



## Knowledge, attitudes and practices of health providers on malaria control measures in the Democratic Republic of Congo

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### Abstract

**Context:** Plasmodium falciparum malaria is the leading cause of death and morbidity in the Democratic Republic of Congo. Despite the existing of several control methods, cases of malaria are still increasing.

**Objectives:** To measure the level of knowledge of health care providers on malaria and ways to control it, and to determine attitudes and practices to perform when malaria occurs.

**Methodology:** This was a facility-based cross-sectional study involving 467 health care providers in xx health facilities. All care providers who were on duty on the day of the survey were included. Data collection consisted in a face-to-face interview using a study questionnaire. Two knowledge scores were created. The analyses were carried out using EPI INFO software version 3.5.1

**Results:** Of the 467, providers 70% of these providers were retrained on malaria control measures. Only 4% of care providers know the signs of seriousness. The use of LLIN and cleaning up of the environment are the best-known preventive measures, while IPT-SP ( $p \leq 0.001$ ) and even less the indoor spraying ( $p = NS$ ) of insecticide are less well known. At-risk groups are better known by care providers in referral hospitals than in health posts and centers (84.6% vs 67.1 %,  $p < 0.001$ ). At the knowledge level, more than 66% care providers from private sector have an inadequate state of knowledge compared to 40% of providers from public sector ( $p < 0.001$ ). Also, only 17% care providers from private sector versus 43.8% from public sector have above-average knowledge ( $p < 0.001$ ). The referral is considered as measure of care in almost 30% of cases in the public sector against only 4.1% in the private sector ( $p < 0.001$ ).

**Conclusion:** Ignorance of signs of seriousness, lack of willingness to transfer patients, etc., are factors contributing to the delay of significant progress. To solve this problem, the integration of private care providers meeting a number of criteria, the awareness of all care providers and good retraining should be stressed.

**Keywords:** Plasmodium falciparum, malaria, democratic republic of congo, health care providers, knowledge assessment

### Introduction

Malaria remains the major endemic worldwide [1, 2]. Annually, the World Health Organisation (WHO) notes 216 million (IC95 %: 196-263 million) cases of malaria and 438.000 cases of deaths worldwide. Among them, children under the age of 5 and pregnant women remain the most affected [3, 4]. Most cases (90%) occurred in the Africa region of the WHO and about 80 % are in sub-Saharan Africa. Nigeria as well as the Democratic Republic of Congo (DRC) carry almost half of malaria cases in this part of the continent (4-8). In DRC, plasmodium falciparum malaria is the major cause of morbidity and mortality [9]. It is responsible of 39% of reason of consultations for all the combined ages, where by 1 in 39 % of mortality cases is attributed in children <5 years interned in a healthy facility. It is the cause of mortality cited in more than 27% of cases. In hospitalised children under 5 years, plasmodium falciparum malaria has a lethality of 6 % [10]. The National Malaria Control Program (NMCP) in the DRC promotes the disease control methods recommended by the WHO. These include the use of long-lasting insecticide-treated mosquito nets, intermittent preventive treatment for pregnant women, intra domiciled spraying of insecticides, use of artemisinin derivatives for simple (mild or acute) malaria and the use of injectable Artesunate in severe malaria. In the case where Artesunate injection is contraindicated or in case of treatment failure with

Artesunate injection, the NMCP recommends the use of quinine [1, 4, 11, 12].

To enable the country to implement national policy guidelines, a serie of health system reforms took place four years ago [13]. Among them, is the decentralization of the provincial health divisions, which have several responsibilities, including notably the implementation of the national health policy at the health zone level. At the level of the latter, the provision of care is made offered both by the public as well as the private sectors. At this stage we ask ourselves whether the national policy guidelines related to malaria control measures are being met by public and private sector providers in rural and semi-rural areas of the Northern Provinces and Sud-Ubangi District. To answer this question, we conducted a survey of knowledge, attitudes and practices among these providers to measure their level of knowledge about malaria and the means of control, and to determine their attitudes and practices to these clinical situations.

### Materials and Method

This study was observational, descriptive and cross-sectional and was conducted among health care providers (nurses and doctors) in rural and semi-rural areas of the provinces of North and South Ubangi in the DRC. Health care providers belonging to private and public health facilities were interviewed in the Gemena, Bominenge,

Karawa, Bogose-Nubea, Tandala and Bwamanda Health Zones (HZ). In these HZ, there are private and public health facilities. As part of this study, the health facilities under agreement were assimilated to public training.

**Sampling and sample size** Our sampling consisted in recruiting all the providers who were present and available during the passage of the investigators in the health facilities. Healthcare providers in public and private health facilities who identify and treat malaria cases were all interviewed. To be part of the study, the provider should be qualified (nurse or doctor) who voluntarily give their consent to enter the study and be present in a health facility during the time of the investigation. Community relays in the various community care sites were not included in the study.

We interviewed a total of 467 private and public sector providers in 114 health facilities. This size was sufficient in view of our problematic, statistical and epidemiological criteria and of the desired degree of precision. The 6 Health Zones contain a total of 142 officially recognized health facilities. Health facilities that are located more than 100 km from the main office of the HZ were considered inaccessible and therefore the care providers from these health facilities were not interviewed. In addition, the health service providers at the first level (health center and health post) whose facilities were closed at the time of the interviewer were not interviewed. In some cases, all care providers were either not available for interviews at the facility or did not consent, in both cases those health facilities were also excluded from the study

**Collection Procedure and Tool**

To collect the information, we used the interviewing technique of the care providers as a collection technique using a standardized questionnaire. The collection tool was tested prior to its use as part of this serie.

An authorization from the National Ethics Committee has been obtained. After this stage, the study protocol was defended in the different Provincial Health Divisions of North and South Ubangi. Investigators were recruited and trained in Gemena in South Ubangi Province. Using a standardized questionnaire, the interviewers interviewed public and private sector providers after obtaining their informed consent. The interview lasted on average 20 to 30 minutes per provider. The duration of all the collection was one month. There were two levels of form verification before entry. The data collector verified each completed form after the interview before thanking the provider and before starting another interview. The second verification was done by the supervisor who was required to assist in 20 to 30% of the interviews. A sample of 5% of the forms had been verified for compliance. At a compliance rate of at least 95%, the seizure was considered valid and acquiescent.

**Data Processing and Analysis**

The survey cards (investigation sheets) were codified using a codification guide developed for this purpose. The analyzes were carried out using EPIINFO software version 3.5.1 The proportion (95% Confidence Interval) of the knowledge, attitudes and practice of public and private health care providers about malaria and control measures was found by relating their knowledge, attitudes and practices to all enrolled providers respectively to the public and private sectors.

The dependent variable was knowledge or ignorance of malaria or its control measures and the good or bad attitudes and practices of public and private sector providers in a case of malaria.

**Two knowledge scores were created:** the first is composed of 10 signs of severe malaria and the second is composed of elements related to the signs of danger, prevention and treatment.

Types Of Score	Score elements	Variables
Score at 10 elements	Diagnostic	Coma stage I
		Generalized convulsions
		Cardiovascular collapse
		Respiratory distress
		Anaemia
		Diffuse haemorrhage
		Renal failure
		Hypoglycaemia
		Metabolic acidosis
		Haemoglobinuria macroscopic
Score at 17 elements	Diagnostic	Coma stage I
		Generalized convulsions
		Cardiovascular collapse
		Respiratory distress
		Anaemia
		Diffuse haemorrhage
		Renal insufficiency
		Hypoglycaemia
		Metabolic acidosis
		macroscopic haemoglobinuria
	Diagnostic	Coma stage I
		ACT Utilisation for simple malaria
		Artesunate injectable Utilisation for severe malaria
	Prevention	Utilisation of quinine for severe malaria
		Utilisation of LLIN
		Utilisation of LLIN
		TPI/SP in pregnant women
	Environmental sanitation	
	Intra-domiciliary spraying of insecticides	

In fact, we had considered that if a provider knows how to name at least five out of ten signs of severe malaria, then he knows these signs and if the provider does not mention at least five signs out of ten he was considered to be unaware of the symptoms of severe malaria [11] We looked for mean and standard deviation for the 17-variable score. Based on the average, two scales of knowledge were created. The first scale considered that providers with below-average knowledge had unsuitable knowledge, whereas those with average or higher knowledge were considered to have adequate knowledge. The second scale ranked providers according to their knowledge compared to the average (below-average knowledge, average knowledge, and above-average knowledge).

A threshold of significance lower than 5% was considered.

**Resultats**

The 467 respondents in this study work in 114 private and public health facilities in the provinces of North and South Ubangi. They are all nurses or doctors’ men and women. The details of the general characteristics of these providers are presented in Table I. The other tables present the level of knowledge of the providers about malaria and LLIN and their attitudes and practices in case of fever.

**Sample Characteristics**

**Table 1:** General characteristics of health care providers interviewed in malaria treatment facilities (n = 467)

Variables	Province of origine		Total
	North Ubangi	South Ubangi	
Effective	N (%)	N (%)	N (%)
Sex			
Male	221(59,4)	64(67,4)	285(61,0)
Female	151(40,6)	31(32,6)	182(39,0)
Trade practice time			
≤ 5years	152(40,9)	39(41,1)	191(40,9)
>5years	220(59,1)	56(58,9)	276(59,1)
Recyclage			
Yes	258(69,4)	74(77,9)	332(71,1)
No	114(30,6)	21(22,1)	135(28,9)
Training in which the interviewee works			
Public	308(82,8)	85(89,5)	393(84,2)
Private	64(17,2)	10(10,5)	74(15,8)
Delivery structure			
Health Centre and Station	238(64,0)	54(56,8)	292(62,5)
Hospital	134(36,0)	41(43,2)	175(37,5)
Level of education			
Nurses	356(95,7)	95(100,0)	451(96,6)
Doctors	16(4,3)	0(0,0)	16(3,4)

It can be seen from this table that nearly 60% of claimants have a duration of more than 5 years of practice. It should also be noted that more than 70% of providers have already been recycled at least once on malaria control measures. Among interviewed providers, almost 16% are from the

private sector. Males are more represented (61%) than females (39%)

**Knowledge of Health Care Providers about Malaria and Llin**

**Table 2 a:** Knowledge of health care providers about malaria (n = 467)

knowlegde	Public	Private	Total	p
	n (%)	n (%)	n (%)	
Plasmodium, causative agent	191(48,6)	33(44,6)	224(48,0)	NS
Signs of severity (≥5)	13(3,3)	—	13(2,8)	NS
Knowledge of prevention measures				
Use of LLIN	370(94,1)	65(87,8)	435(93,1)	0,04
Vector control through sanitation	294(74,8)	41(55,4)	335(71,7)	≤0,001
Indoor spraying of Insecticide	50(12,7)	7(9,5)	57(12,2)	NS
ITP/SP in pregnant women	138(35,1)	8(10,8)	146(31,3)	≤0,001
Knowledge of prevention measures for pregnant women				
IPT based on SP	298(75,8)	28(37,8)	326(69,8)	≤0,001
Use of LLIN	343(87,3)	52(70,3)	395(84,6)	≤0,001
Correct management of malaria episodes	72(18,3)	16(21,6)	88(18,8)	NS
Knowledge of the mode of transmission of malaria				
Sting of Female Anopheles	377(95,9)	69(93,2)	446(95,5)	NS
Foetal maternal transmission	41(10,4)	—	42(9,0)	0,01
Blood Transfusion	63(16,0)	5(6,8)	68(14,6)	0,03
Knowledge of at-risk groups of malaria				
Children < 5ans	343(87,3)	49(66,2)	392(83,9)	≤0,001
Pregnant women	310(78,9)	34(45,9)	344(73,7)	≤0,001

**P:** p-value, **LLIN:** Long-Lasting Insecticide Net, **IPT / SP:** Sulfadoxine-Pyrimethamine-based Intermittent Preventive Therapy, **NS:** Not Significant.

It can be seen that almost 50% of private and public sector providers are aware of the causal agent of malaria while ignoring the signs of severity. In total, less than 4% of public sector providers cited at least 5 severity signs out of the 10 recommended by WHO. With respect to preventive measures, the use of LLIN and environmental sanitation measures are best known by both groups of providers, while the IPT-SP ( $p \leq 0.001$ ) and even less the intra domicile spraying of Insecticide ( $p = NS$ ) are two least known measures.

Private sector providers ignore at 60% that Sulfadoxine-Pyrimethamine Intermittent Preventive Therapy is a measure to prevent malaria as well as its consequences in pregnant women ( $p \leq 0.001$ ). In both cases (private and public), only about 20% mention the correct management of each episode of malaria as a method of prevention and its consequences in pregnant women.

Regarding the mode of transmission of malaria, providers mention over 90% female anopheles bites, while maternal-fetal transmission and transmission through blood transfusion are almost unknown by both private and public providers. The two groups at risk for malaria are known by over 78% of private sector providers, while only 66% of private sector providers mention children under 5 years, while pregnant women are cited by only 46% of providers.

**Table 2 b:** Knowledge of Care Providers about Malaria based on Delivery Structure

Knowledge	Structure of service			p
	Center and health post n (%)	Hospital n (%)	Total n (%)	
Plasmodium, agent causal	128(43,8)	96(54,9)	224(48,0)	0,02
Signs of severity ( $\geq 5$ )	6(2,1)	7(4,0)	13(2,8)	NS
Knowledge Structure of service				
Use of LLIN	271(92,8)	164(93,7)	435(93,1)	NS
Vector control through sanitation	196(67,1)	139(79,4)	335(71,7)	0,004
Intense spraying of Insecticide	26(8,9)	31(17,7)	57(12,2)	0,004
TPI/SP in pregnant women	88(30,1)	58(33,1)	146(31,3)	NS
Knowledge of prevention measures for pregnant women				
TPI base SP	187(64,0)	139(79,4)	326(69,8)	$\leq 0,001$
Use of LLIN	237(81,2)	158(90,3)	395(84,6)	0,008
Correct management of malaria episodes	53(18,2)	35(20,0)	88(18,8)	NS
Knowledge of the mode of transmission of malaria				
Sting of female anophele foeto-maternal transfusion	275(94,2)	171(97,7)	446(95,5)	NS
Blood transfusion	20(6,8)	22(12,6)	42(9,0)	0,03
	30(10,3)	38(21,7)	68(14,6)	$\leq 0,001$
Knowledge of at-risk groups of malaria				
children < 5ans	236(80,8)	156(89,1)	392(83,9)	0,01
Pregnant women	196(67,1)	148(84,6)	344(73,7)	$\leq 0,001$

Providers in the general referral hospital have a higher knowledge gradient than providers at the first level of care (health center and health post). Indeed, nearly 55% of general referral hospital providers mentioned plasmodium as the causative agent of malaria compared to only 43.8% of

first-line care providers ( $p = 0.02$ ). With regard to groups at risk of malaria, providers of HGR mention pregnant women in the order of 84.6%, whereas only 67.1% of health posts and centres providers mention them ( $\leq 0.001$ ).

**Table 2 c:** Knowledge of Caregivers on LLIN (n = 467)

Knowledge and Attitudes	Public N (%)	Private N (%)	Total N (%)	P
LLIN can not reduce episodes of malaria in stable transmission medium	271(69,0)	57(77,0)	328(70,2)	NS
Torn LLIN can not be used	123(31,3)	29(39,2)	152(32,5)	NS
In the same house, the use of the impregnated mosquito net or not increased the risk of sting in the person who does not use	278(70,7)	30(40,5)	308(66,0)	$\leq 0,001$
Advice given to patients by providers				
a. Never wash the LLIN with soap dust or spread the LLIN in the sun	114(29,0)	14(18,9)	128(27,4)	NS
b. Spread the LLIN at least 24 hours under the shade and current before use	330(84,0)	42(56,8)	372(79,7)	$\leq 0,001$
c. LLIN can be cleaned has remained effective	73(18,6)	5(6,8)	78(16,7)	$p=0,01$

Regarding LLIN, a significant number of public sector providers (31.0%) and of private sector (23.0%) are unaware that LLIN can reduce episodes of malaria in the stable transmission medium. For a torn LLIN, less than 35% of providers think that it can still be used.

More than 70% of public sector providers think that in the same house, the use of a mosquito net in a person exposes the person who does not use mosquito bites. This idea is supported only by 40% of private sector providers ( $\leq 0.001$ ). Among the advice given to the users of the LLIN, it can be noted that more than 70% of service providers are unaware

that it is not necessary to wash the LLIN with dust soap or spread the LLIN in the sun, as this may lose its effectiveness. Nearly 85% of public sector providers advise spreading the LLIN under the shadows with a draft for at

least 24 hours before use, while nearly 35% of private sector providers ignore this fact ( $\leq 0.001$ ). Overall, only about 20% of private and public sector providers know that a cleaned LLIN can remain effective.

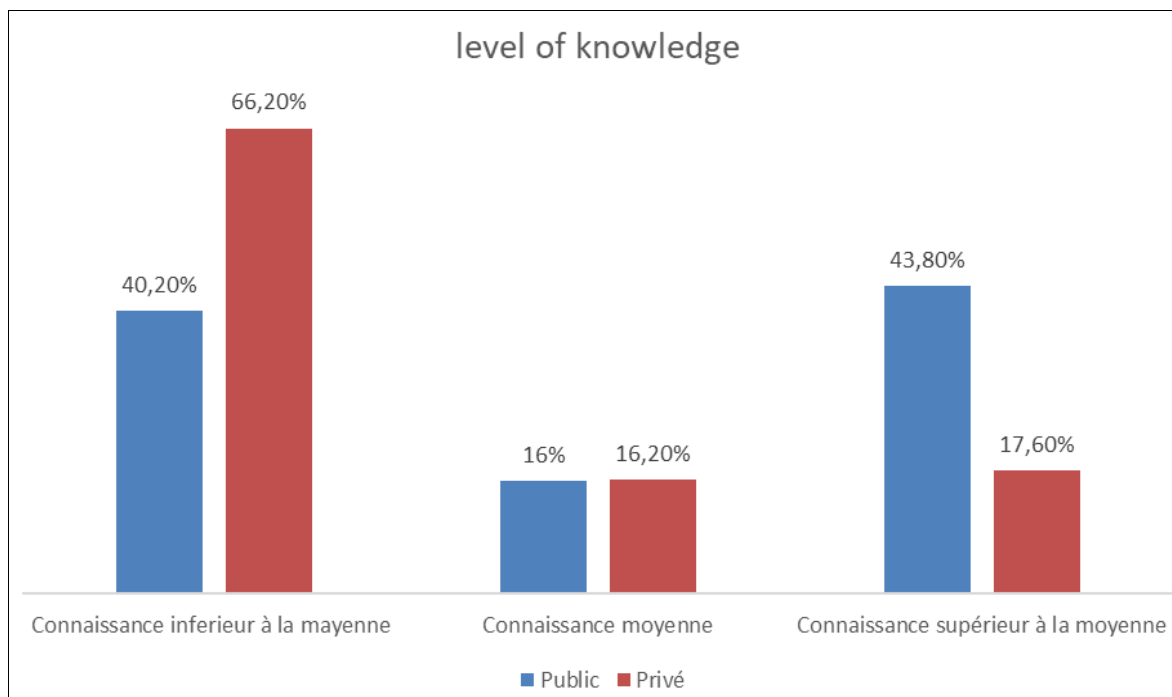
**Table 2 d:** Malaria Knowledge Scale (Diagnosis, Treatment and Prevention) (n = 476)

Knowledge Scale of the providers	Public	Private	Total	P-value
	N (%)	N (%)	N (%)	
State of knowledge on malariae				
Unsuitable state of knowledge	158(40,2)	49(66,2)	207(44,3)	< 0,001
Appropriate state of knowledge	235(59,8)	25(33,8)	260(55,7)	
Level of knowledge Malaria				
Below average knowledge	158(40,2)	49(66,2)	207(44,3)	<0,001
Average Knowledge	63(16,0)	12(16,2)	75(16,1)	
Knowledge above average	172(43,8)	13(17,6)	185(39,6)	

The average of this scale of 6 and its standard deviation was  $\pm 2$

This table indicates that providers know in average 6 signs out of 17 signs that make up the malaria knowledge score. In relation to this score, the scale of knowledge shows that more than 66% of private sector providers have an unsuitable state of knowledge compared to 40% of the

public sector ( $p < 0.001$ ). This scale also shows that only 17% of private providers versus 43.8% of public sector providers have above-average knowledge of malaria ( $p < 0.001$ ). Overall, 44% of providers have below-average knowledge.



**Fig 2:** Level of knowledge by health delivery sector.

Public sector providers have a better level of knowledge than the private sector.

**Table 2 e:** Scale of knowledge in relation to demographic variables

Variable	Knowledge		Total	P-value
	Suitable state	Unsuitable state		
	N (%)	N (%)		
Sex				
Male	176(61,7)	109(38,2)	285(100,0)	<0,001
Female	84(46,2)	98(53,8)	182(100,0)	
Recyclage				
Yes	207(62,3)	125(37,7)	332(100,0)	<0,001
No	53(39,3)	82(60,7)	135(100,0)	
Delivery structure				
Post and Health Center	130(44,5)	162(55,5)	292(100,0)	<0,001
Hospital	130(74,3)	45(25,7)	175(100,0)	
Level of education				
Nurses	246(54,5)	205(45,5)	451(100,0)	0,009
Doctors	14(87,5)	-	16(100,0)	

It should be noted that males has a state of adequate knowledge (61.7%) higher compared to females (46.2%) ( $p < 0.001$ ). The provider who has been retrained at least once on malaria during his career has a better knowledge gradient than the one who has never been ( $p < 0.001$ ). This table also shows that when performing general referral hospital,

adequate knowledge of malaria is available only at the level of the first-step level of care ( $< 0.001$ ).

**Main attitudes and practices of health care providers on malaria**

**Table 3:** Attitudes and practices of health care providers (n = 476)

Attitudes	Public	Private	Total	P
	N (%)	N (%)	N (%)	
<b>Attitude in front of GE or TDR negative</b>				
Give an antimalarial	269 (68.4)	62 (83.8)	331 (70.9)	0.007
Do not give an antimalarial	124 (31,6)	12 (16,2)	136 (29,1)	
<b>Attitude in front of fever</b>				
Pre-laboratory treatment	202 (51.4)	11 (14.9)	213 (45.6)	$\leq 0.001$
Laboratory before treatment	191 (48,6)	63 (85,1)	254 (54,4)	
<b>Reference to severe cases of malaria</b>				
Antimalarial drugs prescribed to patients	110 (28.0)	3 (4.1)	113 (24.2)	$\leq 0.001$
<b>Simple malaria</b>				
Fansidar	11 (2.8)	3 (4.1)	14 (3.0)	NS
ACT 452	382 (97.2)	70 (94.0)	(96.8)	NS
Artesunate IV	16 (4.1)	3 (4.1)	19 (4.1)	NS
Amodiaquine monotherapy	0 (0,0)	4 (5,4)	4 (0,9)	$\leq 0.001$
<b>Serious malaria</b>				
ACT	7 (1.8)	1 (1.4)	8 (1.7)	NS
Artesunate IV	194 (49.4)	20 (27.0)	45 (, 8)	$\leq 0.001$
Amodiaquine monotherapy	0 (0,0)	2 (2,7)	2 (0,4)	0.001
Quinine	185 (47.1)	59 (79.7)	244 (52.2)	$\leq 0.001$

In relation to attitudes and practices, it should be noted that in a negative case of Gouts epaisse and RDT, nearly 70% of public sector providers and 83% of the private sector recommend an antimalarial. In the case of severe malaria, reference is also considered as a measure of care in almost 30% of cases in the public sector for only 4.1% in the private sector ( $p \leq 0.001$ ).

In a case of simple malaria, it appears that ACTs are prescribed in nearly 95% of cases in both sectors. However, it should be noted that some providers still prescribe Fansidar for the purpose of curing a patient with malaria.

In the case of severe malaria, public sector providers prescribe both quinine (47.1%) and injectable artesunate (49.4%), while private sector providers prefer quinine in almost 80% of cases. case ( $p \leq 0.001$ ).

**Table 4:** Presence of documents retracing the national malaria control policy in the health facility (n = 476)

Documents	Public	Private	Total	p
	N (%)	N (%)	N (%)	
Flow chart	201 (51.1)	10 (13.5)	211 (45.2)	$\leq 0.001$
Other documents				
Guide or protocol on malaria control	207 (52,7)	9 (12,2)	216 (46,3)	$\leq 0.001$
Library	56 (14.2)	3 (4.1)	59 (12.6)	0.01
National Malaria Journals	40 (10,2)	2 (2,7)	42 (9,0)	0.04

Only about half of the public sector providers have the flowcharts related to malaria care, while in private clinics only 13% of providers have these charts ( $p \leq 0.001$ ). This situation remains more or less the same for the guide or protocol on the measures to fight against malaria. Concerning the library, only 12% of all providers have a library. Overall, less than 10% of providers have access to

the country's scientific journals that track the evolution of malaria in the different Provincial Health Divisions.

**Discussion**

The objective of this study was to measure the knowledge of public and private sector providers about malaria and its methods as well as to determine the attitudes and practices of the latter in case of fever.

It should be noted that nearly 70% of providers have already been recycled at least once in malaria control measures. Although these figures are higher than those presented by Mandoko *et al* in 2016 in Kinshasa <sup>[11]</sup>, the number of 30% of providers who are not retrained recycled still remains high. The reintegration recycling of all malaria care providers is one of the priorities of the National Malaria Control Program, as better management of malaria by providers requires ongoing training of health personnel from both the private and the public sector <sup>[12]</sup>.

**Key or Main Knowledge of Providers on Malaria and LLIN**

Our study shows that less than 50% of private and public sector providers mention Plasmodium as the causative agent of malaria, and less than 5% of public and private sector providers know at least five signs of severe malaria. This situation in rural and semi-rural areas is far inferior compare to Mandoko *et al*. (38.8% in Kinshasa) <sup>[11]</sup>. It is very alarming in a country where malaria is the leading cause of morbidity and mortality, 39% of outpatient of all ages and 39% of deaths occurring in children under 5 years in hospital <sup>[10]</sup>. The lack of awareness on dangerous signs by health care providers results in a large delay in transferring patients from the health center to the reference levels authorized to manage malaria, which would increase mortality in rural areas of the Northern Provinces and Sud-

Ubangi provinces. This aspect of things was developed in Madagascar by Raobijaona *et al* in 2000 and showed that the mortality was raised to more than 45% when the reference period was greater than 3 days, against 8.5% when the reference period was less than at 24h<sup>[14]</sup>.

It is demonstrated in our study that it is the providers of general referral hospitals (GRH) who have the appropriate level of knowledge to diagnose, treat and prevent malaria. This idea is consistent with the strategic plan of the hospital reform on its human resource component which would like there to be a gradient of knowledge between the providers of the GRH and those of the center and the health post<sup>[15]</sup>. This gradient of knowledge between providers of these two levels is supported in the collection of organizational standards of the Health Zone in DR Congo. These standards stipulate that the provision of care in the structures of first-level should be supervised by providers of the reference general hospital and in this case a knowledge gradient is desired<sup>[16]</sup>.

In relation to malaria prevention measures, the use of LLIN is the best-known prevention tool by public sector providers (95%) and private sector providers (87.8%). While in pregnant women, nearly 25% of public sector providers still do not know that ITP-SP is used as a preventive treatment versus 38% of private sector providers. These results go in the same direction as Romay and al who in 2016, demonstrated that LLIN is the best-known form of malaria prevention<sup>[17]</sup>.

Even though 70% of providers are recycled at least once on the malaria control measures in our series, there is still a lot of work to be done to help them master the methods of malaria control recommended by national politics. As Mandoko<sup>[11]</sup> pointed out in Kinshasa, quality recycling remains a problem in rural areas for the control of national policy, and this recycling should target not only public sector providers but also those in the private sector. This reinforcement of capacities of healthcare providers should respect the strategic axes of the Strategic Plan of the hospital reform of 2010 in its human resources component. This plan proposes that only highly qualified persons provide continuing training for providers and supervisory activities in first-level structures<sup>[15]</sup>. The choice of providers to be retrained recycled should give priority to those who actually deliver rather than to those in management positions who have less time in actual care delivery.

The best-known means of transmission for both private (93.2%) and public (95.9%) providers are mosquito bites (female anopheles). Fetal-maternal transmission and blood transfusion transmission are less known by the provider group. This lack of knowledge of other transmission pathways can lead to delayed diagnosis, especially in the case of congenital malaria, which is associated with high neonatal mortality<sup>[18, 20]</sup>.

For malaria risk groups, nearly 80% of public sector providers mention pregnant women and children under 5, while more than half of private sector providers do not know that pregnant women are a high-risk group of malaria and its consequences. These results show the need to integrate private providers in the continuing education of care professionals as they gain a significant clientele among patients and not integrate them could delay the progress of malaria control measures that the country recommend.

Regarding the LLIN, it should be noted that the providers of

both private and the public sectors present some insufficiency that will need to be corrected through quality training and retraining recycling. This lack of knowledge on the maintenance and aeration practices of the LLIN is very dangerous because the users will not follow this advice, risk developing a skin allergy and abandon the use<sup>[15, 20, 22]</sup>. This would be an obstacle to the implementation of the National Malaria Control Policy.

The level of knowledge of providers in these two provinces on LLIN is lower when comparing these results with those of Hoffman and al, who in a multicenter study in developing countries (Senegal, Tanzania, Ghana and Laos) showed that over 50% of providers were aware that a cleaned LLIN may remain effective<sup>[23]</sup>.

Considering the scale of knowledge, we note that the average knowledge of providers in these two provinces on diagnosis, treatment and prevention is low. In addition, only a total of 39% of providers have above-average knowledge of malaria and its control measures. This result casts doubt on the quality of the providers' recycling.

Only providers in the public sector have the flowcharts and protocols that describe malaria control measures. This situation shows that the private sector, although playing a significant role in our health system, seems to be neglected in the staffing of different documents that trace the National Malaria Control Policy national policy of fight against malaria. In order to address this concern, it will be very important for the system to see some useful private individuals who can integrate the health system and, as far as possible, provide these private individuals with documents that outline the measures to combat malaria.

It should also be noted that in the public sector there is a low level of possession of protocols or flow charts that trace the National Malaria Control Policy. When compared with Hoffman's results in Tanzania where 80% of providers had the guides or protocols that track malaria control measures<sup>[23]</sup>. In this sense, the NMCP has a lot of work to provide care providers with simple and serious management guides for malaria.

### **Attitudes and Practices of Health Care Providers on Malaria**

Given a negative case of Gouts epaisse and RDT, the attitude of healthcare providers in both public (68.4%) and private (83.8%) sectors to give an antimalarial does not conform with the National Health Policy. asks to look for other causes of fevers<sup>[23]</sup>. In total, less than 30% of all providers in these two provinces follow this National Policy. However, in an environment where it is difficult to make a biological diagnosis of malaria in case of fever, it is recommended to make the presumptive diagnosis of malaria, and in this case only, an antimalarial can be given<sup>[24]</sup>.

In relation to the case of severe malaria, it is noted that less than 25% of providers in both sectors think of a referral. This low level of reference of complicated cases had been evoked since 2016 in Kinshasa by Mandoko<sup>[11]</sup>. And this attitude of not thinking about the reference is very dangerous with the risk of increasing malaria mortality in first-level Health facilities. This situation shows how politico-health authorities should help regulate and control the private sector. This contribution of politico-sanitary authorities should go through supervisions and the

integration of the private sector into retraining [14, 25, 26].

In relation to the drugs prescribed for a case of simple malaria, it should be noted that ACTs are preferred to other drugs in both types of providers (97% public versus 94% private). This shows that providers have been sensitized by the National Malaria Control Program on the drugs to be used [21, 23, 27].

It is also encouraging that Artesunate IV is also prescribed by both private and public sector providers for severe malaria. These results show that the efforts were provided by the NMCP after the work of Mandoko *et al* which showed that only 1.7% of providers resorted to intravenous artesunate in 2016 in urban areas [11], compared with 45, 8% in 2018 in rural and semi-rural areas of North and South Ubangi provinces.

### Conclusion

Lack of knowledge on signs of malaria severity, lack of willingness to transfer patients to referral levels, lack of knowledge of other malaria transmission pathways, and inadequate counselling on use of LLIN, associated with lack of documents retracing the measures / procedures for fighting malaria in the health facilities, are elements that delay the significant advances of the National Policy in the fight against malaria. To solve this problem, the integration of private providers responding to a number of criteria, awareness of all providers and quality recycling should be strengthened.

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