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Research

Resource mapping and malaria surveillance capacity of health facilities in Federal Capital Territory, Abuja, Nigeria-June 2020

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ABSTRACT

Introduction: Malaria is responsible for about 500 million cases and one million deaths annually. A disease of high burden in sub-Saharan Africa, with challenges of resource deficit leading to delayed elimination, we determine resources available in health facilities for malaria surveillance, identified gaps, and made recommendations towards malaria elimination in Nigeria. **Methods:** Cross-sectional survey was conducted to determine the availability of malaria surveillance tools and officers, their knowledge, and the laboratory capacity of facilities. Knowledge was graded against a total score of 100 percent and ?70 percent score was considered good knowledge. Descriptive, bivariate, and multivariate analysis was done, and the 95% confidence interval of the adjusted odds ratio were reported. **Results:** A total of 221 facilities were studied. Mean age of respondents was 37.6 years ± 8.4, and 66.0% were males. All facilities studied had malaria focal persons and 85.5% were Community Health Officers (CHOs). Eighty-eight percent had good knowledge of malaria surveillance. Being a Nurse (p=0.004), Record Officers (p=0.03), and a duration of 1-5years as Malaria surveillance in-charge (p<0.001) were associated with, and predicting factors for good knowledge. While 95.0% report on indicators timely, 90.0% routinely analyzed their data. Surveillance tools available in facilities were outpatient and inpatient registers, outpatient and inpatient patient's card, and reporting forms. Only 16.3% of facilities had computers, while 59.0% of facilities had a functional laboratory with about half of the treated malaria cases laboratory confirmed. **Conclusion:** Resources and capacity for malaria diagnosis within the health facilities were sub-optimal. Conscious and deliberate efforts through training, equipping, and enhanced supportive supervision would be required to improve the system towards malaria elimination.

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KEYWORDS: Resources, Malaria, Surveillance, Federal Capital Territory, Nigeria

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Introduction

Malaria is one of the important vector-borne diseases with high fatality rates in tropical countries [1]. It is caused by the bites of mosquitos of the *Anopheles spp.* causing plasmodium infection in humans. Globally, malaria is responsible for about 500 million cases and one million deaths each year [2]. In 2017, there were an estimated 219 million cases of malaria with 435,000 in 87 countries. The WHO African Region carries a disproportionately high share of the global malaria burden. In 2017, the region was home to 92% of malaria cases and 93% of malaria deaths [3]. It has consistently remained a disease of high burden in Africa and most developing countries. As a disease of high burden, it impacts negatively on the economy of the already struggling developing countries most of which are in Africa [4]. Malaria is highly endemic in Nigeria where young children and pregnant mothers are the most affected according to reports [5]. African Heads of states, met in Abuja, Nigeria on April 25, 2000, to express commitment to the Roll Back Malaria (RBM) initiative seeing the economic burden the disease has placed on the continent [2,6]. Malaria Surveillance was identified as key to reducing the burden of malaria and its control in the meeting.

Effective surveillance is required at all points from malaria control to malaria elimination. The human and non-human resources are among the component of an effective surveillance system which consists of the tools, procedures, people, and structures [7]. Challenges of inadequate structures, lack of surveillance tools, noncompliance to existing procedures by program officers, general resource deficit, and suboptimal capacity of program officers to malaria surveillance have been highlighted in some studies [8]. Hence, efforts to eradicate malaria has been elusive with planning and intervention activities very challenging [9]. Globally, the ineffective malaria surveillance with poor resources have translated to poor program outputs. A report of seventeen countries in Africa involved in a malaria surveillance system evaluation showed that 14(82%) countries use paper-based collection of incidence data at the health facilities with 80% of cases treated without laboratory diagnostic information [10]. In the countries where electronic data collection was practices 3(18%), the extent at which this electronic data collection occurred varied among countries [10,11]. Across Nigeria, studies showed that malaria surveillance resources and the quality of laboratory testing need to be improved and ensure the quality of laboratory confirmation especially in high transmission areas [12].

As observed during supportive supervisions, resources in malaria programs are identified as a 'weak point&rsqup; towards malaria elimination in Nigeria. However, the extent of this is yet to be determined in parts of the country including Federal Capital Territory (FCT). This has impacted negatively the interventions towards eliminating malaria in Nigeria. Through this study, we hoped to identify the proportion of resource challenges and make recommendation based on findings to improve the system.

Methods

Participants

All 221 public health facility in FCT which has been in operation for at least one year were included in the study while those with interrupted services at the time of the study, were excluded from the study. The private health facilities were also excluded due to their uneven spread in the territory.

Study setting and design

We conducted a cross-sectional study and mapping of resources for malaria surveillance in 221 public health facilities in FCT between June - August, 2020.

Our study setting is the FCT in Nigeria with a landmass area of 7,315 sq.km, of which the definite city occupies 275.3 sq.km [12]. FCT has a tropical wet and dry climate [13]. The city experiences three weather conditions annually; warm, humid rainy season, and a blistering dry season [14]. The rainy season begins from April and ends in October.

FCT located at the center Figure 1 of the country, Nigeria, and has a projected population of 4,464,785 according to the National Population Commission census with males accounting for (52%) at 9.3% annual growth rate [14]. It is served by approximately 257 public health facilities; 3 Tertiary, 14 Secondary, and 240 Primary Health Care (PHC) facilities; and about 250 private health facilities. This study was conducted in the Six Area Councils (Municipal, Bwari, Gwagwalada, Kuje, Kwali and Abaji) of the Federal Capital, targeting the public health facilities where one MFP is expected to routinely collect, collate, analyze and report to the next level in the reporting channel.

A pretested structured interviewer-administered questionnaire was used to determine availability of malaria surveillance tools and officers, their knowledge and laboratory capacity in the 221 health facilities.

Sample size determination

We achieved a representative sample size for the study after having estimated the required minimum sample size at a 95% confidence interval and prevalence of 50 %, since no information exist in any previous study on this research topic [15].

$$n = \frac{Z_{\alpha}^2 p(1-p)}{d^2}$$

n = minimum sample size

Z_{α}^2 = Standard normal deviate. (At 5% type 1 error where (p<0.05), standard normal deviate is 1.96

p = 0.5. For this study, 0.5 was used since no information exist in any previous study on this research topic [15].

d= Absolute error or precision indicating how close the proportion of interest is to the desired estimate, we used 0.05 in this study;

$$n = \frac{(1.96)^2 \times 0.5(1-0.5)}{0.05^2} = 384$$

Finite population correction for proportions

With target population is 257(≈ approximate number of public health facilities in the FCT) we sampled without replacement, applying finite population correction.

$$nf = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

n = Minimum sample size calculated (384)

N = Total population of public health facilities in FCT

$$n = \frac{384}{1 + \frac{(384-1)}{257}} = 155$$

A design effect factor of 1.5 was considered based on anticipated clustering of responses due to the sampling technique used.

(1.5 x 155) = 232.5

Allowing for non-response rate of 5% (232.5/0.95) = 221 ref [16].

The minimum sample size of this study was therefore estimated at 221.

Sampling technique

A stratified cluster sampling technique was used. The clusters were the primary health facility units of the various Area Councils.

The list of all the PHCs were grouped according to Area Councils as sampling frames. There were 70 PHCs (Municipal), 36 PHCs(Bwari), 35PHCs(Gwagwalada), 34PHCs(Abaji), 33PHCs(Kwali), and 32PHCs(Kuje) as obtained from the routine report of the diseases of Public health importance in FCT. From table of random numbers, we selected randomly 52 PHCs from Municipal, 31(Bwari), 31(Gwagwalada), 30(Abaji), 30(Kwali), and 30(Kuje) (based on the proportion of reporting facilities by each Area council in the routine monthly reporting platform) making a total of 204 PHCs. All 14 secondary and 3 tertiary health facilities were purposively selected for the survey. We obtained a total of 221 health facilities (204PHCs, 14 secondary, and 3 tertiary health facilities). In the PHCs the respondents were persons responsible for malaria surveillance. One respondent from each health facility

Data collection

Research assistants were trained to reduce inter-observer variation in data collection. They were regularly supervised to ensure quality data collection. In each facility, pretested structured questionnaires were administered to the in-charge malaria surveillance. Assessment checklist was used to determine which malaria surveillance tool was available in the facilities; this was used as a check on the responses provided by the respondents. All the interviews were conducted privately to ensure confidentiality after obtaining their written informed consents. This questionnaire was developed based on the specific objectives of this research work, considering the resources for malaria surveillance to be mapped as identified during the pre-mapping stage of resource mapping.

The resources mapped in this study are the specific employees in-charge of malaria surveillance in the facilities, equipment, documents and materials directly involved in the conduct malaria surveillance activities in the facilities. Other resources outside the scope of this study were excluded based on compliance with the study protocol.

The questionnaire consisted of the sociodemographic data of respondents, respondents´ knowledge and capacity for malaria surveillance, malaria surveillance tools and laboratory capacity for diagnosis.

Data analysis

Descriptive and analytical statistics were used to summarize the data obtained. Knowledge on malaria surveillance (summary of responses to knowledge indicator variables (suspected and confirmed case definitions, presentation of malaria cases (severe, non-severe), components of complicated malaria, and routine reporting of malaria indicators) was graded against a total score of 100 percent and ≥70 percent score was considered good knowledge (scores ≥70 percent is academically considered an upper limit grade score), otherwise poor knowledge. Findings were summarized and presented in tables, charts and maps. Continuous variables were summarized using mean, range, and standard deviation. Frequencies and proportions were used to summarize categorical variables. In bivariate analysis, fishers exact test (It´s appropriate to use Fisher´s exact test, in particular when dealing with small counts) was used to test associations between categorical outcome variables and explanatory variables. Multivariate analysis was conducted using multiple logic regression to determine predictors of knowledge of malaria surveillance. The level of significance was set at 5%.

Ethical Considerations

Ethical approval was obtained from the FCT Health Research Ethics Committee FHREC/2020/01/12/18-02-20 and written informed consent was obtained from each respondent before participating in the study.

Results

Sample characteristics

A total of 221 health facilities participated in this study; with one respondent from each facility, a mean age of 37.6 ± 8.4 years and age range of 20-59 years. The facilities sampled were evenly spread (see Figure 2). Two Hundred and Four (92.0%) of facilities were primary facilities, secondary facilities 14(6%), and tertiary 3(2%). Among the respondents, 145 (66.0%) were male, 119 (53.9%) were aged greater than 35 years of age, 82 (37.1%) were of the Gbagyi ethnicity, 211 (95.5%) attended tertiary institutions, 181(81.9%) were married among the respondents. Other demographic characteristics are shown in **Table 1**.

Availability of Malaria Surveillance Officers in the Health Facilities

Among the 221 facilities surveyed, 160(72.4%) had their facility in-charge double as in-charge of malaria surveillance activities, while in other facilities, they were, record officers 22(10%), malaria focal persons 18(8.1%), and surveillance focal persons 10(4.5%) **Table 2**. Some (131, 59.3%) of the respondents have been in-charge of malaria activities for 1-5 years, 66 (29.9%) of them for 6-10 years, 20(9%) others for more than 10years while only 4(1.8%) have been in-charge for less than one year. Majority (189, 85.5%) were Community Health Officers, 15(6.8%) Nurses, 9(4%) Record Officers, 3(1.4%) Medical Officers, and others (2.3%) comprising Scientific Officers, Laboratory Scientist and Cashier **Table 2**.

Malaria Surveillance Officers´ Knowledge of Malaria Surveillance

One hundred and ninety-five respondents (88.2%) understood suspected malaria cases while 132 (59.7%) understood confirmed malaria cases. Most of them (99.0%) understood how malaria cases present. Some (164, 74.2%) of respondents understood the signs and symptoms. One hundred and forty-eight (67.0%) defined correctly what routine reporting in Malaria surveillance is **Table 3**).

Malaria Surveillance Officers´ Capacity on Malaria Surveillance

Two hundred and nine (95%) sent reports timely. One Hundred and eighty-Five (83.7%) keep the 'monthly malaria report'. None of the surveyed health facilities had a 'list of foci' and 'entomological database'.

Among 221 respondents, 184 (83.6%) analyzed malaria indicators monthly, 11(5.0%) quarterly, 3(1.4%) annually, 1(0.4%), while 21(9.6%) do not **Figure 2**. Sixty percent of those who carry out analysis, use the analysis in malaria intervention activities, 80 (40.0%) did not use the analyzed data. Some of the activities includes determining effective malaria drug within the catchment area which is served by the facility 18(15.1%), determining burden and trends of cases overtime 25(21.0%), generating reports for policymaking 29(24.5%), and other malaria intervention activities 34(28.6%), health education & awareness creation on malaria prevention 40(33.6%) and guide the distribution of LLITN and other malaria commodities to end-users 21(17.6%) **Figure 3**.

Available Malaria Surveillance Tools in the Health Facilities

Availability of malaria surveillance tools showed that, only 36 facilities (16.3%) have computers, 15(6.8%) case investigation forms, 106 (48.0%) reporting forms, 55 (24.9%) tally sheets, 158(71.5%) registers, 114(51.6%) patients´ cards, 9(4.1%) dashboards, and 13(5.9%) training materials.

Most of the computers 22(61.1%) available during the survey were found in the facilities from Municipal Area Council, others were from Abaji 8(22.2%) and Bwari 6(16.7%). All 3(100%) tertiary facilities studied had computers while the rest were available in 10(71.4%) secondary facilities and 23(11.3%) primary health facilities. Only 1(0.5%) facility had all the surveillance tools while 24(10.9%) facilities had at least one of the surveillance tool.

In aggregate, Abaji, Bwari and Gwagwalada Area Councils had more of the tools (2 to 3 tools per facility), with Municipal, Kuje and Kwali Area Council having less (1 to 2 tools per facility) **Figure 4**.

Laboratory Capacity for Malaria Diagnosis and Proportion of Tested/Untested Malaria Cases

One hundred and thirty-two (59.9%) facilities had a functional laboratory (in-use during the survey), out of which 113 (85.6.%) had the capacity to conduct microscopy tests. Some of the facilities with functional laboratories 108(81.8%) carry out other confirmatory tests such as the RDT, serological and, quantitative buffy coat. Eleven (5.0%) of the all the facilities studied perform only microscopy test confirmatory procedure, while 95 (43%) conduct either microscopy, RDT or other confirmatory tests. During this study, 19,544 cases of malaria cases were treated in the health facilities surveyed. About half 10,143 (51.9%) were confirmed using either microscopy test 1,014 (7.0%), RDT 9,118(89.95%), serological test, or quantitative buffy coat technique.

Association between Respondents´ Malaria Surveillance Knowledge and other Characteristics

Significant associations were found between the respondents´ level of education, designation, duration of years as malaria in charge, and their malaria surveillance knowledge. The odds of MFP having good malaria surveillance knowledge was 6 times less if the MFPs´ level of education is 'secondary' (Secondary vs Tertiary; OR: 0.94; 95% CI: 0.19,0.98) and 77 times less when the MFPs´ duration as malaria surveillance in-charge is <1 year (<1year vs >10years; OR: 0.23; 95% CI: 0.12,0.67).

The odds of MFPs having good malaria surveillance knowledge was also about 5 times more when the MFPs´ designation is 'nursing' (Nurse vs CHO; OR: 4.83; 95% CI: 1.63,14.3), 4 times more when their designation is 'Record Officer' (Record Officer vs CHO; OR: 4.41; 95% CI: 1.12,17.4) and 3 times more when MFPs´ duration as malaria surveillance in-charge is 1-5 years (1-5years vs >10years; OR: 3.42; 95% CI: 1.76,7.24) **Table 4**.

Predictors of Malaria Focal Persons´ Malaria Surveillance Knowledge

After adjusting for confounders, having a Nurse, Record Officer as in charge of Malaria surveillance and being in-charge of Malaria surveillance for 1-5 years remained significantly associated with good knowledge of malaria surveillance **Table 4**.

The odds of Malaria surveillance in-charge who were Nurses having good knowledge of malaria surveillance were 4 times more than other cadres (aOR: 4.71, 95% CI: 1.58, 13.9), the odds of in-charges who were Record Officers having good knowledge of malaria surveillance were 5 times more than other cadres (aOR: 5.38,95% CI: 1.27, 22.7) and the odds of those in-charges who had been in the position for 1-5 years having good knowledge were 3 times more than those who have been in-charge at different durations (aOR: 3.40, 95% CI: 1.65, 7.34) **Table 4**.

Association between other characteristics and Non-Availability of Malaria Surveillance Tools in the Facilities

Significant associations were found between the location of facilities, and non-availability of malaria surveillance tools. The odds of not having malaria surveillance tools in the facilities were 61 times less if a facility is located in 'Kwali Area council' (Kwali vs Abaji; OR: 0.39; 95% CI: 0.26,0.59), 36 times less if a facility is located in 'Kuje Area council' (Kuje vs Abaji; OR: 0.64; 95% CI: 0.44,0.93) and 33 times less if a facility is located in 'Municipal Area council'(Municipal vs Abaji; OR: 0.67; 95% CI: 0.49,0.93). While the odds having malaria surveillance tool available in a facility was about one time more when the facility is situated in 'Bwari' (Bwari vs Abaji; OR: 1.03; 95% CI: 0.72, 1.47). **Table 5**.

Predictors of Availability Malaria Surveillance Tools

After adjusting for confounders, having a health facility in Kwali Area Council remained significantly associated with non-availability of malaria surveillance tools in the facilities (see Table 5). The odds of facilities situated at Kwali Area Council not having malaria surveillance tool were 66 times less than other Area Councils (aOR: 0.34, 95% CI: 0.44, 2.46).

Discussion

Malaria surveillance is critical to achieving malaria elimination goals. Human and nonhuman resources contribute to the strategic goals of malaria surveillance. According to WHO; "Malaria surveillance system consists of the tools, procedures, people and structures [17]. In this study, we observed the availability of persons responsible for malaria surveillance activities in the health facilities. In most of the surveyed facilities, the facility in-charges doubled as the malaria surveillance in-charge. The cadres of other malaria surveillance officers in this study were Record Officers, DSNOs, and MFPs. Canavati et al., 2016 suggested in their studies that various cadres of officers in the health profession can function as malaria surveillance officers, where such officers are trained [11,18]. Ruebush et al., agreed with them but stated that, having officers dedicated only to the work of malaria surveillance, will yield a preferred result with maximum service delivery [18,19]. Unfortunately, only 8.2% of the malaria officers in our study were MFPs.

More than half (59.3%) of the respondents had been in-charge of malaria surveillance for 1-5 years. This finding is consistent with studies conducted by Olugbade et al., 2012 and Kureya et al., 2016, but contrary to Tyakaray et al., 2020. Tyakaray in her study observed that most of the MFPs had been in the position of malaria surveillance officers for 11-15 years [20,21]. Their study did not determine the reason for this disparity.

Most of the malaria surveillance officers were CHOs, which is similar to the finding of Tyakaray et al, 2020; where majority (91.4%) of the malaria surveillance officers in their study were CHOs. The cadre of the malaria surveillance officers in our study varied including Nurses, Record Officers and Medical Doctors [20,21]. Having most respondents in this study as CHOs was not a surprise considering the study of Slavea et al, and Abimbola et al. These two studies showed that CHOs/CHEWs are the most frequently found cadre of health professionals in primary health facilities [22,23].

Knowledge assessment of the respondents on malaria surveillance showed that they have good knowledge in some aspect (index of suspicion) of malaria, but poor knowledge of routine reporting and the role of laboratories in confirmation of malaria cases. This is similar to the outcome of the study by Sumadhya et al., 2015 in Srilanka but contrary to the study by Aniwada et al., 2016 in Enugu Nigeria where the study participants showed very good knowledge of malaria surveillance [24,25].

Respondents who mentioned correctly the presentation of a 'suspected malaria case' indicates good knowledge. This finding was not a surprise since all the respondents function within the facilities and would have witnessed cases first hand. This finding is in agreement with the study by Ladi-Akinyemi et al., where a 'higher percentage of healthcare workers had good knowledge on the mode of transmission of malaria and signs and symptoms of simple malaria'. The findings of our study however, are in disagreement with Ladi-Akinyemi et al., who found that 'less than half and one-third of the heath-care workers had good knowledge of case definition of simple and complicated malaria respectively '[26].

Those who understood clearly, 'routine reporting' were below the 80% minimum benchmark of 'World Malaria Report 2018 'and 'Malaria Consortium Project Brief' on reducing the malaria burden in Nigeria, 2018 [3]. However, in practice, the respondents in this study exceeded the minimum required benchmark of 80 percent expected in routine reporting. According to Avong et al., 2018, training and continuous training would greatly improve the knowledge and frequency of reporting as they observed 100 percent improvement among participants in the frequency of reporting after a training exercise compared to the status of reporting before the training [27].

Our study equally showed that awareness of how often reports are to be sent to the next level was good (90.4 percent), however, they were 9.6 percent of respondents who do not know they should report to the next level at all. In similarity to the study by Ofili et al., 2003; only 11.9 percent of surveyed healthcare workers had a good knowledge of disease notification [28].

The availability of malaria surveillance tools showed that, 36 facilities (16.3%) had computers for malaria surveillance activities and other tools in varied degrees. Robust and responsive information systems are critical for successful malaria control and elimination [29]. According to Ohrt et al., computers are undoubtedly the most important tool in malaria surveillance with the potentials of integrating all other paper-based tools thereby making management and reporting almost seamless. Unfortunately, only 16.3 percent of the health facilities in our study had computers for malaria surveillance activities. This is consistent with findings of Alwan et al, 2015, which showed that computer availability was generally low in the facilities surveyed in their study and was lower for public primary health care centers [30,31]. This finding is critical to malaria surveillance, control, and elimination. However, in our study the availability was low.

Furthermore, other paper-base tools like case investigation forms, tally sheets and reporting forms were not available in some of the facilities at the time of this study. The reason for the absence of these documents might be as a result of stock out of commodities in the face of COVID-19 pandemic response, as more attention was channeled towards the pandemic at the detriment of other diseases of public health importance. Nghochuzie et al, 2020; agreed completely with this possibility in their study, 'Pausing the Fight Against Malaria to Combat the COVID-19 Pandemic in Africa: Is the Future of Malaria Bleak?'. Their study showed that they occurred a geometric rise in the malaria mortality and morbidity during the COVID-19 pandemic across some African countries partly due to shortage in the commodities and consumable used in malaria elimination programs across the continent [32]. Rogerson et al, 2020 also corroborated the findings of Nghochuzie in their study, Identifying and combating the impact of COVID-19 on malaria´. They stated that scarcity of commodities and consumable for malaria response suffered greatly, more so, as companies shifted their attention from production of malaria related consumables to COVID-19, especially in the low and middle income countries(LMIC) [33].

As observed in our study, 'list of loci' and entomological database were not found in any of the facilities. The reason for the absence of these tools in the facilities was not determined in the study, however, it may not be unconnected with the findings of Rumisha et al, 2014. In their study, they mentioned that the collection of entomological data of mosquitos across African countries of Tanzania, Kenya, Mozambique, Senegal, Ghana and Burkina Faso was the only of such data available in Africa [34]. Malaria transmission is measured using entomological inoculation rate (EIR) [34], without which, understanding the heterogeneity of malaria transmission will be difficult; the understanding of which required in the process of malaria eradication and elimination process. Chanda et al disagreed with the scarcity of the entomological data in the continent through their study, 'Operational scale entomological intervention for malaria control: strategies, achievement and challenges in Zambia' [35]. He clearly stated that capacity and data to undertake entomological assessment is available in Zambia, but added however that it is an aspect of malaria eradication strategy which will require strengthening if malaria control will be successful in the Continent. In laboratory capacity across the facilities, 132 (59.9%) had functional laboratory and 113 (51.1%) conduct microscopy tests. This finding is consistent with Kyabayinze et al., finding in Uganda where health facilities had inadequate resource capacity for effective health care delivery including parasite-based malaria diagnosis. In their study, 24% of Health facilities had malaria diagnostics, 29% had functional microscopy and 20% had only RDTs in use(36). Our study differed from the findings of Abreha et al, 2014; in Ethiopia where most of the health facilities had basic infrastructure and equipment to perform malaria laboratory test [37].

One of the findings of our study is that, confirming malaria using the RDT procedure is quite a popular practice among health facilities in the FCT. That is consistent with the findings of Wilson et al, where, the most commonly used method for identifying causes of malaria remains the microscopic examination, however, the authors stated that there is growing use of malaria rapid diagnostic test in many parts of the world [38].

In this study, about half (51.9%) of the treated malaria cases were confirmed using a confirmatory test, which is similar to the findings of Fraol et al, 2014; in Ethiopia, where 67.4% of the treated malaria cases were confirmed. The author alluded that lack of training and low work experience of laboratory professionals were factors associated with malaria microscopy diagnostic performance [39]. In contrary, Bamiselu et al., 2016; in Ogun State Nigeria, showed high level of compliance to treatment of most (98.1%) malaria cases after the confirmatory test in their study. The authors suggested that awareness of national treatment guidelines was responsible for this level of compliance among health workers in both public (98.1 %) and private (94.8 %) settings [40].

The limitations we encountered in this study include the study design, social desirability bias and common method bias. It was difficult to determine causality between independent and dependent variables due to the inability to fulfill time sequence criteria. Predictors found were only considered suggestive. The study design was limiting in the sense that the study was carried out at one-time-point and gives no indication of sequence of events. Where all the outcome factors are difficult to determine when they occurred; whether before, after or during the process that was studied. This being so, the predictors found can only be suggestive. The social desirability bias was mitigated by training the research assistant to adopt indirect questioning of the respondents where necessary, while the common method bias was mitigated by training the research assistants on asking the questions using procedures which made the respondents to provide answer in easy and non-stylish manner. The respondents were encouraged to provide answers based on the information within their purview.

The average distribution of the malaria surveillance tools across Area councils and health facility types which showed more tools available in the secondary and tertiary health facilities on buttressed the neglect of the primary level of healthcare in the country. Abdulrahaman et al, 2012 and Alenoghena et al, 2014 unanimously presented in the study the obvious neglect of the primary healthcare system in Nigeria. They both called on the authorities to reform the healthcare system where the primary healthcare system will be repositioned as the first and closest healthcare system to the communities [41,42].

Conclusion

Human and nonhuman resources were available for malaria surveillance activities within the health facilities in the FCT, however, they were suboptimal. Most of the MFPs were not dedicated solely to the duty of malaria surveillance. The knowledge and practice of malaria surveillance among some MFPs was poor but being a Nurse, Record Officer, and being in position as in-charge malaria surveillance up to five years may improve the knowledge and practice of officers in malaria surveillance activities. Near absence of basic tools like computers for malaria surveillance, empirical treatment of many malaria cases which may lead to development of resistant strains and suboptimal laboratory capacity, underscores the need to review and reposition the program of malaria elimination in the FCT to achieve the set program goal of malaria eradication.

What is known about this topic

- There is Malaria Surveillance System (MSS) under the Malaria Elimination Program (MEP) in the Federal Capital Territory, Nigeria
- There have been concerted effort to eliminate malaria in Nigeria and other developing countries of the World.

What this study add

- The study reveals the spread and designation of the personnel in charge of MSS in the facilities across the Territory
- The study further shows the capacity of the personnel, tools available for their operation and the predictor of knowledge of these officers involved in MSS
- The study also identified gaps in the MSS and made valuable recommendation for improvements.

Competing interests

The authors declare no competing interests.

Authors' Contributions

Henry Uguru Ekechi –Conception, Data collection, analysis, drafting and editing. Ajayi IkeOluwa – Conception, Manuscript review and Editing. Aderemi Kehinde –Manuscript review and Editing. Umeokonkwo David Chukwuma –Manuscript review and analysis. Dan-Nwafor Chioma – Manuscript review. Ameh Celestine – Manuscript review and analysis. Balogun Muhammad Shakir – Administration and review.

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Table and Figures

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Table 1: Sociodemographic Characteristics of the Respondents (N=221)

Variable	Frequency(n)	Proportion(%)
Age group (years)		
<20-25	14	6.3
26-30	36	16.3
31-35	52	23.5
>35	119	53.9
Gender		
Male	145	66.0
Female	76	34.0
Religion		
Christianity	104	47.1
Islam	115	52.0
Traditional	2	0.9
Ethnicity		
Gbagyi	82	37.1
Hausa	53	24.0
Igbo	21	9.5
Yoruba	21	9.5
Other*	44	19.9
Marital Status		
Married	181	81.9
Single	35	15.8
Divorced	4	1.8
Widowed	1	0.5
Highest Level of Education		
Tertiary	211	95.5
Secondary	10	4.5

Ethnicity (Other)* = Aho, Bassa, Birom, Ebira, Eggon, Ganagana, Idoma, Igala, Nupe, Kotor & Tiv

Table 2: Frequency Distribution of Malaria Surveillance Officers in the Health Facilities N=221		
Variables	**Frequency (n)**	**Proportion (%)**
Persons responsible for Malaria surveillance in this facility		
Facility In-charge	160	72.4
Record Officer	22	10.0
Malaria Focal Person	18	8.1
Surveillance Focal Person	10	4.5
Others*	11	5.0
Duration of time of respondents as Malaria surveillance in-charge		
< 1 year	4	1.8
1-5 years	131	59.3
6-10 years	66	29.9
> 10 years	20	9.0
Designations of Malaria in-charges		
CHO	189	85.5
Nurse	15	6.8
Record Officer	9	4.0
Medical Officer	3	1.4
Others	5	2.3
Others* = Scientific officers, Laboratory Scientist and Cashier		

Table 3: Malaria Surveillance Officers' Knowledge of Malaria Surveillance N=221		
Variables	**Frequency (n)**	**Proportion (%)**
Respondents who mentioned correctly the case definition of a suspected malaria case	195	88.2
Respondents who mentioned correctly the case definition of a confirmed malaria case	132	59.7
Malaria can present as either uncomplicated (non-severe) or complicated (severe)	219	99.0
Respondents who mentioned correctly the signs & symptoms that differentiate complicated from uncomplicated malaria	164	74.2
Respondents who mentioned correctly what is routine reporting in malaria surveillance	148	67.0
Available malaria surveillance report in the health facilities as indicated by respondents		
Monthly malaria reports	185	83.7
Monthly malaria reports & register of malaria program (Health structure and staffing)	19	8.6
Register of malaria programme & Malaria case investigation forms	11	5.0
Monthly malaria reports & Focus Investigation form	3	1.4
Monthly malaria reports, Register of malaria program (Health structure and staffing), A vector control & Intervention Database)	1	0.5
Monthly malaria reports & Malaria case notifications	1	0.5
Monthly malaria reports, Malaria case notifications, Register of malaria program	1	0.5
Respondents who utilize analyzed data in their malaria surveillance activities	119	60.0
**Multiple response*		

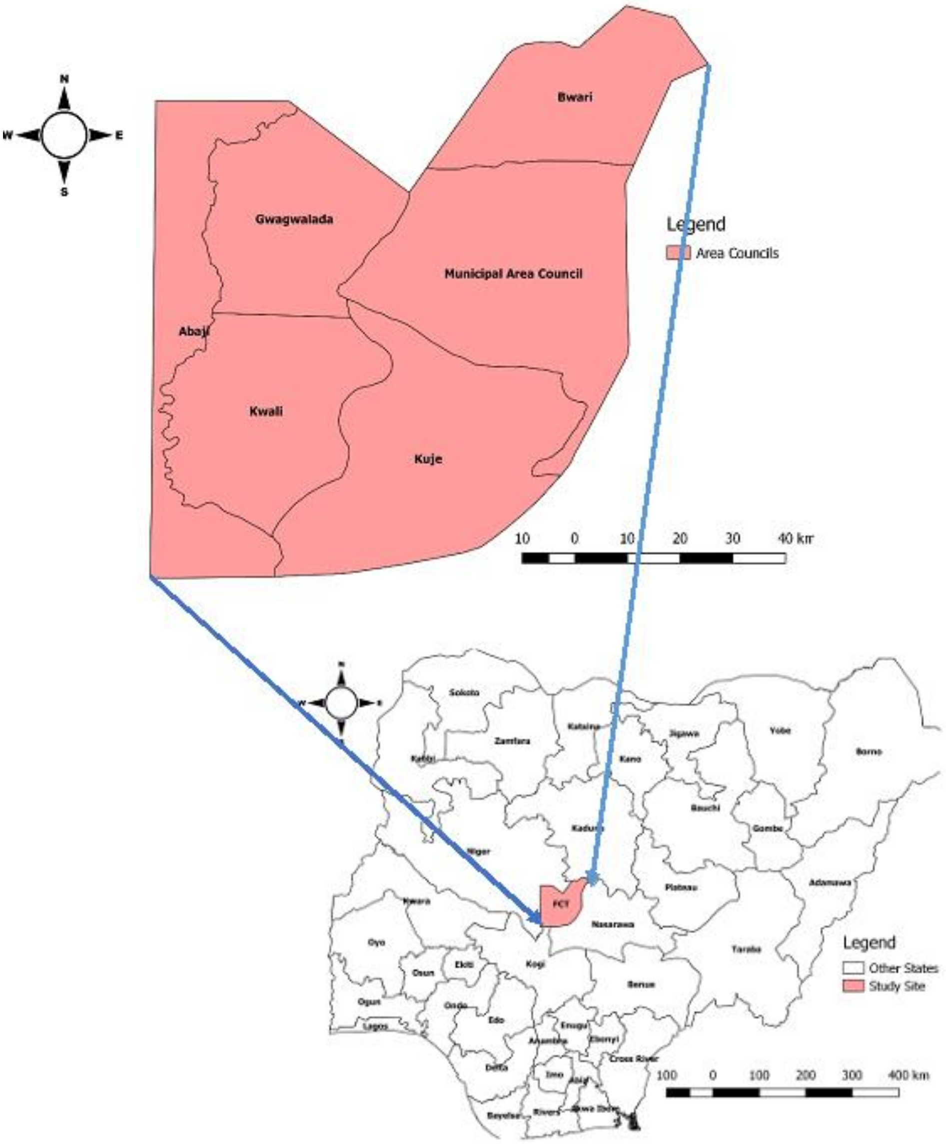
Table 4: Respondents Characteristics Significantly Associated with the Knowledge of Malaria Surveillance						
Characteristics		**Case definition***		**Crude OR (95%CI)**	**p-Value**	**Adjusted OR 95%(CI)**
		Correct	**Wrong**			
Gender	Male	128(88.3)	17(11.7)	Reference		
	Female	70(92.1)	6(7.9)	0.65(0.24, 1.71)	0.20	
Age-group	>35	18(15.1)	101(84.9)	Reference		
	<20-25	3(21.4)	11(78.6)	0.20(0.01, 2.98)	0.32	
	26-30	10(27.8)	26(72.2)	0.38(0.02, 6.76)	0.51	
	31-35	11(21.2)	41(78.8)	0.27(0.02, 4.64)	0.37	
Marital Status	Single	6(17.1)	29(82.9)	Reference		
Level of Education	Married	36(19.4)	150(80.6)	0.86(0.33, 2.23)	0.37	
	Widowed	1(100.0)	0(0.0)	1.25(0.67,1.87)	0.63	
	Divorced	2(50.0)	2(50.0)	0.12(0.22, 1.38)	0.53	
	Tertiary	40(19.0)	171(81.0)	Reference		
	Secondary	2(20.0)	8(80.0)	0.94(0.19, 0.98)	0.04*	0.97(0.22,1.03)
Designation	CHOs	29(15.3)	160(84.7)	Reference		
	Nurse	7(46.7)	8(53.3)	4.83(1.63, 14.3)	0.004*	4.71(1.58, 13.9)*
	Record Officer	4(44.4)	5(55.6)	4.41(1.12, 17.4)	0.03*	5.38(1.27, 22.7)*
	Medical Officer	1(33.3)	2(66.7)	2.76(0.24, 31.4)	0.41	
	Others*	2(40.0)	3(60.0)	3.68(0.59, 22.9)	0.16	
Number of Years as MS in-charge	>10	5(25.0)	15(75.0)	Reference		
	<1	0(0.0)	4(100.0)	0.23(0.12, 0.67)	0.03*	0.34(0.18, 1.28)
	1-5	25(19.1)	106(80.1)	3.42(1.76, 7.24)	<0.001*	3.40(1.65, 7.34)*
	6-10	13(19.7)	53(80.3)	1.43(0.24, 31.4)	0.11	

Note: *p<0.05, MS= Malaria Surveillance

Others* = Scientific officers, Laboratory Scientist and Cashier

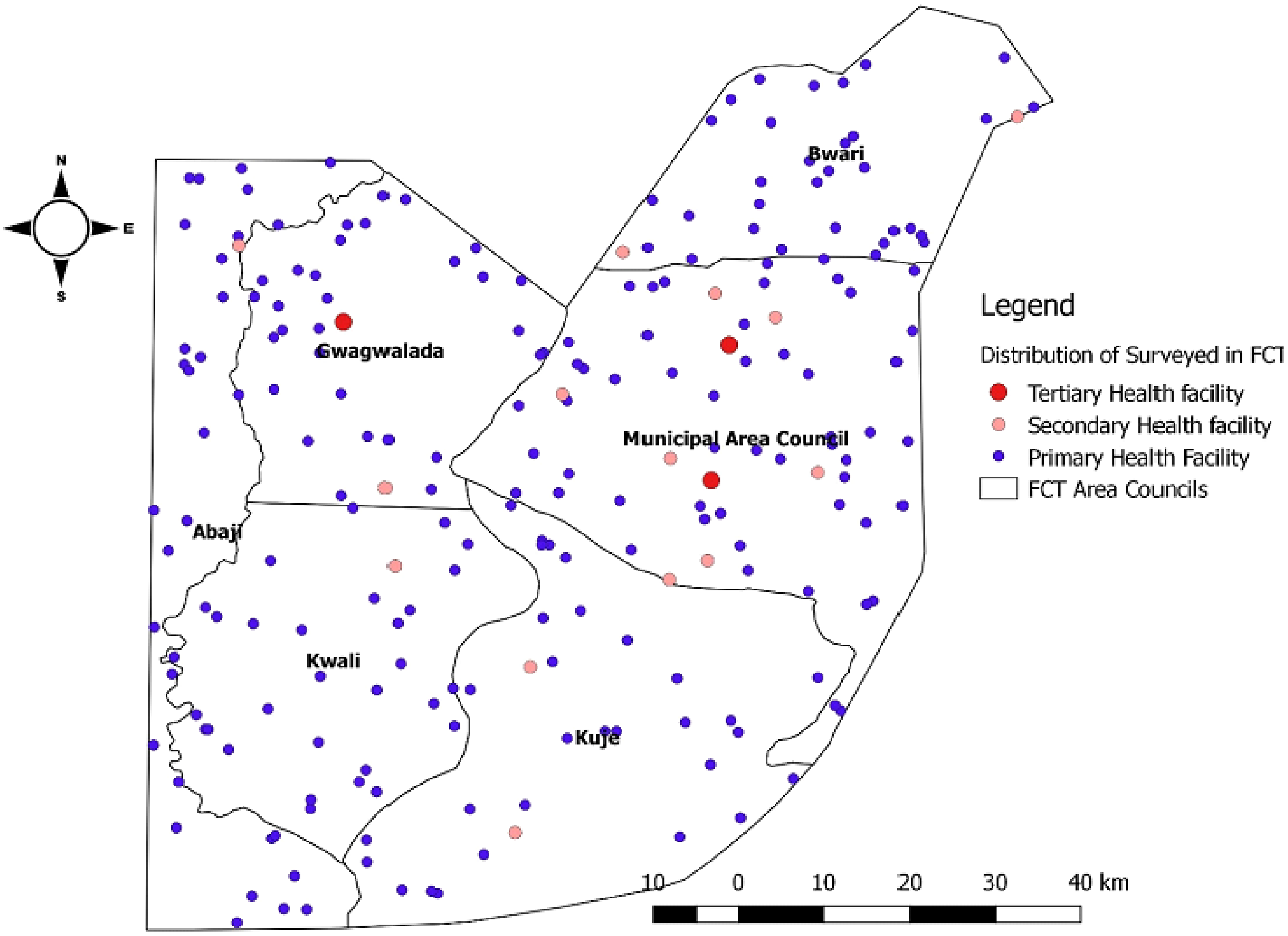
Case Definition* = Used to represent the summary of responses to the knowledge indicator variables (suspected and confirmed case definitions, presentation of malaria cases (severe, non-severe), components of complicated malaria, Routine reporting of malaria indicators)

Table 5: Characteristics Significantly Associated with the Availability of Malaria Surveillance Tool						
Characteristics		**Availability of Mal. surveillance tool**		**Crude OR (95%CI)**	**p-Value**	**Adjusted OR 95%(CI)**
		Present	**Absent**			
Location	Abaji	95(37.1)	161(62.9)	Reference		
	Bwari	100(37.9)	164(62.1)	1.03(0.72, 1.47)	0.008*	
	Gwagwalada	86(33.6)	170(66.4)	0.86(0.59, 1.23)	0.459	
	Kwali	47(19.0)	201(81.0)	0.39(0.26, 0.59)	<0.0001*	0.34(0.44, 2.46)*
	Kuje	70(27.3)	186(72.7)	0.64(0.44, 0.93)	0.023*	
	Municipal	139(28.5)	349(71.5)	0.67(0.49, 0.93)	0.019*	
Hospital Type	Primary	488(29.9)	1144(70.1)	Reference		
	Secondary	42(37.5)	70(62.5)	1.53(1.03, 2.28)	0.039*	
	Tertiary	7(29.2)	17(70.8)	0.97(0.39, 2.34)	1.000	



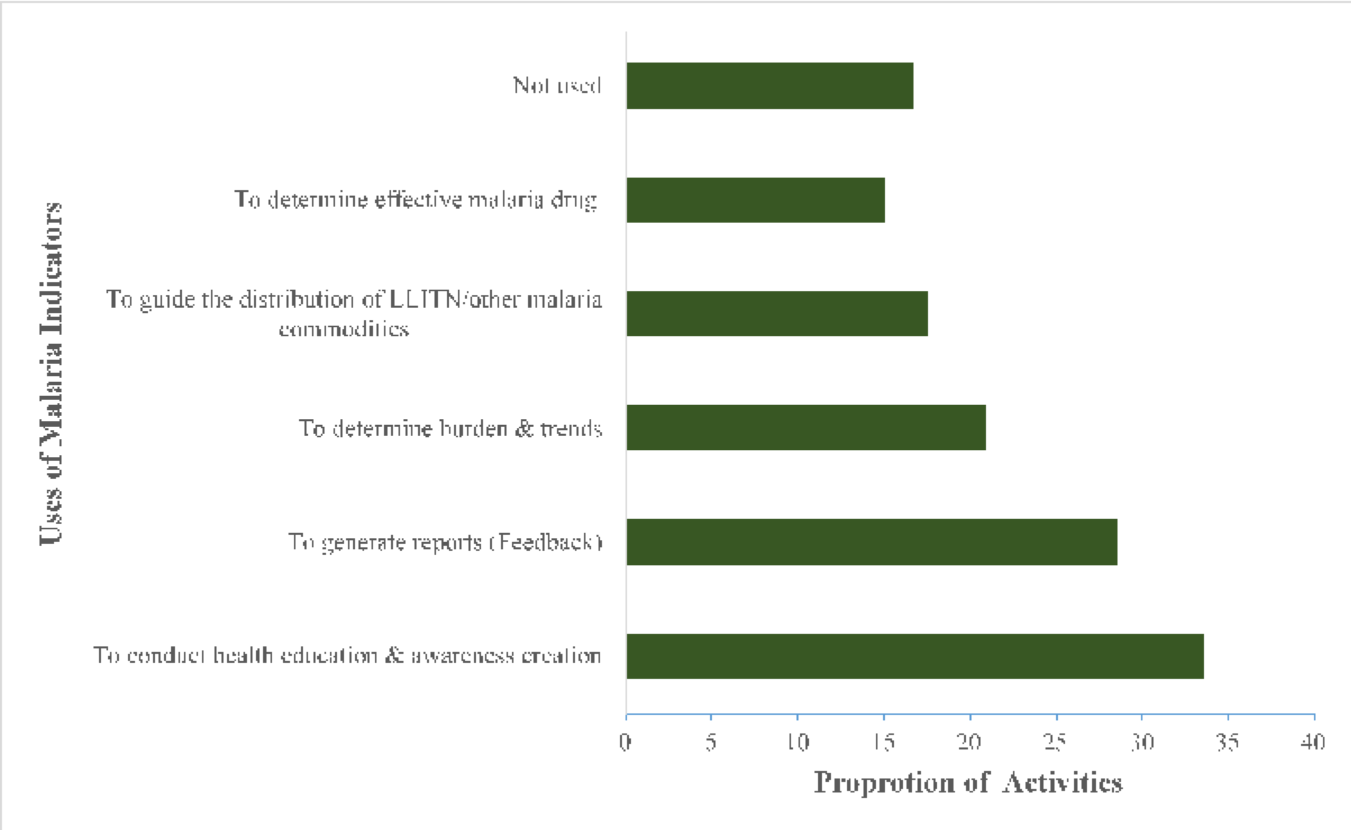
From the map of Nigeria, the FCT is shown located at the center of the country and zoomed out showing the study sites-the six Area councils

Figure 1: Nigeria Map showing FCT



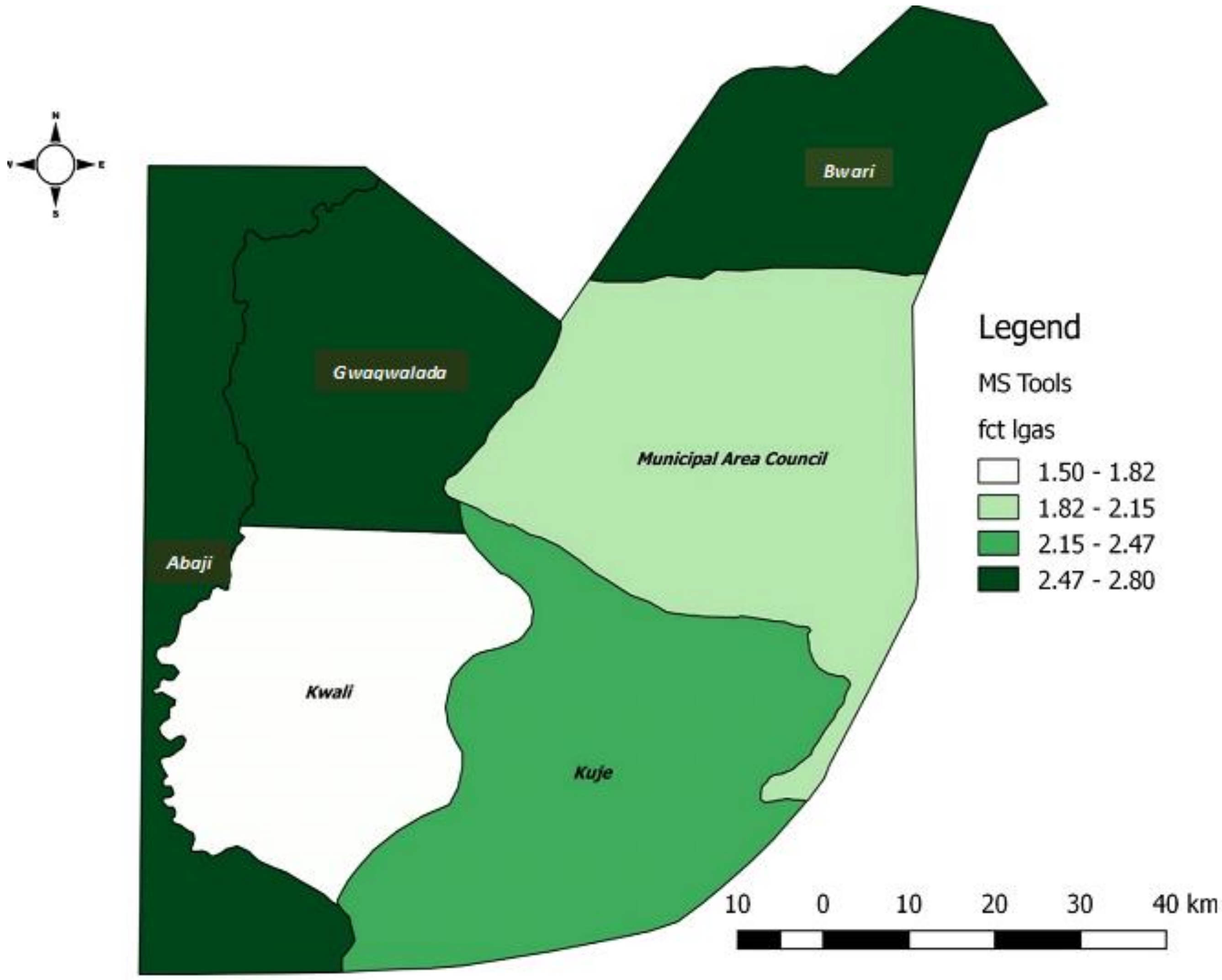
The smaller blue dot represents the location and distribution of the primary health facilities which were studied, bigger pink dots represents the location and distribution of the secondary health facilities which were studied and the red biggest dot represents the location and distribution of the tertiary health facilities which were studied

Figure 2: FCT Map showing distribution/location of the health facilities that participated in the study



The X-axis represents the proportion of activities carried out. Y-axis represents the activities for which the analyzed malaria indicators are used for.

Figure 3: Percentage distribution of activities carried out Using the findings of the analyzed malaria indicators



The dark green area represents Area Councils with average malaria tool distribution of 2.5-3 tools per health facility, Green area represents Area Council with average malaria tool distribution of 2-2.5 tools per health facility, Light green represents Area Council with average malaria tool distribution of 1.8-2 tools per health facility and the white area represents Area Council with average malaria tool distribution of 1.5.-1.8 tools per health facility.

Figure 4: Distribution of the Average number of Malaria Surveillance Tools by Facilities in the Six Area Councils