Evaluation of Medical Technologies Used to Manage Malaria in Efoulan Health District of Yaounde-Cameroon

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Abstract

Purpose: This study aimed at evaluating medical technologies used to manage malaria at Efoulan health’s district. Problem: With almost 3 million of confirmed cases per year, malaria is the disease that most affects Cameroonians. From March 2020, Cameroon witnessed the advent of massive cases of COVID-19, whose symptoms almost coincide with those of malaria, causing a mix of medical technologies meanwhile, populations and medical personnel are required not to get confused between malaria and Covid-19. Methods: We conducted a retrospective cross-sectional qualitative study for analytical purposes at three levels of comparative analyzes (Malaria protocol, Malaria equipment, and Malaria drugs) using Anova and Pearson correlation. Results: Our study revealed that Malaria protocol in hospitals was moderately and positively correlated to WHO (2023) [1] guidelines at 41.8% [r(30) = .41.8, 95%, p = .019]. Malaria equipment found within the community were statistically significantly different (F(2, 96) = [10.688], p = 0.00) from those recommended by Long (2009) [2] (p = 0.001, 95% C.I. = [-2.01, -0.41]). Antimalarial drugs used within the community and in hospitals were respectively moderately positively correlated at 43.5% [r(20) = .435, 95%, p = .043] and highly positively correlated at 53.3% [r(20) = .533, 95%, p = .011] to WHO (2023) [1] guidelines. Conclusion: To strengthen malaria control, health education on complete malaria protocol must be carried out, first aid medical centers must be better equipped, drugs must be prescribed according to patient’s histories and pre-referral treatments must be applied within the community while integrating traditional concoctions into modern medicine.

More Information


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Keywords:
Evaluation, Medical Technologies, Malaria Management, Health District, Cameroon.
Introduction

According to WHO (2020), medical technologies also known as health technologies are the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives [3]. In Cameroon, the burden of malaria remains a public health problem. In fact, malaria is the most widespread endemic disease in Cameroon [4]. From March 2020, the massive advent of covid-19 cases in Cameroon had a strong impact on health facilities and households. From self-medication, to healing with natural herbs, to conventional medicine, everyone has used the medical technology they could do better with [5]. However, malaria and covid-19 have almost the same symptoms.

Having notice that patients were increasingly registering in health facilities, populations and medical personnel were required not to get confuse between malaria and Covid-19. In the absence of diagnostic tests, it is not always easy to make the difference between the two. How was medical technology being used in the health district of Efoulan to manage malaria in covid-19 setting? This research question motivated the interest of studying our problem which was the mixture of medical technologies weakening malaria control at the Efoulan health’s district in Yaounde-Cameroon.

Our main objective was to evaluate the medical technologies used to manage malaria in Efoulan Health District of Yaounde-Cameroon. In order to realize this objective, we divided the concept of “medical technologies” into protocols, equipment and drugs according to the professional dominance theory. It’s true that all requirements to manage malaria are available into WHO (2023) [1], CDC (2023) [6] and Long (2009) [2] guidelines, but was this knowledge used to strengthen malaria control in Efoulan Health District of Yaounde-Cameroon? This question was still unanswered.

Therefore to evaluate the professionalism of the population and medical personnel on malaria control in Efoulan Health District, we formulated three hypotheses. First of all, malaria protocols found both within the community and in hospitals, are correlated to WHO (2023) [1] and CDC (2023) [6] guidelines. Secondly, there is no difference between malaria equipment found within the community and in hospitals, and those recommended by Long (2009) [2]. And finally, there is a correlation between antimalarial drugs used within the community and prescribed in hospitals, with those ofWHO (2023) [1] and CDC (2023) [6] guidelines.

Materials and Methods

Research type

We conducted a retrospective cross-sectional qualitative study for analytical purposes.

Site of the study

The study was carried out in Efoulan health’s district of the city of Yaounde in Cameroon.

Participant Characteristics

Our study population consists of the community and health personnel.

Inclusion and exclusion criteria

All concerned participants were the residents of the health district of Efoulan; or health personnel working in the district of Efoulan who expressed their interest in the study.

Sampling procedure

We used a non-probabilistic sampling by reasoned choice procedure, which made it possible to reproduce the target population as faithfully as possible, taking into account its characteristics. This type of sampling also makes it possible to have a diversity of points of view on the perceptions of malaria in relation to the medical technologies necessary for its management.

In this study, internal diversification was used. This took into account the strategic levels of the health pyramid ranging from a reference hospital (the military hospital of Yaounde), to the community, via a district medical center (CMA of Obili) and an ambulatory health facility. External diversification was also taken into account. In this study; it was about sex and the workplace.

Sampling by reasoned choice was well indicated insofar as it made it possible to obtain a sample with a good knowledge of the phenomenon to be studied and providing a rich description of it at the moment of the interviews. This diversification made it possible to have a homogeneous sample and consequently a better description of the perception of malaria.

Participants were recruited via an interview guide. It was made of two major parts; a first part which identified the team of investigators and provided useful information on the study. Then came a second part reserved for the actual collection of survey data.

Data collection technique

In this study, we used triangulation as the data collection technique. It consisted of a documentary review, interviews and non-participatory observation. Interviews were conducted both in French and in English according to the native language of each respondent.

Data collection tools

Data collection tools for our study were a semi-structured interview guide, a checklist, a logbook and a documentary analysis sheet.

Data Analysis

The first part of data analysis was done in 6 steps inspired by the thematic analysis model of Braun &
Clarke (2006) [7]. These steps are the full transcription, the coding, the grouping, the proofreading, the thematic grouping and the presentation. Transcription was made with the help of YouTube Robots. Coding and grouping were done using Atlas-ti 6 software. And finally, thematic grouping was carried out according to the table below:

<table>
<thead>
<tr>
<th>Malaria Protocol (procedure)</th>
<th>Clinical signs (symptoms) established to diagnose malaria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Para-clinical signs sought through lab exams</td>
</tr>
<tr>
<td></td>
<td>Knowledge of malaria treatment</td>
</tr>
<tr>
<td>Malaria equipment</td>
<td>RDT kit</td>
</tr>
<tr>
<td></td>
<td>Supplies and equipment for microscopy smear</td>
</tr>
<tr>
<td></td>
<td>Other equipment</td>
</tr>
<tr>
<td>Malaria drugs</td>
<td>Drugs for uncomplicated Malaria</td>
</tr>
<tr>
<td></td>
<td>Drugs for severe malaria</td>
</tr>
</tbody>
</table>

To conclude, the second part of our analysis consisted in quantitatively comparing our results with standards from WHO (2023) [1], CDC (2023) [6] and Long (2009) [2] on the global management of malaria using Anova and Pearson correlation under SPSS 25 software. More precisely, Malaria protocol discovered within the community (ambulatory first aid health centers included) and in hospitals of Efoulan Health’s district were compared to WHO (2023) [1], CDC (2023) [6] guidelines. Also, the group of equipment present in the community and the group of equipment present at the hospitals of Efoulan health’s district were compared to those recommended by Long (2009) [2]. Finally, the use of antimalarial drugs within the community (ambulatory first aid health centers included) and in hospitals of Efoulan Health’s district were compared to prescriptions found in WHO (2023) [1], CDC (2023) [6] guidelines.

**Results**

**Malaria Protocol (procedure)**
Malaria protocol is a set of antimalarial guidelines. It’s made of Clinical signs (symptoms) established to diagnose malaria (uncomplicated and severe), Para-clinical signs sought through lab exams, and directives on Malaria treatment (uncomplicated or severe).

**Clinical signs (symptoms) established to diagnose malaria**
Respondents provided converging answers regarding the symptoms of malaria. In fact, while many of them know the symptoms of malaria, no one in the community knows almost all the symptoms of malaria.

- Increased body temperature and fever
  In fact, at the community level, respondents named increased body temperature and fever as the main symptom of malaria. Respondent 1 emphasized that before making a diagnosis of malaria, one must first take the temperature of the person concerned. Likewise for Respondent 8, a body affected by malaria is above all a warm body. Respondent 3 added that usually in children, malaria starts with lots of headaches accompanied by body warming. Finally, Respondent 13 stated that the symptom that challenges him to suspect malaria is usually a high fever.
- Headaches and chills
  Similarly, malaria is recognized in the community by a sign of headaches and chills. For Respondent 2, symptoms of malaria include: Headache, fever, chills. Respondent 9, the head of an ambulatory health center, said most malaria patients he saw had headaches. He said: “I think we have here, most patients complain of headaches.” When you have malaria, you shiver, you catch cold, Respondent 4 mentioned it. Respondent 10, a doctor at the Obili sub-division medical center, told us about the symptoms presented by patients suffering from malaria, in particular headaches and chills.
- Other symptoms
  Investigation reveals other symptoms of malaria like: insomnia/hypersomnia, yellow urine, fainting, diarrhea, seizures, fatigue, physical dehydration, sunken eyes, low temperature, body aches, abdominal pain and loss of appetite. This is noticeable in the following speeches: “Headache, fever, chills [while shivering]. Yah, that’s all I can know, for that one. Someone to pee, sleep a lot, down, you pee can be yellow…” said Respondent 2. In addition, Respondent 8 declared that when suffering from malaria we might lose consciousness. Then Respondent 3 testified to a case she experienced, saying a youth suffering from malaria passed out on her hands. Respondent 9 pointed out: “I think we have here, most patients will complain of headache and fever, there is fatigue, and clinically sometimes we can also see the patient’s addition signs, especially for those who have been away for a while without any support, as you can tell from the physical appearance they have for hydration signs of frustration like sunken eyes.” Respondent 10 added that there are other signs apart from fever, there are polyarthritic, in fact pain, the patient will complain of back pain, neck pain, he has pain everywhere. Respondent 10 continued
mentioning while talking of malaria symptoms that sometimes in children, under 5 children, we often, find body pain, abdominal pains. And Respondent 13 conclude on the lack of appetite when someone has malaria.

In general, survey participants were able to indicate the different symptoms of uncomplicated malaria as stipulated by WHO (2023) [1].

**Distinction between uncomplicated and severe malaria**

- At the community level
  In the community, the distinction between the forms of malaria is very little established. For many, it is up to the medical staff to establish the difference, as illustrated by the following words from Respondent 2: “Yah, unfortunately, I can’t say I know everything, type of malaria, I can’t say I know, I am not a doctor”. Nevertheless, some symptoms of severe malaria are well known to the community. These are convulsions, fainting and diarrhea as stipulated by Respondent 3. In general, such patients are immediately deported to the nearest health facility in a case of severe malaria. Here’s what Respondent 9 revealed to us: “Yeah, those patients who have hemodynamic threatening conditions like they’re very bad because some patients can also have vomiting, they can throw up and lose so much weight and when there’s that kind severe dehydration who are the pulse is too weak in this case, we must refer.”

- At the hospital level
  Confirmatory tests for a suspected case of malaria are well known in hospitals by health personnel. In fact, when the clinical symptoms of malaria are present in a patient, it is also necessary to seek confirmation by para-clinical signs, as Respondent 10, a doctor on duty at the Obili subdivision medical center explained to us. In this case, patients are therefore usually sent to the laboratory to be tested on "blood smear”. Respondent 12, a lab technician at the military hospital of Yaounde confirmed that lab’s diagnoses for malaria are always done after consultation; patients are referred to the laboratory for a blood smear test. In addition, a rapid diagnostic test (RDT) can also be requested, as Respondent 11, a lab technician at the Obili subdivision medical center said they perform blood smear and RDT also.

**Knowledge of malaria treatment**

- At the community level
  According to the comments collected from our Respondents, malaria treatment mastered by the community is that of simple malaria. In fact, to deal with uncomplicated malaria, people in the community always start by lowering the body temperature of the person concerned. They give the patient tablets like Efferalgan, paracetamol, or they put a wet towel on his head and all that to control his body temperature. Here is what Respondent 2 said: “No... You first take the temperature, if the temperature is high, if you have paracet [paracetamol], you give it to the child, before going to the hospital.” Respondent 1 added: “You can even look for efferalgan to calm the temperature.” In the same vein, respondent 3 insisted on the administration of efferalgan or paracetamol depending on the age of the patient, and then an observation is made every four hours until the next 24 hours before deciding to act otherwise.

Additionally, in the community, traditional concoctions are also used to treat malaria. Respondent 13 specified that as far as he remember, the first interventions alongside his parents to cure malaria were oriented towards traditional medicine. Here’s what Respondent 2 said: “Yah, but sometimes, it’s always good too to boil the fever grass. It’s always good... When a child can be
having something... Even you... I myself, sometimes, I can be feeling just bored I just feel to boil the fever grass.” So, among these concoctions is fever grass. When local care is not enough, patients go to the closest health center where 4 hours of additional care are initiated. To this end, the management of malaria at the community level is supplemented by other tablets such as artemether, artesunate or malacure, as confirmed by Respondent 9: “at the start there are tablets to which we give tablets artenether heerr, artesunate, malacure” If patient are unable to ingest, they are given an injection or they can also be put on drip in the event of severe dehydration. In this regard, Respondent 9 specified: “The injection is... to... to... to manage it, the most of the injection that we use are injections of arteme artemether based on arteme artemesin according to the kilogram, and the first dose and the drip as heerrr glucose. Huhum after the blood sugar, drive by the goal... the glucose can be put in place with an injection of hydrate, it can be taken as the first injection inside, heerr, so finally, we wait 4 hours to see the temperature to lower . He descends.”

At the hospital level

The management of malaria in an intra-hospital environment is done according to well-established protocols for this purpose. In fact three protocols are to be followed: that of injectable artesunate, that of injectable artemether and that of quinine infusion. This is what Respondent 10 told us, insisting that the injectable artesunate protocol is the best. This treatment makes it possible to treat inner malaria but for the treatment of symptoms such as fever when they are still present at the time of treatment, paracetamol must be added to it and by injection, glucose serum has also to be associated with vitamin ampoules to dehydrate weakened patients.

Evaluation of Malaria protocol

Comparing Malaria protocol discovered within the community (ambulatory first aid health centers included) and in hospitals of Eoulan Health’s district to WHO (2023) [1], CDC (2023) [6] guidelines gave the following results:

<table>
<thead>
<tr>
<th></th>
<th>Community</th>
<th>Hospital</th>
<th>WHO</th>
<th>CDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>1</td>
<td>0.63**</td>
<td>0.303</td>
<td>-0.149</td>
</tr>
<tr>
<td>p</td>
<td>0.000</td>
<td>1</td>
<td>0.098</td>
<td>0.107</td>
</tr>
<tr>
<td>n</td>
<td>32</td>
<td>32</td>
<td>31</td>
<td>32</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level
* . Correlation is significant at the 0.05 level

After recoding as shown in the table above, Malaria protocols within the community and at the hospital were found to be positively highly correlated at 63% $[r(30) = .63, 99%, p = .000]$. In addition, Malaria protocol at the hospital was moderately positively correlated to WHO (2023) [1] guidelines for malaria management at 41.8% $[r(30) = .41.8, 95%, p = .019]$. No correlation was found between malaria guidelines given by CDC (2023) [6] and malaria protocol found both within the community $[p = 0.417]$ and in the hospital $[p = 0.559]$.

Malaria equipment

Types of diagnostic tests available

- At the community level

Within the community, the population proceeds to the malaria test following a finding on the rise in body temperature. To achieve this, they use a thermometer or proceeds by a touching of skin if necessary. Here is what Respondent 8 in the community told us that normally the best way to see if the body is hot is to touch the body or if not it works too by using a thermometer. Moreover, still in the community, when faced with a suspected case of malaria, community health workers usually only perform a rapid diagnostic test before administering treatment. Here is what Respondent 9 said: “...we [ambulatory health center staff] use mostly rapid test, we can do what they call goute-epaise [blood smear], because our microscope has a problem.”

- At the hospital level

When the clinical symptoms of malaria are present, it is also necessary to seek confirmation by para-clinical signs, as explained to us by Respondent 10, a doctor on
duty at the Obili Subdivision Medical Center. In fact, clinicians will order a blood smear test and see if it is positive or not. Thus, the confirmation test for malaria done in the hospital is blood smear. In addition, the rapid diagnostic test (RDT) is also performed in an intrahospital setting, as Respondent 11 confirmed that at the Obili Subdivision Medical Center, laboratory workers perform both blood smear and rapid diagnostic test to confirm suspected cases of malaria.

**Equipment (supplies, instruments, devices) available**

- **At the community level**
  Thermometers are well known in the community and partake for the management of malaria. Although it is also present in the hospital, a thermometer is the first tool used in the community. In fact, people of the community use the thermometer to perform their first malaria test by checking the rise in body temperature. This is what Respondent 8 reminded us of when he said in the community to check the body temperature, thermometer is used or a body skin touch is performed. In the community, whenever the body temperature elevation test is positive, antimalarial drugs are used to lower the temperature.

Considering first aid ambulatory health centers within the community of Efoulan, RDT kits are also present among antimalarial equipment and include the following list of tools: cassettes; gloves; alcohol sanitizing swabs, lancets, timers and registers, as revealed by our cross checklist. Other antimalarial equipment includes centrifuges, cotton wool, blood pressure machines and hemoglobin (HB) machines.

- **At the hospital level**
  Microscope and strips do not exist in the community and are only present in the hospital. To this end, Respondent 11 answered with a “Yes” to talk about the equipment for the diagnosis of malaria in the laboratory of Obili Subdivision Medical Center. He therefore also performed a demonstration as shown in the Figure 1.

In addition to RDT kits also available at the hospital level, our cross checklist also shows smear microscopy supplies and devices among antimalarial equipment found in hospitals, including binocular microscopes, microscope slides and slide boxes, Giemsa stain, lens cleaning fluid, plastic serological pipettes, lens cleaning wipes, immersion oil, lancets, alcohol swabs, timers, gloves and registers.

![Figure 1: Microscope and strips simulation](image)

**Evaluation of malaria equipment**

Comparing the group of equipment present in the community and the group of equipment present at the hospitals with those recommended by Long (2009) [2], we found the following results:

As shown in the table below, ANOVA revealed that there was a statistically significant difference ($F(2, 96) = 10.688$, $p = 0.00$) between at least two groups of malaria equipment among those found within the community and those found in hospitals compared to those recommended by Long (2009) [2].

<table>
<thead>
<tr>
<th>Malaria Equipment</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>40.081</td>
<td>2</td>
<td>20.040</td>
<td>10.688</td>
<td>0.0</td>
</tr>
<tr>
<td>Within Groups</td>
<td>180.000</td>
<td>96</td>
<td>1.875</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>220.081</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Tukey’s HSD Test for multiple comparisons showed that malaria equipment was significantly different between those recommended by Long (2009) [2] and those found within the community as presented in the table below ($p = 0.001$, 95% C.I. = [-2.01, -0.41]).
Table 4. Gap of malaria equipment within the community

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>-1,212&lt;sup&gt;*&lt;/sup&gt;</td>
<td>0.337</td>
<td>0.001</td>
<td>-2.01 to -0.41</td>
</tr>
<tr>
<td>Hospital</td>
<td>0.242</td>
<td>0.337</td>
<td>0.753</td>
<td>-0.56 to 1.04</td>
</tr>
</tbody>
</table>

<sup>*</sup> The mean difference is significant at the 0.05 level.

There was no statistically significant difference (p=0.753) between malaria equipment found in hospitals and those recommended by Long (2009) [2]. In fact, malaria equipment found in hospitals were positively and moderately correlated at 35% (r(31) = 0.351, 95%, p = .045) to those recommended by Long (2009) [2] as shown in the table below:

Table 5: Malaria equipment in hospitals

<table>
<thead>
<tr>
<th></th>
<th>Community</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>-0.279</td>
<td>0.351&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.116</td>
<td>0.045</td>
</tr>
<tr>
<td>N</td>
<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

<sup>*</sup> Correlation is significant at the 0.05 level.

ANOVA also revealed a significant 18% effect of equipment (\(\eta^2 = 0.182\)) on the management of malaria per group (community and hospital) as shown in the table below:

Table 6: Effect of malaria equipment

<table>
<thead>
<tr>
<th></th>
<th>Eta Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria Equipment * Group</td>
<td>0.427</td>
</tr>
</tbody>
</table>

Malaria drugs

**Drugs for uncomplicated malaria**

Drugs to manage uncomplicated malaria exist both in the community and in the hospital. In the community, antimalarial drugs are often used to control the patient’s body temperature and treat fever. These drugs include tablets such as Efferalgan, paracetamol or artemether. These drugs are directly available in the nearest pharmacies. Respondent 3 confirmed this point of view by saying that she use to go to the closest pharmacy where she meets a doctor for a prescription on antimalarial treatment which she then administer to her children when they have fever and she will wait 48 hours. If after 48 hours, the temperature still does not drop, then she goes to the hospital. On the other hand, many more traditional concoctions such as fever grass are also used in the community to manage malaria.

**Drugs for severe malaria**

The management of severe malaria is generally carried out in the hospital. Drugs available for that are injectable artemether, injectable artesunate, or quinine in infusion. According to the treatment ministered to the patient, glucose serum and injectable paracetamol can be added to the list to treat the fever and to rehydrate the patient. In his speech, Respondent 10 confirmed that if the patient can tolerate oral treatment and is strong enough, oral treatment can be administered to him just as it is done in the community. But if the patient does not tolerate oral treatment, the patience is vomiting, which is a criterion of gravity, then the medical staff goes directly to the treatment of severe malaria by administering an injectable artemether, injectable artesunate, or quinine in infusion. At this level, inner malaria is treated, now for the treatment of symptoms such as fever, injectable paracetamol is used and according to the patient’s weight, it can be associated with glucose serum, so that the patient can gain a little of energy, and vitamins can also be added. These drugs are also well available in the hospital pharmacy, as Respondent 12 pointed out while
explaining that some patients often approach medical staff seeking to buy prescribed medicines and they are directed to the hospital pharmacy.

**Evaluation of malaria drugs**

The use of antimalarial drugs within the community (ambulatory first aid health centers included) and in hospitals of Efoulan Health’s district were compared to prescriptions found in WHO (2023) [1], CDC (2023) [6] guidelines and the results were as follows:

<table>
<thead>
<tr>
<th></th>
<th>Community</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>p</strong></td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>n</strong></td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td><strong>Community</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>1</td>
<td>.854**</td>
</tr>
<tr>
<td><strong>Hospital</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>.854**</td>
<td>1</td>
</tr>
<tr>
<td><strong>WHO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>.435*</td>
<td>.533**</td>
</tr>
<tr>
<td><strong>CDC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>.153</td>
<td>.247</td>
</tr>
</tbody>
</table>

**Discussion**

**Correlations in Malaria protocols**

- Correlation between Malaria protocol within the community and in hospitals

Our results showed that Malaria protocols within the community and at the hospital were found to be positively highly correlated at 63% \( r(30) = .63, 99%, p = .000 \).

However, this correlation is not perfect; having not showed a score greater than 80% and therefore additional steps must be taken within the community on applying malaria protocol. Firstly, clinical signs or symptoms for malaria identification remain a problem within the community. Many established symptoms for malaria severity are still unknown within the community. Among these clinical signs, our findings reveal that Body aches and General malaise are still not commonly associated to malaria within the community. Secondary, para-clinical signs sought through lab exams to diagnose malaria within the community are limited to those revealed by a Rapid Diagnostic Test (RDT). Meanwhile, according to CDC (2023) [6], the use of RDT does not eliminate the need for malaria microscopy. RDT may not be able to detect some infections with lower numbers of malaria parasites circulated in the patient’s bloodstream. These findings agree with Adepoju (2021) [8] who demonstrated that Rapid diagnostic tests may be missing up to 20% of malaria cases in Cameroon.

These undetected malaria patients are those with a lower parasitemia (less than 4% of malaria parasites in the bloodstream) [1]. Following the referral system, patients are only sent to hospitals when their case is worsening. Therefore, if nothing is gone, 20% of malaria patients in Cameroon will continue to get detected only when malaria becomes severe. Knowing that severe malaria leads drastically to death, it will be a good move in the fight against malaria if all diagnosed cases could be detected when there are still uncomplicated.

- Correlation between WHO (2023) guidelines and Malaria protocol in hospitals

Malaria protocol at the hospital was moderately positively correlated to WHO (2023) [1] guidelines for malaria management at 41.8% \( r(30) = .41.8, 95%, p = .019 \).

A simple moderate correlation between WHO (2023) [1] guidelines for Malaria management and malaria protocol at the hospital in Efoulan Health district is a proof that efforts still needed to be carried out in Efoulan’s hospitals concerning malaria management. In fact, some clinical symptoms associated with the severity of malaria and pointed out by WHO (2023) [1] guidelines were not associated to malaria identification for the medical staff in Efoulan’s hospitals. Among these symptoms, we can cite Confusion, Breathing difficulty/Acute respiratory distress syndrome (ARDS), Dark or bloody urine, and Abnormal bleeding.

Ignoring some of these signs like ARDS as symptoms for severe malaria which are also common to Covid-19 therefore explain why malaria can be misdiagnosed as Covid-19 in this health district. This finding is supported by Konozy et al. (2022) [9] who confirmed that malaria cases might be misdiagnosed as COVID-19. In addition, Hussein et al. (2020) [10] explained how people with
fever may be tested for COVID-19 and then sent home due to a negative result, ignoring the possibility of malaria. It therefore becomes crucial and vital to update the medical staff skills on the management of malaria.

- No correlation between CDC (2023) guidelines and Malaria protocol both within the community and in hospitals

The absence of correlation between CDC (2023) [6] guidelines for malaria management and malaria protocol found both within the community and in the hospital of the health district of Efoulan is clearly justified by the difference of Epidemiological patterns. In one hand, Malaria guidelines given by CDC (2023) [6] target non endemic countries where each case must be treated at the root with the aim of eradicating the infection mostly brought in by travellers. This is the pattern of developed countries like the United States of America.

In another hand, Malaria protocol found both within the community and at the hospital in Efoulan health’s district is derived from WHO (2023) [1] guidelines for the community and at the hospital in Cameroon.

Apart from additional signs associated with malaria which are revealed by CDC (2023) [6] guidelines, CDC (2023) [6] approach of malaria management is Plasmodium species focused. In fact, travellers may come from various malaria endemic countries harboring different strains of malaria. It’s therefore crucial to be concise on the type of malaria virus health practitioners are dealing with. For this aim, CDC (2023) [6] approach of malaria management include Polymerase Chain Reaction (PCR) test in addition to classic paramedical diagnostic methods which are Rapid Diagnostic Tests (RDT) found in the community and Smear microscopy found in hospitals of Efoulan health’s district.

In fact, PCR is recommended in CDC (2023) [6] guidelines for a sensitive and specific detection of Plasmodium species DNA from peripheral blood of the patient. PCR may be more sensitive than conventional microscopy in very low parasitemias and is more specific for species identification. Lastly, another major difference between CDC (2023) [6] guidelines for malaria management and malaria protocol found both within the community and in the hospital of the health district of Efoulan is the final aim hidden behind each approach. Following CDC (2023) [6] guidelines, each case is manage for eradication meanwhile protocol found both within the community and in the hospital in the health district of Efoulan aims to cure the case and avoid dead. To accomplish its purpose, CDC (2023) [6] include for each malaria case manage Drug resistance tests et studies which are absent the protocol discovers both within the community and at the hospital of Efoulan health’s district.

**Effects of Malaria equipment**

- Difference between Malaria equipment found within the community and those recommended by Long (2009)

According to ANOVA and Tukey’s HSD tests, Malaria equipment found within the community (ambulatory first aid health centers included) were statistically significantly different (F(2, 96) = [10.688], p = 0.00) from those recommended by [2] (p = 0.001, 95% C.I. = [-2.01, -0.41]).

In fact, within the community (ambulatory first aid health centers included), we noticed that many of the equipment used to diagnose malaria as recommended by Long (2009) [2] were absent and were replaced by other kinds of equipment. Why investigating we realized that the main reason behind this change was financial shortage. It will be difficult to find equipment for smear microscopy within the community due to the expensive price of a Binocular microscope on Cameroon market.

Malaria equipment found within the community but not mention by Long (2009) [2] were: Thermometers; Centrifuges, Cotton wool, Blood Pressure apparatus and HB machine. In hospitals and in the community, an RDT costs about 2 dollars and the population instead of undergoing this malaria test, will rather measure the temperature of a suspected case by using a thermometer and even sometimes by simply touching the patient’s skin. These methods used within the community will give way to the usual traditional treatment first then to a symptomatic treatment if the signs of disease persist. The community only starts paying for any type of test when the disease gets worse. To address the lack of money in the community, centrifuges are used in ambulatory first aid health centers as a low-cost malaria diagnostic tool following the explanation of KRIS (2017) [11]. Additional devices like Cotton wool, Blood Pressure apparatus and HB
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To reach this target, we formulated the question of how medical technology was being used in the health district of Efoulan to manage malaria in covid-19 setting. In order to analyse these medical technologies, each phenomenon was broken down into its different elements following the professional dominance theory. This model of health conceptualized by Eliot Freidson in 1970 in his postulate, suggests that professionalism can use legal expertise and powers to develop hegemonic control over an area of human life and culture. This professionalism towards the use of medical technologies to control malaria, is indeed what we analysed in this study.

Our study revealed that Malaria protocols within the community and in hospitals were positively highly correlated at 63% \[ r(30) = .63, 99\%, p = .000 \]. In addition, Malaria protocol at the hospital was moderately positively correlated to WHO (2023) [1] guidelines for malaria management at 41.8\% \[ r(30) = .41.8, 95\%, p = .019 \]. Finally, no correlation were found between CDC (2023) [6] guidelines and Malaria protocol both within the community and in hospitals. Malaria equipment found within the community (ambulatory first aid health centers included) were statistically significantly different \( F(2, 96) = [10.688], p = 0.00 \) from those recommended by Long (2009) [2] \( p = 0.001, 95\% \text{ C.I.} = [-2.01, -0.41] \). There was no statistically significant difference \( p = 0.753 \) between antimalarial equipment found in hospitals and those recommended by Long (2009) [2]. ANOVA also revealed a significant 18.2\% effect of equipment \( \eta^2 = 0.182 \) on the management of malaria per group (community and hospital).

Antimalarial drugs used within the community and hospital's prescription for malaria were perfectly correlation at 85.4\% \[ r(20) = .854, 99\%, p = .000 \]. The use of antimalarial drugs within the community (first aid ambulatory health centers included) and hospital's prescription for malaria were respectively moderately positively correlated at 43.5\% \[ r(20) = .435, 95\%, p = .043 \] and highly positively correlated at 53.3\% \[ r(20) = .533, 95\%, p = .011 \] to prescriptions recommended by WHO (2023) [1] guidelines for malaria treatment.

To strengthen malaria control, health education on complete malaria protocol must be carried out, first aid medical centers must be better equipped, drugs must be prescribed according to patient’s histories and pre-referral treatments must be applied within the community while integrating traditional concoctions in modern medicine.

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Conflict of Interests

Authors declare no conflict of interest.

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