent of children under 5 with fever for whom care or treatment was sought)	Government health center 39%	Government health post or mobile clinic 32%	Government clinic/ dispensary 19%
Personnel trained in mRDT, microscopy, or case management/treatment of malaria in children	65%	96%	47%
Guidelines for diagnosis and treatment of malaria	71%	94%	65%
Diagnostic capacity	41%	74%	27%
ACTs available	99%	96%	94%
Malaria service readiness index	32%	69%	19%

Recommendations for improvement

Among the four components of malaria service readiness in the facilities most frequented by febrile children, diagnostic capacity is the weakest area in all three countries. Ways to improve diagnostic capacity include increasing the number of trained personnel as well as making national case management guidelines more readily available.

In Tanzania and Malawi, the facility types most frequented by febrile children performed poorer than other higher level government facilities, particularly in the area of trained personnel. These facilities have lower proportions of trained personnel across all three training categories (mRDT, microscopy, and case management/treatment). Training should be prioritized for personnel working in facilities where case is most frequently sought, as is the case in Senegal.

All three countries performed well in the availability of ACTs and RDTs, however, this must be maintained.

REFERENCES

1. World Health Organization. 2017. *World Malaria Report 2017*. Geneva, Switzerland: World Health Organization.

2. World Health Organization. 2015. *Global Technical Strategy for Malaria 2016-2030*. Geneva: Switzerland: World Health Organization.

3. World Health Organization. 2015. *Guidelines for the Treatment of Malaria. 3rd edition*. Geneva, Switzerland: World Health Organization.

4. Zhao, J., M. Lama, E. Korenromp, P. Aylward, E. Shargie, S. Filler, R. Komatsu, R. Atun. 2012. "Adoption of Rapid Diagnostic Tests for the Diagnosis of Malaria, a Preliminary Analysis of the Global Fund Program Data, 2005 to 2010." *PLoS One* 7(8): e43549. https://doi.org/10.1371/journal.pone.0043549.s001.

5. Lee, E. H., C. H. Olsen, T. Koehlmoos, P. Masuoka, A. Stewart, J. W. Bennett, and J. Mancuso. 2017. "A Cross-sectional Study of Malaria Endemicity and Health System Readiness to Deliver Services in Kenya, Namibia, and Senegal." *Health Policy and Planning* 32(suppl_3): iii75-iii87. https://doi.org/10.1093/heapol/czx114.

6. Zurovac, D., M. Ndhlovu, N. Sipilanyambe, P. Chanda, D. H. Hamer, J. L. Simon, and R. W. Snow. 2007. "Paediatric Malaria Case-management with Artemether-lumefantrine in Zambia: A Repeat Cross-sectional Study." *Malaria Journal* 6(1): 31. https://doi.org/10.1186/1475-2875-6-31.

7. Namuyinga, R.J., D. Mwandama, D. Moyo, A. Gumbo, P. Troell, M. Kobayashi, M. Shah, et al. 2017. "Health Worker Adherence to Malaria Treatment Guidelines at Outpatient Health Facilities in Southern Malawi Following Implementation of Universal Access to Diagnostic Testing." *Malaria Journal* 16 (1): 40. https://doi.org/10.1186/s12936-017-1693-3.

8. Rowe, A. K., G. F. Ponce de León, J. Mihigo, A. C. Santelli, N. P. Miller, P. Van-Dúnem, and J. Malar. 2009. "Quality of Malaria Case Management at Outpatient Health Facilities in Angola." *Malaria Journal* 8(1): 275. http://dx.doi.org/10.1186/1475-2875-8-275.

9. Njogu, J., W. Akhwale, D. H. Hamer, and D. Zurovac. 2008. "Health Facility and Health Worker Readiness to Deliver New National Treatment Policy for Malaria in Kenya." *East African Medical Journal* 85(5): 213-221.

10. Steinhardt, L. C., J. Chinkhumba, A. Wolkon, M. Luka, M. Luhanga, J. Sande, J. Oyugi, et al. 2014. "Quality of Malaria Case Management in Malawi: Results from a Nationally Representative Health Facility Survey." *PLoS One* 9(2): e89050. http://doi.org/10.1371/journal.pone.0089050.

11. Abdelgader, T. M., A. M. Ibrahim, K. A. Elmardi, S. Githinji, D. Zurovac, R. W. Snow, and A. M. Noor, et al., 2012. "Progress Towards Implementation of ACT Malaria Case-Management in Public Health Facilities in the Republic of Sudan: A Cluster-sample Survey." *BMC Public Health*. 12(1): 11. https://doi.org/10.1186/1471-2458-12-11.

12. Poyer, S., T. Shewchuk, S. Tougher, Y. Ye, ACTwatch Group, A. G. Mann, B. A. Willey, et al. 2015. "Availability and Price of Malaria Rapid Diagnostic Tests in the Public and Private Health Sectors in 2011: Results from 10 Nationally Representative Cross-sectional Retail Surveys". *Tropical Medicine & International Health* 20(6): 744-756. https://doi.org/10.1111/tmi.12491.

13. Noor, A. M., I. A. Rage, B. Moonen, and R. W. Snow. 2009. "*Health Service Providers in Somalia:Their Readiness to Provide Malaria Case-management." Malaria Journal* 8(1): 100. https://doi.org/10.1186/1475-2875-8-100.

14. ACTwatch Group, H. Kaula, P. Buyungo and J. Opigo. 2017. "Private Sector Role, Readiness and Performance for Malaria Case Management in Uganda, 2015*." Malaria Journal*. 16(1): 219. https://doi.org/10.1186/s12936-017-1824-x.

15. Kyabayinze, D. J., C. Asiimwe, D. Nakanjako, J. Nabakooza, H. Counihan, and J. K. Tibenderana. 2010. "Use of RDTs to Improve Malaria Diagnosis and Fever Case Management at Primary Health Care Facilities in Uganda*." Malaria Journal.* 9(1): 200. https://doi.org/10.1186/1475-2875-9-200.

16. Ruizendaal, E., S. Dierickx, K. P. Grietens, H. DFH Schallig, F. Pagnoni, and P. F. Mens, 2014. "Success or Failure of Critical Steps in Community Case Management of Malaria with Rapid Diagnostic Tests: A Systematic Review*." Malaria Journal* 13(1): 229. https://doi.org/10.1186/1475-2875-9-200.

17. World Health Organization and UNICEF. 2012. *WHO/UNICEF Joint Statement: Integrated Community Case Management (iCCM) - An Equity-focused Strategy to Improve Access to Essential Treatment Services for Children*. New York, NY: United Nations Children's Fund. https://www.unicef.org/health/files/iCCM_Joint_Statement_2012.pdf.

18. Rowe, S. Y., J. M. Kelly, M. A. Olewe, D. G. Kleinbaum, J. E. McGowan Jr, D. A. McFarland , R. Rochat, and M. S. Deming. 2007. "Effect of Multiple Interventions on Community Health Workers' Adherence to Clinical Guidelines in Siaya District, Kenya." *Trans R Soc Trop Med Hyg*, **101**(2): 188-202. https://doi.org/10.1016/j.trstmh.2006.02.023.

19. Mukanga, D., A. B. Tiono, T. Anyorigiya, K. Källander, A. T. Konaté, A. R. Oduro, J. K. Tibenderana, et al. 2012. "Integrated Community Case Management of Fever in Children under Five Using Rapid Diagnostic Tests and Respiratory Rate Counting:A Multi-country Cluster Randomized Trial." *Am J Trop Med Hyg* 87(5 Suppl): 21-9. https://doi.org/10.4269/ajtmh.2012.11-0816..

20. Zurovac, D., J-O. Guintran, W. Donald, E. Naket, J. Malinga, and G. Taleo. 2015. "Health Systems Readiness and Management of Febrile Outpatients under Low Malaria Transmission in Vanuatu." *Malaria Journal*. 14(1): 489. https://doi.org/10.1186/s12936-015-1017-4.

21. Kazembe, L. N., I. Kleinschmidt, T. H. Holtz, and B. L. Sharp. 2006. "Spatial Analysis and Mapping of Malaria Risk in Malawi Using Point-referenced Prevalence of Infection Data." *International Journal of Health Geographics*. 5: 41-41. https://doi.org/10.1186/1476-072X-5-41.

22. USAID. 2018. Malawi Malaria Operational Plan FY 2018. https://www.pmi.gov/docs/default-source/default-document-library/malaria-operational-plans/fy-2018/fy-2018-malawi-malaria-operational-lan.pdf?sfvrsn=5.

23. Ministry of Health (Malawi) and ICF International. 2014. *Malawi Service Provision Assessment 2013-14*. Lilongwe, Malawi: MoH/Malawi and ICF International. https://dhsprogram.com/pubs/pdf/SPA20/SPA20%5BOct-7-2015%5D.pdf.

24. National Malaria Control Programme. *Guidelines for the Treatment of Malaria in Malawi*, 2013. Lilongwe, Malawi: Government of Malawi, Ministry of Health. https://www.severemalaria.org/sites/mmv-smo/files/content/attachments/2017-03-03/Malawi%202013%20Edition%20of%20Malaria%20Treatment%20Guidelines.pdf.

25. USAID. 2018. President's Malaria Initiative, *Senegal- Malaria Operational Plan FY 2018*. https://www.pmi.gov/docs/default-source/default-document-library/malaria-operational-plans/fy-2018/fy-2018-senegal-malaria-operational-plan.pdf?sfvrsn=5.

26. Agence Nationale de la Statistique et de la Démographie (ANSD) and ICF. 2017. *Senegal Enquête Démographique et de Santé Continue (EDS-Continue) 2016*. Dakar, Sénégal: ANSD and Rockville, Maryland, USA: ICF.

27. Programme National de Lutte contre le Paludisme-Senegal. 2015. *Plan Strategique National de Lutte contre le Paludisme au Senegal 2016-2020*. https://fr.africacheck.org/wp-content/uploads/2018/04/Senegal-paludisme-PSN-2016-2020-PNLP.pdf.

28. Dieye, B., M. Affara, L. Sangare, F. Joof, Y. D. Ndiaye, J. F. Gomis, M. Ndiaye, A. Mbaye, et al. 2016. *West Africa International Centers of Excellence for Malaria Research: Drug Resistance Patterns to Artemether-Lumefantrine in Senegal, Mali, and The Gambia. Am J Trop Med Hyg*. 95(5): 1054-1060. https://doi.org/10.4269/ajtmh.16-0053

29. Linn, A. M., Y. Ndiaye, I. Hennessee, S. Gaye, P. Linn, and M. McLaughlin. 2015. *Reduction in Symptomatic Malaria Prevalence Through Proactive Community Treatment in Rural Senegal. Trop Med Int Health*, 20(11): 1438-1446. https://doi.org/10.1111/tmi.12564

30. National Malaria Control Programme -The United Republic of Tanzania, 2014. *National Malaria Strategic Plan 2014–2020* 2014. http://ihi.eprints.org/3314/1/Malaria_Strategic_Plan_Full_Version_02_27_14.pdf.

31. Zanzibar Malaria Elimination Programme - Revolutionary Government of Zanizbar Ministry of Health, 2017. *Zanzibar Malaria Elimination Strategic Plan IV 2018/19-2022/23*.

32. National Malaria Control Programme - The United Republic of Tanzania. 2014. *National Guidelines for Diagnosis and Treatment of Malaria*.

33. Roll Back Malaria Partnership to End Malaria (RBM), 2013. *Household Survey Indicators for Malaria Control*. http://www.malariasurveys.org/documents/Household%20Survey%20Indicators%20for%20Malaria%20Control.pdf.

34. World Health Organization. 2012. *T3: Test. Treat. Track initiative*. http://www.who.int/malaria/areas/test_treat_track/en/.

35. Wang, W., R. Winter, L. Mallick, C. Burgert-Brucker, and E. Carter. 2015. *The Relationship Between the Health Service Environment and Service Utilization: Linking Population Data to Health Hacilities Data in Haiti and Malawi*. *DHS Analytical Studies No.* 51. Rockville, Maryland, USA: ICF International. https://www.dhsprogram.com/pubs/pdf/AS51/AS51.pdf.

APPENDIX INDICATOR CONSTRUCTION

Appendix Table A.1 Facilities offering malaria diagnosis/treatment services

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of all facilities offering malaria diagnosis/treatment services	Number facilities offering malaria diagnosis/treatment services	Inventory Questionnaire	Interviewer observed RDT being conducted: Q1420(6)=1 **OR** Providers in facility diagnose malaria: Q1702=1 **OR** Providers in facility prescribe treatment for malaria: Q1710=1 **OR** Facility had malaria microscopy capacity *(all components 1, 2, and 3)* 1. Light microscope used and functioning: Q840(1) B=1 AND Q840(1)C=1 AND 2. Glass slides and covers used: Q840(8)B=1 AND 3. Giemsa Stain, Field Stain, or Acridine Orange stain available: Q847(1)B=1 OR Q847(2)B=1 OR Q847(3)B=1 **OR** Facility had RDT capacity *(components 1, 2, or 3)* 1. Observed RDT kit (malaria section): Q1706=1 OR 2. Observed RDT kit (parasitology section): Q843=1 OR 3. Observed malaria rapid diagnostic testing: Q1420(6)=1
	Total number of facilities		Total number of facilities interviewed Q006

Appendix Table A.2 Facilities offering curative child care services

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of all facilities offering curative child care services	Number facilities offering curative child care services	Inventory Questionnaire	Q102(03)=1 And Q1201a!=0
	Total number of facilities		Total number of facilities interviewed Q006

Appendix Table A.3 mRDT training

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities with personnel trained in mRDT among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in malaria mRDT in the past 24 months	Health Worker Questionnaire	Health worker personally provides child curative care and has received in-service training *(components 1 and 2)* 1. Health worker personally provides any child curative care services: Q302=1 **AND** 2. Health worker received in-service training or training updates: Child health services section of questionnaire • Perform malaria RDT test: Q304(4)=1 OR Malaria section of questionnaire • Perform malaria RDT test: Q206(3)=1 OR Diagnostic services section of questionnaire • Malaria RDT: Q703(8)=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.4 Microscopy training

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities with personnel trained in malaria microscopy among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in malaria microscopy in the past 24 months	Health Worker Questionnaire	Health worker personally provides child curative care and has received in-service training *(components 1 and 2)* 1. Health worker personally provides any child curative care services: Q302=1 **AND** 2. Health worker received in-service training or training updates: Child health services section of questionnaire • Diagnosis of malaria in children: Q304(3)=1 OR Malaria section of questionnaire • Diagnosing malaria in children: Q206(2)=1 • How to perform malaria microscopy: Q206(8)=1 o Variable only found in 2014-15 TZ SPA OR Diagnostic services section of questionnaire • Malaria Microscopy: Q703(7)=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.5 Case management and treatment training

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities with personnel trained in case management/treatment of malaria in children among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with at least one interviewed provider who reports receiving in-service training in case management/treatment of malaria in children in the past 24 months	Health Worker Questionnaire	Health worker personally provides child curative care and has received in-service training *(components 1 and 2)* 1. Health worker personally provides any child curative care services: Q302=1 **AND** 2. Health worker received in-service training or training updates: Child health services section of questionnaire • Case management/treatment of malaria in children: Q304(5)=1 OR Malaria section of questionnaire • Case management/treatment of malaria in Children: Q206(7)=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.6 Diagnosis and treatment of malaria guidelines

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have national guidelines for diagnosis and treatment of malaria among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with guidelines for diagnosis/treatment of malaria	Inventory Questionnaire	Facility had diagnosis and treatment of malaria guidelines available *(components 1 or 2)* 1. Available and observed *national guidelines* for the diagnosis and treatment of malaria: Q1712=1 OR 2. Available and observed *other* guidelines for the diagnosis and treatment of malaria: Q1714=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.7 mRDT protocol

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have protocol for malaria mRDT among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with protocol for malaria RDT	Inventory Questionnaire	Facility had RDT protocol available *(components 1 or 2)* 1. Interviewer shown training manual, poster, or job aid for using malaria RDT (parasitology section): Q846=1 OR 2. Interviewer shown training manual, poster, or job aid for using malaria RDT (malaria section): Q1709=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.8 mRDT supplies

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have malaria mRDTs supplies among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with malaria RDT supplies	Inventory Questionnaire	Facility had RDT capacity *(components 1, 2, or 3)* 1. Observed RDT kit (malaria section): Q1706=1 **OR** 2. Observed RDT kit (parasitology section): Q843=1 **OR** 3. Observed malaria rapid diagnostic testing: Q1420(6)=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.9 Microscopy supplies

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have malaria microscopy supplies among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with malaria microscopy supplies	Inventory Questionnaire	Facility had malaria microscopy capacity *(all components 1,2,and 3)* 1. Light microscope used and functioning: Q840(1) A=1 AND Q840(1)C=1 **AND** 2. Glass slides and covers used: Q840(8)A=1 **AND** Giemsa Stain, Field Stain, or Acridine Orange stain available: Q847(1)B=1 OR Q847(2)B=1 OR Q847(3)B=1
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.10 Microscopy diagnostic capacity

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have microscopy diagnostic capacity among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with microscopy diagnostic capacity	Inventory Questionnaire	Malaria microscopy capacity *(all components 1 and 2)* 1. Number of facilities with malaria microscopy AND 2. Number of facilities with staff trained in malaria microscopy
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.11 mRDT diagnostic capacity

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have mRDT diagnostic capacity among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities with mRDT diagnostic capacity	Inventory Questionnaire	Malaria RDT capacity *(all components 1,2,and 3)* 1. Number of facilities with protocol for malaria RDT AND 2. Number of facilities with malaria RDT AND 3. Number of facilities with staff trained in malaria RDT
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.12 Diagnostic capacity

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities that have diagnostic capacity (microscopy diagnostic capacity or mRDT diagnostic capacity) among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities that have diagnostic capacity	Inventory Questionnaire and Health Provider Questionnaire	Malaria RDT Capacity *(all components 1,2,and 3)* 4. Number of facilities with protocol for malaria RDT AND 5. Number of facilities with malaria RDT AND 6. Number of facilities with staff trained in malaria RDT **OR** Malaria Microscopy Capacity *(all components 1 and 2)* 3. Number of facilities with malaria microscopy AND 4. Number of facilities with staff trained in malaria microscopy
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.13 Antimalarial availability

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities with ACTs among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities that have ACTs available	Inventory Questionnaire and Health Provider Questionnaire	Facility had antimalarial medicines available: Artemether Lumefrantrine (LA) 6 tablets/pack: Q905(1)=1 OR Artemether Lumefrantrine (LA) 12 tablets/pack: Q905(2)=1 OR Artemether Lumefrantrine (LA) 18 tablets/pack: Q905(3)=1 OR Artemether Lumefrantrine (LA) 24 tablets/pack: Q905(4)=1 *Malawi and Tanzania included the following drugs in addition to the standard drugs listed above:* Artemether – Amodiaquine (ASAQ) 25mg/67.5mg: Q905(10A)=1 OR Artemether – Amodiaquine (ASAQ) 50mg/135mg: Q905(10B)=1 OR Artemether – Amodiaquine (ASAQ) 100mg/270mg: Q905(10C)=1 *Senegal included the following drugs from the "Inventory for Case de Santé Questionnaire" in addition to the standard drugs listed above:* Artemisinin-Based Combination Therapy [ACT] Adult Artemisinin-Based Combination Therapy [ACT] Child Artemisinin-Based Combination Therapy [ACT] Infant
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services

Appendix Table A.14 Malaria service readiness

Definition	Numerator/denominator	Questionnaire	Formula
Proportion of facilities who are malaria service ready among facilities offering malaria diagnosis/treatment services or curative sick child care services	Number of facilities that are malaria service ready	Inventory Questionnaire and Health Provider Questionnaire	Facility has diagnosis and treatment of malaria guidelines available=TRUE AND Facility has ACTs available=TRUE AND Facility has personnel trained in mRDT, microscopy, or case management/treatment of malaria in children=TRUE AND Facility has diagnostic capacity=TRUE
	Total number of facilities offering malaria diagnosis/treatment services or curative sick child care services		Number of facilities offering malaria diagnosis/treatment services or curative sick child care services