

# Awareness of Yemeni Paediatricians and Other Physicians about the International Malaria Management Guidelines in the Major Public Hospitals in Sanaa, Yemen

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## ABSTRACT

**Introduction:** Malaria still represents a substantial morbidity burden in the developing countries including Yemen. Keeping updated with the latest evidence-based prevention and treatment guidelines will improve the overall picture. Hence, this study was undertaken to assess the knowledge of the Yemeni physicians and paediatricians about the same.

**Aim:** To assess awareness of the Yemeni paediatricians compared to other physicians toward the new 2015 World Health Organisation (WHO) Malaria treatment guidelines.

**Materials and Methods:** This cross-sectional descriptive study was performed on 175 physicians from different specialties mainly paediatricians in the four major referring hospitals in Sanaa. A questionnaire was developed with questions related to the diagnosis, treatment and prevention of malaria.

**Results:** Among the respondents, 134 (76%) of the total participants in the study and 47 (74.6%) within the group of paediatricians has correctly recognised issues of clinical diagnosis of malaria. Vulnerable groups to malaria infection were correctly recognised by 44 (69.8%) of the paediatricians. Good proportion of paediatricians knew the correct combination and duration of Artesunate Combination Therapy (ACT) according to the new guidelines. However, only 3 (4.7%) of the paediatricians has recognised correctly the treatment of choice of acute severe malaria.

**Conclusion:** Despite the special situation in Yemen, most paediatricians are aware to the latest guidelines of Malaria management. However, National program should run more awareness and training activities to improve prevention and treatment performance of Yemeni physicians.

**Keywords:** Artesunate combination therapy, Diagnosis, Medical practice, Treatment

## INTRODUCTION

Despite the recognisable improvement of some important indicators of malaria control such as access to malaria intervention and diagnostic testing, malaria still represents a heavy global burden with 212 million new cases and 4,29,000 deaths in 2015. Children under 5 years of age are more vulnerable to this infection and its fatal complications. In 2015, 303,000 children were killed by malaria globally, which represents 70% of the total deaths. Malaria is still an endemic condition in 91 countries; Yemen is one of them [1].

Malaria is an infectious disease caused by the genus *Plasmodium* that infects human red blood cells inoculated by the female *Anopheles* mosquito [2]. Although more than a century has elapsed since the discovery of this parasite, the specific pathological changes in severe malaria are still not completely understood. Two major pathological processes are erythrocytes sequestration, endothelial dysfunction, and activation of coagulation in the cerebral microvessels [3]. Severe malaria is presented with coma, metabolic acidosis, hypoglycaemia, severe anaemia and acute renal failure. The progress from uncomplicated malaria to severe form occurs more commonly among children and may take only a few hours if effective treatment is not offered [2]. Main causes of fatal outcome in paediatric malaria are cerebral malaria, hypoxia, jaundice, severe thrombocytopenia, leukocytosis, and lactic acidosis [4].

WHO has developed its Global Technical Strategy for Malaria 2016-2030 targeting reduction in malaria cases and deaths [1]. Although the strategy concentrates on prevention, management of malaria cases remains an important step in malaria control.

In Yemen, around 6, 724, 424 and 20, 899, 635 people from the population of 26, 832, 215 are at high and low-moderate risk of malaria infection respectively. About 38,254 malaria cases were confirmed by Rapid Diagnostic Test (RDT) during 2015 in Yemen. Most cases were infected with *Plasmodium falciparum* [1].

Artesunate-Sulphadoxine-Pyrimethamine combination is the drug of choice according to the drug policy of malaria in Yemen from 2015, both for confirmed and unconfirmed uncomplicated cases [1], although any combination of ACTs is recommended according to the latest WHO guidelines [2].

Since uncomplicated malaria could rapidly progress to severe malaria with fatal outcomes, commitment to the guidelines of the diagnosis and treatment of malaria cases represents an important issue in controlling malaria and reducing its burden worldwide [2].

National and international policies to manage malaria are important tools to control its morbidity and mortality. Health workers including physicians at different health facilities should be aware and committed to the latest evidence-based guidelines for the management of this disease. This study aimed at exploring the knowledge and practices of paediatricians in comparison to other physicians in four major referral hospitals in Sanaa, Yemen regarding management of malaria cases especially in children.

## MATERIALS AND METHODS

The study design was a cross-sectional descriptive study. The study included 175 physicians from different specialties (including paediatricians) working in four major referral hospitals in Sanaa, who are supposed to be involved in the management of malaria cases. These hospitals are: Al-Thawra hospital, Al-Sabeen, Al-

Kuwait and Al-Jomhoori hospital. Sample size was calculated using Open Epi version 3.01. Assuming a power of 80% and a maximum allowable error of 0.05 and adding 10% for possible drop, sample size was calculated to be 200, however, during sample collection we could not reach the target sample. The study was performed between March and April 2017. Registered physicians in different specialties in the targeted hospitals were included.

The questionnaire that was composed of 23 questions in English which covered different aspects of information such as sex, years of medical practice, specialty, number of patients diagnosed with malaria per month and the hospital at which the physician is practicing. The questionnaire also inquired about main diagnosis and management issues of malaria cases. The questionnaire was applied by direct (face-to-face) interviews to the enrolled physicians. Answers were assumed correct when they co-incided with the Treatment guidelines of Malaria, 2015, WHO. The Ethical Committee of faculty of medicine and health Sciences, University of Science and Technology, Sanaa approved the study proposal. The number of the approval is MECA No. (EAC/UST 132). The voluntary nature of the study was explained to the physicians and an oral informed consent was taken from them to participate after the nature of the study was explained. They had the full choice to leave the study at any point.

### STATISTICAL ANALYSIS

Data was collected, entered, reviewed then analysed using IBM SPSS, version 21.0. Descriptive statistics (frequencies and percentages) were used to show the physician responses. Chi-square test was used to detect the association between certain variables of the physicians and their responses. Data was tabulated and presented in the suitable forms. The results were considered significant at  $p < 0.05$ .

### RESULTS

**Demographic characteristics of the participated physicians:** Although the targeted number of participants was 200, 175 responded to the questionnaire. The causes of non-participation were the busy schedule of the physicians.

Paediatricians composed the majority of the participating physicians in the four hospitals. They represented 19 (38.77%) of those from the Al-Thawra hospital, 13 (28.26%) in Al-Sabeen hospital, 18 (46.15%) in Al-Jomhoori hospital and 13 (31.7%) in Al-Kuwait hospital [Table/Fig-1].

[Table/Fig-2] describes the distribution of the enrolled physicians according to different demographic characteristic. It shows that more male physicians 96 (54.9%) participated in this study, than females. Paediatricians composed the major portion of the physicians in this study representing 63 (36%), of the sample while Board resident from different specialties composed 25.1%. [Table/Fig-2] shows that 71 (40.6%) of the physicians have five to 10 years of practice, 59 (33.7%) have less than five years of practice. About 92 (52.6%) of the physicians managed 1-5 cases of malaria per month.

Characteristics		Frequency of physicians	Percent %
Specialty	General practitioners	22	12.6
	Internist	16	9.1
	Surgeon	9	5.1
	Paediatrician	63	36.0
	Other specialty	7	4.0
	Board resident	44	25.1
	Internship	14	8.0
Years of practice	Less than 5 years	59	33.7
	5-10 years	71	40.6
	11-20 years	21	12
	More than 20 years	8	4.6
	Intern	16	9.1
Gender	Male	96	54.9
	Female	79	45.1
Number of malaria patients diagnosed and managed per month	None	68	38.9
	1-5 cases	92	52.6
	6-10 cases	8	4.5
	More than 10 cases	7	4
	Total	175	100

[Table/Fig-2]: Characteristics of the participating physicians according to their specialty, years of medical practice, gender and number of malaria cases managed per month (n=175).

**Responses of the paediatricians to the diagnostic issues of malaria cases:** [Table/Fig-3] shows the percentages of correct responses of the paediatricians to the diagnostic issues of malaria. Responses were considered correct when it matched the policy of the Malaria management guidelines, WHO, 2015 [2].

Large proportion of paediatricians 47 (74.6%) answered correctly to the questions related to clinical diagnosis of malaria. However, less percentage within the group of paediatricians, 10 (15.9%) and less percentage of all participants 37 (21.1%) had recognised the correct method to confirm the diagnosis of malaria, which was

Diagnostic issue	Total frequency of correct answers	Total percent of correct answers (%)	Frequency and (Percent) of correct answers within the group of paediatricians (%)
Clinically malaria can be diagnosed by?	134	76.6	47 (74.6)
All cases of suspected malaria should be confirmed by?	37	21.1	10 (15.9)
Vulnerable groups to malaria infection are?	110	62.9	44 (69.8)
Rapid diagnostic testing (RDT) is useful in?	73	41.7	20 (31.7)

[Table/Fig-3]: Correct responses of the participants to the diagnostic issues of malaria.

Hospital	Specialty							Total
	General practitioners	Internist	Surgeon	Paediatricians	Other specialty	Board residents	internships	
Al-Thawra	3	7	5	19	4	10	1	49
Al-Sabeen	11	0	0	13	0	10	12	46
Al-jomhori	5	2	2	18	2	9	1	39
Al-Kuwait	3	7	2	13	1	15	0	41
Total	22	16	9	63	7	44	14	175

[Table/Fig-1]: Distribution of the participating physicians according to hospitals.

parasitological microscopy or RDT. The majority confirmed the diagnosis by RDT and parasitological microscopy. However, about 44 (69.8%) of the paediatricians knew that the most vulnerable groups to malaria were both children and travelers to endemic areas.

**Responses of the paediatricians to treatment issues of uncomplicated *Plasmodium falciparum* malaria cases:** The questionnaire included eight questions related to the management of acute uncomplicated *Plasmodium falciparum* malaria infection.

[Table/Fig-4] shows that 78 (44.6%) of all the participants and 27 (42.8%) within the group of paediatricians correctly recognised that anyone of the known ACT could be used effectively in the treatment of uncomplicated malaria. The rest chose to give one specific combination such as; Artemether- Lumefantrine (24%), Dihydroartemisinin-Piperaquine combination (15%), Artesunate- Mefloquine combination (9.7%), Artesunate- Amodiaquine combination (2.3%) or Artesunate-Sulphadoxin Pyrimethamine (4%).

Treatment issue	Total frequency of correct answers	Total percent of correct answers (%)	Frequency and (Percent) of correct answers within the group of paediatricians (%)
All children and adults (except pregnant women) having uncomplicated <i>Plasmodium falciparum</i> malaria should receive (the correct combination is)?	78	44.6	27 (42.8)
Duration of the treatment with ACT combination therapy?	94	53.7	42 (66.6)
Dosing of ACT should be weight based or age based?	126	72	42 (66.6)
Write the recommended total dose of Artemether-Lumefantrine combination therapy?	19	10.9	18 (28.6)
The dose of Artesunate-Sulphadoxin Pyrimethamine (SP) is?	125	71.4	46 (73.0)
Treat infant less than 6 months having uncomplicated <i>Plasmodium falciparum</i> malaria with?	29	16.6	9 (14.3)
Treatment of pregnant mothers with uncomplicated <i>Plasmodium falciparum</i> malaria in the first trimester with?	43	24.6	24 (38.1)
Treatment failure is most probably due to?	119	68	47 (74.6)

**[Table/Fig-4]:** Correct responses of the participants to treatment issues of acute uncomplicated malaria *Plasmodium falciparum* cases.

The majority of the participants, 94 (53.7%) and the majority within the group of paediatricians 42 (66.6%), had recognised the correct duration of ACT. Also, the majority of participants, 126 (72%) and the majority within the group of paediatricians, 42 (66.6%), have recognised that the doses of ACT should be weight-based rather than age-based.

Only 19 (10.9%) of the whole participants and 18 (28.6%) within the group of paediatricians wrote the correct dose for Artemether-Lumefantrine combination, which is uncommonly used in Yemen. On the contrary, 125 (71.4%) of participants and 46 (73%) within the group of the paediatricians wrote the correct dose of Artesunate-sulphadoxin Pyrimethamine combination which is commonly used in Yemen. Only 29 (16.6%) of the participants and 9 (14.3%) of the paediatricians recognised that the correct treatment of infants aged less than six months is any ACT combination as 5 kg dose. The remaining has recognised Quinine alone or Artesunate alone as the drug of choice for this category.

Within the group of the paediatricians, 24 (38.1%) had recognised the correct treatment of pregnant mothers with uncomplicated

*Plasmodium falciparum* malaria in the first trimester, which was seven days of Quinine and Clindamycin. Only 47 (74.6%) of the paediatricians expected that treatment failure was most probably due to low compliance and poor adherence to the treatment, which was the correct answer, rather than bad quality of the combination or co-administration of food.

**Responses of the participants to issues related to treatment failure and reducing transmissibility of *Plasmodium falciparum* malaria:** [Table/Fig-5] shows the percentages paediatricians who chose the correct answer according to the guidelines.

About 114 (65.1%) of the total participants and 44 (69.8%) within the group of the paediatricians agreed that treatment failure should be confirmed, possibly, by microscopy which is the correct answer. On the other side, Only about 19% of both categories decided to give another ACT for three days in case of treatment failure which was the recommended policy according to the guidelines. The rest decided to give Quinine for seven days, which was an old policy.

Issue	Total frequency of correct answers	Total percent of correct answers (%)	Frequency and (Percent) of correct answers within the group of paediatricians (%)
Should treatment failure be confirmed with microscopy?	114	65.1	44 (69.8)
In treatment failure with one ACTs, the second line treatment is ?	32	18.3	12 (19)
Reducing transmissibility of <i>Plasmodium falciparum</i> infection in low transmission areas is done by?	45	25.7	19 (30.2)
Malnourished children having <i>Plasmodium falciparum</i> malaria should receive?	75	42.9	42 (66.6)
Primaquine should not be given for what category of patients?	117	66.9	54 (85.7)

**[Table/Fig-5]:** Correct responses of participants to issues related to treatment failure and reducing transmissibility of *Plasmodium falciparum* malaria.

About 45 (25.7%) of the total participants and 19 (30.2%) within the group of the paediatricians chose to reduce the transmissibility of *Plasmodium falciparum* malaria by Primaquine at low single dose in the first day of ACT which was the recommended policy. The remaining decided to give daily Primaquine for seven days or SP daily for seven days after ACT.

The majority of the participants, 117 (66.9%), and 54 (85.7%) within the group of paediatricians, had correctly recognised that Primaquine should not be given for infants less than six months old, pregnant mothers in the first trimester and breastfeeding mothers in the first six months with uncomplicated *Plasmodium falciparum* malaria.

**Responses of the enrolled paediatricians regarding treatment and prevention of relapse of *P. vivax*, *malariae*, *ovale* and *knowlesi* malaria:** [Table/Fig-6] shows the percentages of the correct responses of the total enrolled participants.

Small proportion, 20 (31.7%), of the paediatricians chose the correct method to treat *P. vivax*, *malariae*, *ovale* and *knowlesi* malaria for patients in case of chloroquine resistance. The majority of them chose to treat with Quinine for seven days instead of ACT combination.

Regarding prevention of relapse of *P. vivax* and *P. ovale*, a good proportion of the total participants, 74 (42.3%), and 35 (55.5%) within the group of the paediatricians responded correctly, i.e., (to treat with Primaquine 0.25 mg/kg daily for 14 days).

Issue	Total frequency of correct answers	Total percent of correct answers (%)	Frequency and (Percent) of correct answers within the group of paediatricians (%)
Treat <i>P. vivax</i> , <i>malariae</i> , <i>ovale</i> and <i>knowlesi</i> malaria in case of chloroquine resistance (except in the pregnant women for the first trimester and breast feeding mothers <6 months) by?	49	28	20 (31.7)
Prevent the relapse of <i>P. vivax</i> and <i>P. ovale</i> except pregnant women, infants <6 months, breastfeeding women of <six-month-old, people known as G6PD with?	74	42.3	35 (55.5)

**[Table/Fig-6]:** Correct responses of the participants regarding treatment and relapse prevention of *P. vivax*, *malariae*, *ovale* and *knowlesi* malaria.

**Responses of the enrolled paediatricians regarding treatment of acute severe *Plasmodium falciparum* malaria:** [Table/Fig-7] shows the percentages of correct answers of the total enrolled physicians and paediatricians. Less proportion of the total participants, 18 (10.3%), and only 3 (4.7%) of the paediatricians recognised the correct drug of choice for the treatment of severe malaria (intravenous or intramuscular Artesunate for at least 24 hours followed by ACT for three days). The majority responded by giving intravenous Quinine. Moreover, only 57 (32.6%) of the total participants and 12 (19%) within the group of the paediatricians wrote the correct dose of parenteral Artesunate for severe malaria in children <20 kg body weight.

Issue	Total frequency of correct answers	Total percent of correct answers (%)	Frequency and (Percent) of correct answers within the group of paediatricians (%)
Drug of choice for treating adults and children including infants, pregnant and lactating mothers with severe malaria is?	18	10.3	3 (4.7)
What will be the dose of Artesunate in case you will give parenteral Artesunate, for children <20 kg?	57	32.6	12 (19)
First alternative to Artesunate in severe malaria is?	25	14.3	11 (17.4)
Pre-referral treatment of severe malaria in children <6 years where injections are not available?	77	44	40 (63.4)

**[Table/Fig-7]:** Correct responses of the participants to issues of treatment of severe malaria.

Only 11 (17.4%) of the paediatricians and 25 (14.3%) of all participants chose to give intramuscular Artemether as an alternative to Artesunate, which is recently recommended. The larger proportion chose to give parenteral Quinine.

Good proportion, 40 (63.4%), of the paediatricians and 77 (44%) of the participants chose the correct pre-referral treatment of severe malaria in children <6 years when injections were not available i.e., by giving a single dose of rectal Artesunate.

## Overall Performance

### Association between demographic characteristics of the enrolled physicians and their responses:

- Years of Medical Practice:** Generally, all participants with 5-10 years duration of medical practice had more correct answers to diagnostic and treatment issues of malaria cases but the difference was not statistically significant (p-value: 0.089 and 0.123 respectively). Otherwise, there were no clear significant relations [Table/Fig-8].

Characteristic of the group of enrolled physicians	Management issue	Per-cent of correct answers	Chi-square
Years of medical practice- from 5-10 years	Clinical diagnosis of malaria cases	81.40 %	0.089
	Writing treatment doses for uncomplicated malaria cases	80.80%	0.123
Specialty-paediatricians	Duration of ACT therapy for uncomplicated malaria	67,2%	0.011*
Specialty-Internists	Recommended total dose of Artemether-Lumefantrine combination therapy	41.7%	0.092
	The correct dose of Artesunate-Sulphadoxin Pyrimethamine (SP) is:	78.6%	0.524
	Treat infant less than 6 months having uncomplicated <i>Plasmodium falciparum</i> malaria with:	30.8%	0.026*
	Treatment of pregnant mothers with uncomplicated <i>Plasmodium falciparum</i> malaria in the first trimester with:	81.8%	0.043*
	Vulnerable groups for malaria are	80.00%	0.008*
Students in the internship period	Reducing transmissibility of <i>Plasmodium falciparum</i> infection is done by:	62.5%	0.151
Hospital affiliation- Aljomhoori	The dose of Artesunate- sulphadoxin Pyrimethamine (SP) is:	88.9%	0.055
Hospital affiliation- Al-Kuwait	Treatment of pregnant mothers with uncomplicated <i>P. falciparum</i> malaria in the first trimester with:	77.2%	0.185

**[Table/Fig-8]:** Relationship between some demographic characteristics of the participants and their responses.

\*Significant at p<0.05

- Specialty of the physicians:** [Table/Fig-8] shows that more paediatricians and internists have correctly recognised malaria diagnostic and treatment issues compared to other specialties enrolled in the study. This difference was statistically significant as shown in [Table/Fig-8]. Other issues included in the study were answered variably among all specialties without certain difference in favour of one specialty. Gender of the involved physicians did not have significant effects on their responses.

## DISCUSSION

This cross-sectional study was performed on 175 physicians from different specialties working in four major governmental referral hospitals in Sanaa, Yemen. Paediatricians represented the major bulk of them. More male physicians has participated in this study, this is consistent with other studies where participation of the males was more [5,6].

The majority of the respondents were in the category from one to ten years duration of medical practice. This coincides with similar study in Malawi where the range of medical practice was 1-9 years [6]. This category represents the major target for training. In contrast, in Nigeria, a similar study revealed that most of the participants 21% had 21-25 years of medical practice [5].

The majority of the participating physicians treat 1-5 malaria cases per month. In a study in Malawi, more malaria patients, 10-70 (median is 35), were seen per week [6]. This could be because Sanaa city is not an endemic area for malaria.

Paediatricians included in this study have shown a good level of awareness regarding diagnostic issues of malaria cases according to the Guidelines 2015. This was clearer among paediatricians and internists. The gap in the diagnosis was in the confirmation of malaria cases, which according to the guidelines is equally by microscopy and RDT. However, most of the participants and most of paediatricians chose to confirm the diagnosis by RDT and microscopy at the same time. This may be because of less accessibility to quality microscopic examinations in Sanaa.

Regarding the case management of acute uncomplicated case of *Plasmodium falciparum* malaria the majority of paediatricians managed their cases with correct combinations and duration of ACT. Moreover, the majority of them recognised that any combination would be effective equally. Most of them recognised that the main cause of treatment failure is decreased compliance and knew the correct dosage of the most common combination in Yemen, Artesunate-SP. This coincides with similar study in Malawi [6] and another one in India where a good proportion of health workers showed compliance with the national guidelines [7], in Kenya [8], and in Nigeria [9]. In contrast, a study in Congo concluded poor adherence to the management guidelines by the health workers [10].

In this study, majority out of the whole participants and the majority within the group of paediatricians did not recognise the treatment of infants less than six months and pregnant mothers correctly, which is an important gap of knowledge and practice. Most of them treated these two categories with Quinine alone, which is the old policy in Yemen. This could be explained partially by the decreased time interval between the emergence of the new guidelines and the time of this study since it usually takes time for the new guidelines to be part of the daily practice of physicians [10].

A good percentage of paediatricians as well as of the whole participants responded correctly to the questions related to treatment failure and reducing the transmissibility of *Plasmodium falciparum* malaria. Additionally, a good proportion of them have identified malnutrition as a risk factor for severe malaria and recognised the correct treatment of infants with malaria and malnutrition, which is an important issue in malaria management [11] due to its effect on immune mechanisms [12,13].

This study showed there was a gap in the knowledge regarding using an alternative to ACT in case of treatment failure since most of the paediatricians identified Quinine as the first alternative rather than using another ACT. Using Quinine in treatment failure has been the standard policy in Yemen for a long time. Another gap was in reducing transmissibility of *Plasmodium falciparum* since most of the physicians used Sulphadoxine-Pyrimethamine rather than Primaquine for this purpose, which is an old national policy.

Only a small percentage of paediatricians, were aware to the correct treatment of malaria cases infected with *P. vivax*, *malariae*, *ovale* and *knowlesi* malaria. However, a good proportion of them responded correctly to the relapse prevention of the above mentioned species which is Primaquine. Generally, there was a gap in this area of knowledge and practice. This could be explained by the fact that these species are uncommon in Yemen especially Sanaa [1,14-16].

Another important gap was the treatment of severe malaria. The responses of paediatricians as well as other participants were unexpectedly below average. Only minor percentage of them knew that the drug of choice for treating severe malaria is intravenous or intramuscular Artesunate followed by oral ACT. Most of the responses recognised Quinine as the drug of choice, which is the old policy in Yemen. This coincides with the study in Malawi which concluded the need to more training for health workers regarding ACT use [6,7].

In addition, only a minor percentage of paediatricians recognised intramuscular Artemether as the first alternative for Artesunate in treating severe malaria. Again, the majority recognised Quinine instead. This reflects the need to active training programs for health workers to improve their adherence to the national guidelines [17,18]. However, a good proportion of the paediatricians recognised rectal Artemisinin as the correct pre-

referral treatment for severe malaria in children <6 years, which is an important issue in Yemen since many cases are referred from rural areas where injectable forms and trained health workers may not be available.

When the association between the demographic factors and the responses of the participants was studied, there was no characteristic pattern of this relation. Generally, paediatricians and internists were more oriented to diagnosis and treatment issues than the other categories of the participating physicians. This may be explained because these two categories usually see more, though not statistically significant, number of patients with malaria than other specialties. Furthermore, more physicians and paediatricians with a duration of practice between five and ten years recognised correctly the diagnosis and treatment issues of uncomplicated malaria according to the guidelines although this association was not statistically significant.

## LIMITATION

This study was limited in the number of participants included as we could not collect data from the calculated number of participants and hence present study was under powered. Larger studies with more paediatricians from different areas other than Sanaa as well as private sector hospitals would be more valuable.

## CONCLUSION

Most paediatricians were aware of the latest guidelines issued by WHO in 2015 regarding malaria diagnosis, treatment and prevention. However, important gaps were detected in the treatment of young infants and pregnant mothers with severe malaria. National program should run more awareness and training activities to improve prevention and treatment performance of Yemeni physicians in order to decrease the disease burden.

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