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FEASIBILITY AND ACCEPTABILITY OF INTRODUCING RAPID DIAGNOSTIC TEST FOR THE MANAGEMENT OF MALARIA AMONG NOMADIC FULANI OF NORTHEASTERN NIGERIA

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Abstract
Malaria is one among the top classified deadly disease, and it is widely spread in the tropical regions of the world especially Africa. Accurate diagnosis usually at an early stage with prompt treatment reducesthe burden of the disease. This study was aimed to assess the feasibility and acceptability of introducing malaria Rapid Diagnostic Test (mRDT) amongnomadic Fulani groupsof northeastern Nigeria. Community-OwnedResourcePersons (CORPs) were selected from the nomadic Fulani camps and trained on malaria Rapid Diagnostic Test (mRDT),and toreferillness that was not malaria to health facilities. Result shows thatsensitivity (96.7%), specificity (93.2%), positive predictive value (96.7%), negative predictive value (93.2%) and accuracy (95.0%) of interpretation of malaria Rapid Diagnostic Test (mRDT) by nomadic Fulaniresource persons were all above ninety percent. Acceptance(95.0%) of malariaRapid Diagnostic Test by nomadic Fulani population was equally above ninety percent. Making use ofmRDT in home management of malaria was feasible and acceptable by the nomadic Fulani.These strategies should be introduced in the nomadic Fulani camps in order to scale down mis-use of anti-malarial drugsand subsequently enhance the control of malaria by nomadic Fulani populationin their sedentary movement.

Keywords: Malaria Rapid Diagnostic Test, nomadic Fulani, northeastern, Nigeria

Introduction

Malaria is one among the top classified deadly disease, and it is widely spread in the tropical regions of the world especially Africa.According to latest world malaria report there were about 219 million cases of malaria in 104 endemic countries with at least 3 million deaths annually(WHO, 2012). about 90% of cases of malaria worldwide occur in Africa south of the sahara (Breman, 2001; Bryce, *et. al.*, 2005;WHO, 2012).Many children living far away from health care units die while travelling to the nearest hospital. These deaths due to malaria usually occur in the first 24 hours of hospital admission. Early diagnosis, prompt and appropriate management usually reduce the burden of the disease (Arnaud, *et. al.* 2005).

The managementof malaria has exceeded even a simple biomedical vision of health, in that parents and non- medical community sectors are now involved in its management (WHO, 2012). This mode of intervention against malaria improves

community-based health care delivery system. The family is known to be the first hospital for any child with high fever in Africa. Improved home management of malaria has a significant reduction in the morbidity and mortality due to the infection (Daniel and Okenu, 1999;Were, 2004; WHO, 2010).

The World Health Organization(2010) recommends that anyone suspected of having malaria should receive diagnosis and treatment with an effective drug within 24 hours of the onset of symptoms. Patientwho do not have access to a health care provider within that time period can as well manage the disease at home(Daniel, *et. al*., 2010). Another challenge is that poor diagnosis continues to hinder the effectivenessof malaria management. The clinical diagnostic approach that is widely used is unreliable because the symptoms of malaria are nonspecific. Microscopic diagnosis has technical and personnel requirements that often cannot be met at the periphery of the health care system (WHO, 1999). Thus the malaria Rapid Diagnostic Test is highly effective method of detecting malaria induced febrile illnesses and is easy to use when compared to the requirements of microscopy (Moody, *et. al*., 2000; Ansah, *et. al*., 2010). In some isolated areas malaria Rapid Diagnostic Tests performed by community volunteers can be used to treat malaria immediately with the aim of reducing the morbidity and mortality of the disease (WHO, 1999). The aim of WHO's Roll Back Malaria programme has been early diagnosis and prompt treatment. For this reason there is the need for early diagnosis and recognition of complicated malaria at a local centre and if warranted to be sent to a higher centre for management at an early stage to avoid mortality. This willlimit overuse of ACT, reduce programme costs of anti-malarials, reduce drug pressure and delay emergence of resistance against ACT (Mishra and Mohanty, 2003).It is not clear how effectively lay people such as nomads living in remote and least served communities could be trained to use the malaria Rapid Diagnostic Test as an aid to malaria management.

The nomadic Fulani have an estimated population of 75 million in the developing World; over 60% of them are in Africa spread over more than twenty one countries. They migrate periodically with their herds to exploit resource (pasture and water) (Omar, 1992). During the wet season when superficial water and pasture are abundant, nomads disperse over large areas of land while in the dry season; they tend to concentrate around wells, rivers, lakes or man-made ponds (Abdikarim and Jolian, 1999). In West Africa, nomads may travel thousands of miles in search of pasture for their animals, often within tribal and clan boundaries (Lamprey, 1983). Although they contribute to the National economies of their countries and are the major producers of milk, meat, and other animal products in many African countries (Abdikarim and Jolian, 1999), they have less access to health care,and usually more exposed to diseases, such as malaria, than the settled population (Chabasse, *et .al.*, 1985). Akogun*et. al* (2012), reported that government programmes in Nigeria to Roll Back Malaria through health education, chemotherapy, insecticides and treated bed nets is yet to be felt by the nomadic Fulani even though they are in greater risk than any other tribes because of their life style and less served by government intervention programmes. They remain reservoirs for fresh infections when the entire population is regarded as free. Often sometimes, those who survive the infection such as malaria returned to their normal habitats and infect non immune relatives (Warsame, 1991). The nomads are

virtually ignored from the health services because it is usually in the hands of the settled populations which do not relate well to them (Abdikarim and Jolian, 1999). They live in small temporary camps close to rivers and water holes where exposure to mosquitoes is very intense.

This study was therefore aimed to assess the feasibility and acceptability of introducing Malaria Rapid Diagnostic Test for the management of childhood febrile illness among nomadic Fulani childrenwhile in their sedentary movement.

MATERIALS AND METHODS

Study area.

The study was conducted in Adamawa State, northeastern Nigeria, situated between latitude 7^{o} and 11^{o} N, and longitude 11^{o} and 14^{o} E. Adamawa state has four pastoral blocks and livestock movements. The Hong-Michika block, Jada-Mayo Belwa block, Toungo block and Benue-trough block. The Benue-Trough block is the largest block occupying 11,000 kms, making up to 40% of the pastoral blocks. The block is a grassland area characterized by the flood plains of the Benue River and that of its tributaries such as rivers Gongola, Kilange and Ine. As a tropical region, the area has two seasons. The dry season starts from November and ends in March; and the rainy season starts in April and ends in October with a mean annual rainfall between 900 and 1100 mm and an average minimum temperature of 18^{o}C and an average maximum temperature of 37^{o}C. The hottest months are March and April with maximum temperature of 40^{o}C (Adebayo and Tukur, 1999).

Study Population

The nomadic camps of study are located in the Benue-trough pastoral block spread across four local government areas. The Benue-trough is conducive for the nomadic Fulani in dry season and serves as a major campsite and stop post in the nomadic North-South migration. The nomads are located in bush encampments in the pastoral block. The study covered twenty three camps spread across the Benue-trough pastoral block.

Pre-survey Contact and Mobilization

Organization that is working with the nomads (Common Heritage Foundation, Yola) was first contacted to get access and seek information on strategy for approaching the nomads. Informal visits and discussion were made with the camp leaders in the market places where many nomads mingle, and as well as in their camps. The visits were to negotiate and develop confidence with the camp leaders and the community as well gain acceptance. This was necessary to ensure maximum co-operation from the nomadic Fulani and was successfully carried out. The informal discussion was helpful in the development of tools for data collection.

RDT Training

One hundred and ninety six (196) nomadic Fulani who served as Community-owned Resource Persons (CORPs) were randomly selected and trained on Rapid Diagnostic Test (RDT). Each CORPs contributed 5-8 hours training every dayfor three weeks. CORPs who demonstrated proficiency during the training programme were enrolled to participate in testing volunteers who had symptoms of malaria..

Rapid Diagnostic Test (RDT)

Malaria Rapid Diagnostic Test kitswere used for the study. Specimens were assayed according to the manufacturer's instructions as reported by Cooke, *et. al*.(1999).Volunteers who were to serve as community-owned resource persons (CORPs)performed the RDT under the supervision of a health personnel.

Procedures of RDT

CORPs gave informed consent to the participants;CORPs cleaned the site of pricking with cotton wool soaked in 70% ethanol; CORPs pricked the thumb or heel correctly; CORPs put a drop of blood on the center of the slide; CORPs spread the blood to a coin size; CORPs air dry slide; CORPs put a drop of blood into the cassette well; CORPs dispensed three drops of buffer into the cassette well; CORPs covered the pricked site with swab; CORPs disposed the used lancet and swab into a safety bin; CORPs waited for 15 minutes for colour development before interpreting the result; CORPs interpreted the result correctly;CORPs put the slide and cassette into the provided envelope (brown envelope for positive RDTs and white envelope for negative RDTs); CORPs gaveArtesunate and Amodiaquine hydrochloride to the participants;CORPs referred participants.

Rapid Diagnostic Testcassette that were dropped in a brown envelope for positive RDT, and white envelope for negative RDT by CORPs were assembled and re-checked by a health personnel if theinterpretation by CORPs were correct.

Parasitological Technique

Thick films were prepared alongside with the RDTs performed by CORPs.The films were stainedwith 10% giemsa and examined under oil immersion objective lens for malaria parasites. Thehealth personnel compared the results of the RDT with parasitological technique.

Administration of questionnaires/Interviews to assess the Acceptabilityof Rapid Diagnostic Test (RDT)

Household surveys were conducted during the operational phase. This was carried out by administering questionnaires to the mothers with children of under-five years. This was to assess themothers acceptability of RDT.Semi-structured interview was also administered to the CORPs, key informants, children, camp leaders and mothers of under-five. The interview was to assess the experience of the CORPs with RDT process, especially the most challenging and interesting aspects of the process, how participants and camp members viewed the RDT work with reference to acceptance, perception of the work, illness outcome and preparedness to continue with the programme.

Ethical Considerations

Ethical clearance was obtained from Adamawa State Ministry of Health.Childrenwith positive malaria parasite tests were treated with Arthemisinin combination therapy.Febrile illness with negative malaria were referred for further diagnosis and management. Drugs administration was performed by health personnel.

Data analysis

Data were entered into a database created in Epidata version 3.1. Data was then transferred toStatistical Analysis System (SAS) version 8.0 and were analysed. Statistical significant difference were indicated by $p<0.05$ and no statistical difference by $p>0.05$.

RESULTS

The study revealed that Community-Owned Resource Persons (CORPs) who gave informed consent before taking blood were 75%, cleaned site of pricking (100.0%), pricked thumb correctly (85.0%). It was observed that CORPs putting one drop of blood on the centre of slide were 80.0%, made smear to coin size (50.0%), air dried slide (90.0%). There were 80.0% of CORPs who correctly pipetted one drop of blood into the cassette well. Ninety percent added 3 drops of buffer correctly into the cassette well, and covered the pricked site

with swab soaked in (70%) ethanol. About 95.0% were able to dispose the used lancet and swab into the provided safety bin containers. CORPs who waited for 15 minutes for colour to developbefore interpreting the results were 100.0%. It was observed that 90.0% of the resource persons were able to interpret Rapid Diagnostic Test (RDT) result correctly, and about 100.0% were able to give arthimisinin combination therapy (ACT) to the participants, and drop both slide and RDT cassette into the appropriate labelled envelopes. Also 95.0% of the CORPs were able to instruct the participants on the step to take after the RDT (Table 1).

Malaria Rapid Diagnostic Test as interpreted by research personnel and CORPS showed that out of 196 participants examined in the camps 64.8% were RDT antigenaemic by the interpretation of research personnel whereas 37.8% were negative. Community-owned resource persons (CORPs) interpreted RDT antigenaemic in 62.2% participants and 37.8% negative. However, both interpretations were not different (p>0.05) (Table 2). The CORPs interpreted 5 positive RDT out of 10, but interpreted negative by the research personnel (false positive), whereas 5 were interpreted negative by CORPs but interpreted positive by the research personnel (false negative).Analysis of the result showed that the interpretation of CORPs gave a sensitivity of 96.7%, specificity, 93.2%, positive predictive value of 96.7%, negative predictive value of 93.2% and percentage accuracy of 95.0%.(Table 3).

The study revealed that 68.9% of the standard parasitological technique were parasitaemic and 31.1% non-parasitaemic.Analysis of the result showed that malaria Rapid Diagnostic Test technique gave a sensitivity of 90.0%, specificity of 98.4%, positive predictive value of 99.2%, and negative predictive value of 81.1% and percentage accuracy of 92.3% (Table 4).

Table 5shows the acceptance of RDT by the nomadic Fulani population. Results indicate that child crying (25.0%), covering the pricked site with swab (5.0%), pipetting blood from the pricked site (15.0%) and struggling with the participants during sample collection (10.0%) was more challengingas reported by the respondents. The study revealed that 45.0% of the respondents did not notice any difficulty in the process, and the most interesting aspectsreported by the respondents was the participants' willingness to use RDT (5.0%), participants' illness outcome (55.0%), Positive RDT results (25.0%) and proximity of drugs and tests to the participants (15.0%). The community perceived the RDT process better than the government-owned clinic (10.0%), and also good for the community (55.0%). Similarly, some respondents (20.0%) acknowledged that RDT is like a government-owned clinic work as while as government-owned hospital (15.0%). When probed whether the RDT process can continue, 5.0% of the respondents reported that the procedure cannot be maintained. Other respondents (55.0%) were not sure whether the RDT process can continue, while40.0%said they are ready to maintain the programme.The preparedness to continue with the programme elicited different views from the respondents. The study revealed that 30.0% of the respondents were prepared to continue with the RDT programme. Some (65.0%) of the respondents don't know whether the RDT programme can continue. In general the acceptance of RDT by the nomads was (95.0%)

Table 1: Use of Rapid Diagnostic Test kit (RDT) by CORPS.

Variables	No.(%)
CORPs giving Informed consent	147(75.0)
" cleaning site of pricking	196(100.0)
" pricking thumb (heel if infant) correctly	166(85.0)
CORPs putting drop of blood on the centre of slide	157(80.0)
" spreading film to coin size	98(50.0)
" air drying slide	176(90.0)
CORPspipeting one drop of blood into the cassette well	157(80.0)
" adding 3 drops of buffer into cassette well	176(90.0)
" covering pricked site with swab	176(90.0)
" disposing used lancet and swab into provided container	186(95.0)
" waiting for 15 minutes for colour development	196(100.0)
" interpreting the result correctly	176(90.0)
" giving Artesunate tablets to participants	196(100.0)
" Putting slide and cassette into envelopes	196(100.0)
" instructing participants on the next step	186(95.0)

Table 2: CORPs Iinterpretation of Rapid Diagnostic Test (RDT) compared with that of research personnel in the diagnosis of *Plasmodium falciparum*.

	Total No. of RDT Examined	No.(%) Positive	No.(%) Negative
CORPS	196	122 (62.2)	74 (37.8)
Research Personnel	196	127 (64.8)	69 (35.2)

Table3: Rapid Diagnostic Test (RDT) Interpreted by research personnel compared with that ofCORPSin the diagnosis of *P. falciparum* infection.

		RDT (RESEARCH PERSONNEL INTERPRETATION)		Total
		RDT +ve	RDT –ve	
RDT (CORPS INTERPRETATIO)	***RDT +v***	**117**	**5**	**122**
	RDT –ve	5	69	74

Sensitivity of RDT interpreted by CORPS: = $\frac{117 \times 100}{117+5}$ = 96.7%

Specificity of RDT interpreted by CORPS:=$\frac{69 \times 100}{69+5}$ = 93.2%

Positive predictive value of RDT interpreted by CORPS:=$\frac{117 \times 100}{117+5}$ = 96.7%

Negative predictive value of RDT interpreted by CORPS:=$\frac{69 \times 100}{69+5}$ = 93.2%

Percentage accuracy of RDT interpreted by CORPS: = $\frac{(117 + 69)}{196} \times 100$ = 95.0%

Table4: Parasitological compared with Rapid Diagnostic Test (RDT).

	RDT+ve(%)	RDT-ve(%)	Total
MP +ve	121(61.7)	14(7.1)	135
MP –ve	1(0.5)	60(30.6)	61
Total	122	74	196

Sensitivity of RDT with Parasitological = $\frac{121 \times 100}{121+14}$ =90.0%

Specificity of RDT with Parasitological = $\frac{60 \times 100}{60+1}$ = 98.4%

Positive predictive value of RDT = $\frac{121 \times 100}{121+1}$ =99.2%

Negative predictive value of RDT = $\frac{60 \times 100}{60+14}$ = 81.1%

Percentage accuracy of RDT = $\frac{121+60 \times 100}{196}$ = 92.3%

Table 5: Acceptance of Rapid Diagnostic Test.

Variables	% Response
Child crying	25.0
Covering pricked site with swab	5.0
not difficult	45.0
Pipetting blood from the pricked site	15.0
Struggling with children	10.0
Participant willingness to use RDT	5.0
Participant's illness outcome	55.0
Positive RDT results	25.0
Proximity of test and drugs to participants	15.0
like it	95.0
don't like it	5.0
Better than government clinic	10.0
Good for the community	55.0
like clinic work	20.0
like government hospital work	15.0
Cannot continue	5.0
Not sure of continuation	55.0
Ready to continue	40.0
Yes	30.0
No	5.0
don't know	65.0

Discussion

The results in Table 1 showed the performance of Community-Owned Resource Persons (CORPs) onRapid Diagnostic Test (RDT). CORPs who sought for informed consent before pricking the volunteers thumbwere more than seventy perecent indicating that the rights of the participants are relatively taken care off by the resource persons. Nearly all the CORPs were able to clean the site of pricking with 70% ethanol, suggesting that there is a high level of understanding by CORPs with regards to safety measures. More than three quarter of the CORPs put exactly one drop of blood on the centre of the slide which impliesadherance to the correct volume of blood required to makethick smear. This may be attributed to the preparedness of the CORPs to learn the procedures of mRDTas an indicator for the full implementation of the programme among the nomads. There were fifty percent chances of making good thick blood smears by the nomadic Fulani CORPs.This implies that fifty percent of thickblood smears made by CORPs were poorly made and it may affect intensity of the morphological pictures of the malaria parasites on the film. Almost eighty percent of the CORPs put one drop of blood into the RDT cassette well, implying adequate proportion of blood to the immobilized malaria antigens. Putting three drops of buffer and covered the pricked site with

cotton wool soaked in 70% ethanol were correctly performed by ninety percent of the CORPs, indicating successful performance in RDT process by the nomads and their readiness to learn the test procedures adequately. More than ninety percent of the CORPs disposed the used lancet and cotton wool into thedisposable bin. This indicatecomplianceof the users with the safety codes of disposing hazardous materials, which may be harmful to the community and participants. Nearly all the nomadic Fulani CORPs allowed the RDT to stay for 15 minutes before interpreting the result. The importancewas to give time for the weak antibodies to develop, and to avoid false reactions that may occur after 15 minutes. It was observed that ninety percent of the nomadic Fulani CORPs were able to read the RDTresult correctly, implying that they have received adequate training for interpreting RDT result. The CORPs were able to properly dispenseddrugs to those who were tested positive for malaria. This showedthat community directed treatment of malaria among nomadic Fulani can be entrusted to the Fulanisirrespective of their family differences that usually occur. Nearly hundred percent of the nomadic Fulani CORPsreferredillnesses that were not malaria to health facilities. Thisimplies strict compliance of the nomadic Fulani CORPs to the referral system which is termed as one of thestrategy in disease management.

Tables 2 and 3 revealed the interpretations of RDT. The overall interpretation of RDT antigenaemia by research personnel and CORPs were similar. However, the combined interpretations were less than the individual interpretation, because the antigenaemia interpreted as positive by CORPs were interpretednegative by the research personnel, and where antigenaemiaare interpreted as negative by the CORPs were in turninterpreted as positive by research personnel, implying false positive and false negative interpretation by CORPs.It is most likely thatsome CORPs may be colour blind to interpret RDT result accurately since the intensity of the positive line was related to the parasite density which may require good sight to interpret. Again it may be that the control lines which appear as negative could be interpreted as positive by the CORPs. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of research personnel interpretation of RDT compared with that of CORPs were all above 90%. This reaffirms the reliability of CORPs in the interpretation of RDT for its use in diagnostic purposes as reported by WHO (2000).

Presence of malaria parasite in the blood was detected higher with parasitological technique as compared to the RDT Technique (Table 4). This suggests the sensitivity of parasitological technique in the diagnosis of malaria and conforms tothe reports of WHO (1999) that thick blood smears stained with giemsa remained the golden standard for the diagnosis of malaria infections. Similarly, reports by (WHO, 1999),Moody, *et. al.(* 2000) indicate that the negative antigenaemia with RDT where parasitological showed positive result could be due to the antigen capture assay, which does not detect antigenaemia where *P. falciparum* is less than 60 parasites/ul. Again the positive antigenaemia with RDT where parasitological technique showed negative could likely be as a result of other foreign antigens or remains of HRP-II antigens which gave false positive results. This is in consonance with the report of Makler and Hinrich (1993), that false positive results can be due to the presence of HRP-II which remains positive for 7-14 days following chemotherapy in a substantial proportion of individuals, even though these patients no longer have parasitaemia as assessed by blood smears.

The sensitivity, specificity, positive predictive values and accuracy of RDT falls between ninety percent. This suggests the reliability of RDT in the diagnosis of malaria infection and is in consonance with the findingsof Moody, *et. al*. (2000) and Kyabayinze*et. al*.(2008) who reported higher effectiveness of RDT in the diagnosis of malaria when compared to the requirements of microscopy. The result of the study reaffirms the use of RDT to diagnose malaria immediately with the aim of reducing morbidity and mortality especially in least served communities such as nomad.

Table 5 shows that child crying, covering the pricked site with cotton wool soaked in 70% ethanol, pipetting blood from the pricked site and struggling with the participants during sample collection were most challenging procedures of RDT process performed by the CORPs. This may be due to the fragile state of these procedures which requires technical expert. These challenges could be as a result of lack of confidence by some CORPs to performmRDT for the participants. Also it may arise as a result of fear by some CORPs to handleparticipants. The most interesting aspect of the RDT process signified by the CORPs was the participant's willingness to use RDT, participant's illness outcome, positive RDT results and proximity of drugs and test to the participants.It is likely that these aspectsof indicators have shown some level of success in the use of RDT by the nomadic Fulani CORPs. Nearly hundred percent of the respondents in the nomadic Fulani camps have accepted the use of RDT. This implies successful implementation of the RDTwhich is an indicator to malaria management by the nomads.

The nomadic Fulani community perceived the RDT process better than the government-owned hospital. Similarly, some respondents of the nomadic Fulani community acknowledged the RDT process as government-owned clinic as well as government-owned hospital works.This is due to the fact that their health needs have been met by the RDT process, which they owned and controlled. The continuity of the RDT process in the nomadic Fulani community elicited different views. It wasobserved that more than fifty percent of mothers of under-five were not sure whether the RDT process can continue in the community. Similarly ,less than fifty percent were of the view that they are ready to continue with the process. The high rate of mothers who were not sure of continuity of the process may likely be due to cost of RDT. The sustenance of any programme may depend on the economy of the people. The nomads complained of lack of fund when they are requested to contribute for any intervention programme. They suffer from health issues while they are regarded as rich by the populace because of the number of cattles they owned. The nomadic Fulanis find it uncomfortableto dispose off their cattles to solvetheirhealth problems. This attitude by the nomadic Fulani may affect their confidence in the continuity of RDT process in the camp which they may own and control in the future. However, the CORPs have performed well in the use of the RDT and community mobilization activities. Thisprogramme should then be encouraged in the nomadic Fulani camps by all stakeholders on health as a trialfor the full implementation of the programme in other similar communities. This may have an impact on malaria scourge to a certain degree.

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