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Providers' Knowledge of the Guidelines for Intermittent Preventive Treatment for Malaria in Pregnancy: Evidence from Bungoma East District, Kenya

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Abstract **Introduction:** Intermittent Preventive Treatment for malaria in pregnancy (IPTp) with sulfadoxine-pyrimethamine is a key intervention for malaria prevention. Providers' knowledge of IPTp guidelines is crucial for effective services and achievement of the Roll Back Malaria target. This study assessed providers' knowledge of the IPTp guidelines, with a view to contributing towards policy deliberations aimed at improving providers' knowledge and service quality. **Methods:** We sourced primary data from 34 providers working in public health facilities, including the district and sub-district hospitals, health centres, and dispensaries. The test items included definition of IPTp; timing of the first IPTp dose; whether women on cotrimoxazole should be given IPTp; as well as whether IPTp can be given with folic acid, among others. Quantitative analysis techniques included frequency distributions and cross-tabulations with Chi Square statistic. **Findings:** Only one-third (29.4%) of the participants provided correct responses to all the ten test items; hence, were considered to be 'knowledgeable' about the guidelines. About 56% of the providers had accessed some training on IPTp, while a significant variation in IPTp knowledge emerged between trained and untrained providers. The study also found significant variation in providers' knowledge of most guidelines across the cadres as well as across health facility tiers. **Interpretation:** The failure of about 71% of the providers to state correct responses to all the test items suggests that providers' knowledge of the guidelines remains low. Trained providers were likely to be more knowledgeable than their untrained counterparts were; clinical officers were likely to be more knowledgeable than community health workers were, while providers at the district hospital were likely to be more knowledgeable than providers at the dispensaries were. The study recommends the need to scale-up in-service training; package and disseminate the guidelines in portable materials; and prioritize training opportunities for lower cadres and providers in lower tier facilities.

Keywords: *Intermittent Preventive Treatment, Providers' knowledge, Pregnancy, Malaria Prevention, Malaria Control*

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1. Introduction

By the end of 2013, World Health Organization (WHO) estimated that about 3.4 billion people were at risk of malaria infection globally. The *World Malaria Report 2013* further indicates that about 207 million (135-287 million) cases of malaria and 627,000 deaths (473,000-789,000) occurred globally in 2012. The bulk of the cases (80%) and deaths (90%) occurred in Africa, with children below five years and pregnant women living in malaria-endemic regions bearing the brunt [WHO, 2013].

Malaria in pregnancy remains a major public health challenge, particularly in the sub-Saharan Africa (SSA). Maternal malaria is highly risky for the mother and her fetus, particularly due to low levels of immunity. WHO's fact sheet indicates that pregnancy quadruples a woman's risk to malaria illness and doubles her risk of death. In this regard, malaria increases the risk of maternal anaemia by up to 15%, increases the risk of preterm delivery by up to 36%, intrauterine growth retardation by up to 70%, low birth weight by up to 14% and infant death by up to 8% [Arulogun & Okereke, 2012]. Furthermore, recent WHO estimations indicate that malaria accounts for about 10,000 maternal deaths and about 200,000 fetal and infant deaths annually, with severe malarial anaemia contributing to more than one-half of reported deaths [WHO, 2013].

Existing statistics further shows that malaria in pregnancy accounts for 5 to 12% of all low-weight births. As noted by Luxemburger et al. (1997) as well as WHO (2007), in low risk zones, episodes of severe malaria significantly associates with stillbirths, spontaneous abortion, premature delivery, and maternal death. However, in high-risk areas, women are susceptible to

asymptomatic infection, with potential results being maternal anaemia and placental parasitaemia. Both situations are conducive for low birth weight and subsequently, infant mortality [Steketee et al., 1996; WHO, 2007].

Intermittent Preventive Treatment in pregnancy (IPTp) with sulfadoxine-pyrimethamine (SP) is one of the key interventions recommended by WHO for the prevention of asymptomatic infections among pregnant women living in moderate to high-risk regions [WHO, 2007; WHO, 2012]. IPTp provides significant protection against maternal anaemia and low birth weight, and reduces significantly the risk of abortion, stillbirth, pre-term deliveries, and maternal mortality. Studies in Kenya (Parise et al., 1998; Shulman et al., 1999) and Malawi (Schultz et al., 1994; Verhoeff et al., 1998) have shown that IPTp using SP when delivered as part of antenatal care significantly reduces the prevalence of maternal anaemia, placental parasitemia and the incidences of low birth weight.

Consequently, all pregnant women should receive the first dose of three tablets ($IPTp_1$), as early as possible after quickening (first noted movements of the fetus), which providers administer under their direct observation. Service providers should give each SP dose at least one month apart, with every scheduled visit to the clinic. WHO recommends a schedule of four antenatal care visits; hence, recipients of $IPTp_1$ should access the second dose ($IPTp_2$) within the 20^{th} week of pregnancy.

In addition, WHO recommends a minimum of $IPTp_2$ protection against malaria for women residing in high-risk regions [WHO, 2007; WHO, 2012]. Providers can administer the last dose of IPTp with SP up to the time of delivery, without safety concerns. WHO further recommends that providers can administer SP either in an empty stomach or with food. However, providers should not give SP together with folic acid at a daily dose equal to or above 5 milligrams as this counteracts efficacy of the tablets. Moreover, service providers should exempt pregnant women receiving cotrimoxazole prophylaxis [WHO, 2012].

The Roll Back Malaria partnership initiative set the $IPTp_2$ coverage target at 80% by 2010 [WHO, 2005; WHO, 2012], and so did the *Kenya National Malaria Strategy (KNMS) 2009-2017*. Although the IPTp remains a powerful strategy against malaria in countries with moderate to high stable malaria transmission, there has been confusion, lapses and very poor coverage in the SSA countries, with little progress towards the $IPTp_2$ coverage target [WHO, 2012]. In Kenya, for instance, the 2008/09 *Demographic and Health Survey (KDHS) Report* indicate that only 15.1% of the participants received $IPTp_2$ [KNBS & ICF Macro, 2010], while the *Malaria Indicator Survey of 2010* recorded a national $IPTp_2$ coverage of 25.7% [MPHS, KNBS & ICF Macro, 2011].

Providers' knowledge of IPTp guidelines is a crucial element for effective delivery of IPTp services and the achievement of the RBM and national IPTp2 coverage targets. Based on this cognizance, the Government of Kenya (GoK), in collaboration with various stakeholders, developed the *National Guidelines for Diagnosis, Treatment, and Prevention of Malaria for Health Workers in Kenya* [Ministry of Health (MoH), 2006], in line with WHO's recommendations [WHO, 2012]. The Guidelines recommend IPTp for all areas of high malaria transmission in the country and the recommended medicine is Sulphadoxine 500mg/Pyrimethamine 25mg given as a dose of three tablets. The Guidelines further requires health workers to administer IPTp with each scheduled visit after quickening to ensure women receive at least two doses during each pregnancy [MoH, 2006].

The Guidelines further indicate that women known to be HIV-infected or with unknown HIV status living in areas of high HIV prevalence (> 10% among pregnant women) should receive at least three doses of IPTp. Besides, health workers should give IPTp at an interval of at least 4 weeks (1 month). The Guidelines further indicate that pregnant women who are HIV positive and are also taking antiretroviral therapy for the Prevention of Mother-to-Child Transmission (PMTCT) should receive IPT; however, those on cotrimoxazole chemoprophylaxis should not be given SP [MoH, 2006].

Furthermore, providers can give IPTp with Tetanus Toxoid (TT) injection, but should not together with folic acid. Taking folic acid should delay for 2 weeks after taking IPTp because folic acid reduces the efficacy of SP. Women who may be allergic to sulphur-based drugs should not receive IPTp doses. The Guidelines provide that providers should give IPTp under Directly Observed Therapy (DOT) at the facilities and patients can take it on an empty stomach [MoH, 2006]. Lastly, the Guidelines also indicate that IPTp can have side effects such as mild headache, nausea, and occasional vomiting, which are not serious. However, providers should be weary of serious side effects such as skin and mucus membrane reaction (mouth or genital lacerations) known as Stevens Johnson Syndrome, but which are quite rare [MoH, 2006].

The delivery of IPTp as per the Guidelines necessitates training to improve awareness and knowledge among the providers, particularly in public health facilities. In view of this, the MoH in collaboration with partners such as USAID and JHPIEGO, organized intermittent training seminars, which targeted providers in regions of malaria endemism [Ngindu et al., 2009]. However, there is limited documentation regarding the extent of such training initiatives, in terms of whether all providers in high-risk malaria zones benefitted, as well as the influence of such initiatives on providers' knowledge about IPTp delivery guidelines [Ngindu et al., 2009].

A review of existing literature reveals that various studies have established that the delivery of IPTp significantly associates with health facility factors such as inconsistent supply of clean drinking water and sharing of drinking cups [Akinleye et al., 2009]; health provider attitudes [Hill & Kazembe, 2006]; waiting time and lack of diagnostic facilities [Mboera et al., 2007]. Other factors influencing IPTp delivery include recipients' knowledge about the recommended drug, dose and interval between doses [Tarimo, 2007; Mubyazi et al., 2005; & Akinleye et al., 2009]; as well as service providers' knowledge level about IPTp [Ali, 2002; Ouma et al., 2007; Arulogun & Okereke, 2012]. However, none of these studies has exclusively focused on service providers' knowledge of the IPTp delivery guidelines, more particularly, in Kenya.

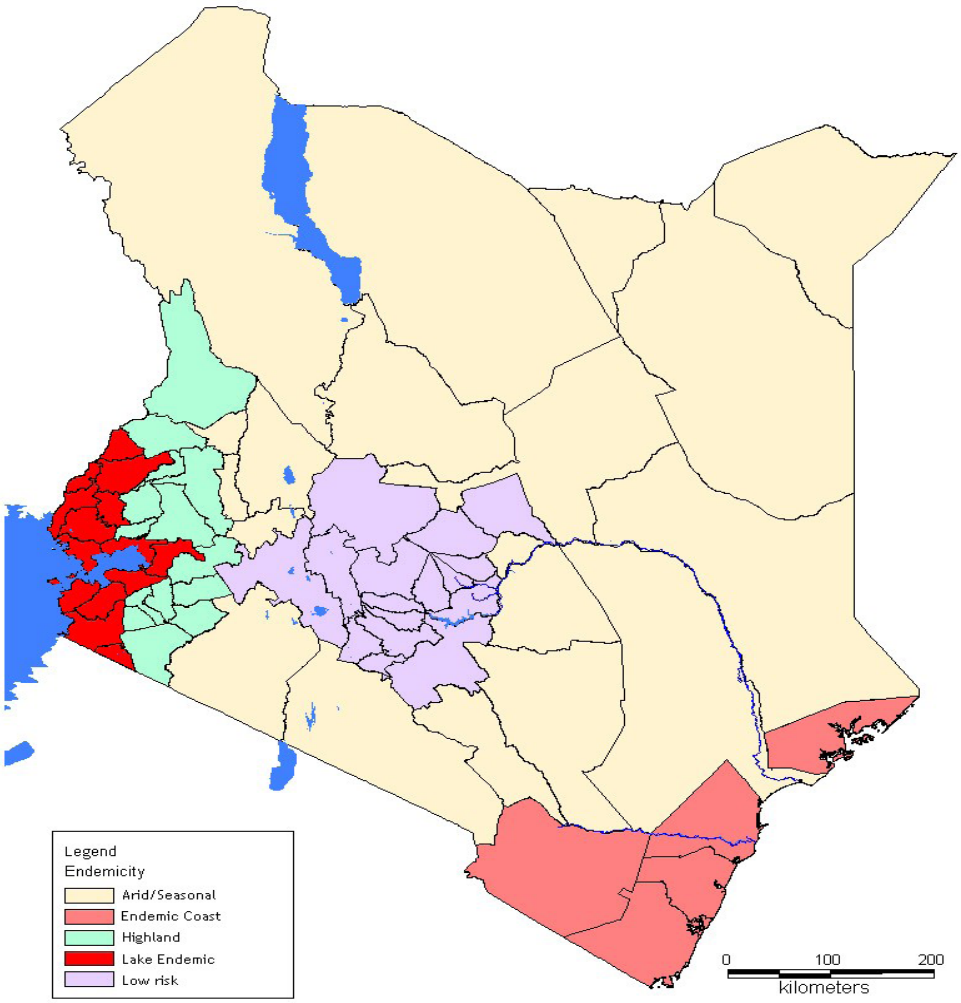
In a recent study, Arulogun and Okereke [2012] dwelt partly on providers' knowledge and partly on IPTp practices, which limited the number of guidelines on which providers' knowledge was tested. This study exclusively assessed providers' knowledge of the IPTp delivery guidelines, based on the training status, cadres,

and health facility tiers, in Bungoma East District of Bungoma County, Kenya. The findings should to contribute to policy deliberations precipitating the need to improve and maintain providers' knowledge, quality of IPTp services as well as attainment of the national and international $IPTp_2$ coverage. As noted by Donkor and Asiedua [2011], the benefits of IPTp can only be realized when providers understand the guidelines for delivery.

2. Methodology

2.1. The Study Area

Kenya has four malaria eco-epidemiological zones, namely, the highland epidemic-prone, malaria-endemic, seasonal malaria transmission, and low-risk malaria areas (Map 1). The highland epidemic-prone zone, covering highlands to the west of the Rift Valley, has a risk class of 5% to less than 20%; the malaria-endemic zone, which covers the Lake Victoria, Western and Coastal regions, has a risk class of 20% or higher. The seasonal malaria transmission zone, including parts of Rift Valley, Eastern and North Eastern regions, has a risk class of less than 5%, while the low-risk zone, which includes Nairobi and Central regions, has a risk class of less than 0.1% [MoH, 2006; MPHS, KNBS & ICF Macro, 2011].



Map 1. Endemicity of malaria in Kenya (Source: Ministry of Health [2006])

Bungoma East is one of the five districts forming Bungoma County, and falls within the lake endemic zone (Map 1). According to the 2009 Population and Housing Census, the District had a population of 257,611 of which 61,827 were women in the reproductive age [KNBS, 2010]. The Health Management Information Systems (HMIS) show that between the months of July and December 2010, the District recorded about 704 maternal deaths, of which malaria contributed 41% (unpublished HMIS reports). Hence, malaria remains the single most important threat to pregnant women and their unborn babies. With an infection risk of 32%, the District reports one of the highest infection rates in region [MPND, 2010]. Prior to the study, we obtained malaria epidemiological data for the period of July to December 2010 from five districts located within the lake endemic zone. Based on this, the selection of Bungoma East District from the set of five districts was purely random.

2.2. Design and Target Population

We applied the cross-sectional survey design, with both quantitative and qualitative approaches to source, process and analyze the requisite information. The quantitative approach elicited quantifiable and numerical data, which we used to generate descriptive and inferential results. While the qualitative approach elicited in-depth information about IPTp service delivery, based on the experiences and professional perspectives of health workers. However, this paper largely presents quantitative

results. Among other participants, this study targeted service providers directly involved in the delivery of IPTp services in public health facilities, including district and sub-district hospitals, as well as health centres and dispensaries.

2.3. Sampling Process

Public health facilities in the District fall into three tiers based on service quantity and quality, including tiers four, three, and two. For the purpose of this study, tier four facilities included the district and sub-district hospitals; tier three included health centres, while tier two included dispensaries. All the health facilities in the sampling frame provided IPTp services, regardless of the tier. Based on this, we applied a three-stage-sampling process to obtain the targeted respondents.

At the first stage, we developed a list of public health facilities, with the assistance of the District Medical Officer of Health (DMOH). The District had 10 public health facilities, including one district hospital, one sub-district hospital, two health centres, and six dispensaries. We stratified the list based on the tiers; in the fourth and third tiers, we applied purposive sampling procedure to select Webuye District Hospital, Bokoli Sub-District Hospital, as well as Webuye and Milo Health Centres. In the second tier, we applied stratified random procedure to select Khaoya, Mukhe, Sinokoo, and Lurare Dispensaries. The stratification criterion ensured proportionate inclusion of rural and urban-based dispensaries. Stratified random sampling procedure ensures a fair representation of elements whose number in the sampling frame is small [Nachmias & Nachmias, 1996].

At the second stage, we purposively selected service providers directly involved in the delivery of IPTp services within the antenatal clinics, based on their incumbency, availability, and accessibility. By cadre, the providers included clinical officers, nurses, and community health workers (CHWs). We used the term 'nurses' to include midwives. Table 1 shows the distribution of service providers across the health facilities involved in the study.

Table 1. Proportionate sample sizes for each health facility

Strata	*Sampled Facilities*	*Number providers*
Level 4	Webuye District Hospital	9
	Bokoli Sub-District Hospital	5
Level 3	Webuye Health Centre	6
	Milo Health Centre	4
Level 2	Khaoya Dispensary	3
	Mukhe Dispensary	2
	Sinokoo Dispensary	2
	Lurare Dispensary	3
	Total	**34**

We took all the providers serving in the antenatal clinics through verbal consenting process before interviews. Included in the study were those directly involved in the delivery of IPTp services, regardless of whether they had accessed training on IPTp delivery guidelines or not.

2.4. Data Collection Instrument

We applied a standard questionnaire to source information through key informant interviews with service providers. Among other data, the questionnaire captured information on providers' demographic and professional profile, as well as knowledge of IPTp guidelines. The questionnaire contained 12 IPTp test items, as indicated in Table 2, which gauged providers' knowledge.

Table 2. Test items used to determine providers' knowledge

Test item	Expected responses
1. Definition of IPTp	Prevention of malaria in pregnant women by giving antimalarial drugs in treatment doses at defined intervals after quickening to clear presumed burden of parasites
2. Recommended drug for IPTp	Sulphadoxine 500mg/Pyrimethamine 25mg given as a dose of three tablets
3. Any three brand names of recommended SP drugs for IPTp	Fansidar, Falcidin, Metakelfin, Amalar, Malareich, Orodar
4. Timing of the first IPTp dose (IPTp1)	As early as possible after quickening (first noted movements of the foetus) within 16th week of gestation
5. Recommended interval between IPTp1 and IPTp2	1 month/4 weeks
6. Whether women on ARVs should be given IPTp	Yes
7. Whether HIV positive women on cotrimoxazole should be given IPTp	No
8. Whether IPTp can be given together with tetanus toxoid	Yes
9. Whether IPTp can be given with folic acid	No
10. Recommended lapse period between IPTp and folic acid	2 weeks/14 days
11. Whether IPTp can be given on an empty stomach	Yes
12. Whether IPTp drugs should be taken at the facility or at home	At the facility through DOT

We requested participants to provide responses, which we gauged against the guidelines to determine their correctness. Whereas correct responses suggested knowledge of the guidelines in question, we took incorrect responses to signify lack of knowledge. We translated the questionnaire into Kiswahili to facilitate communication, ease its implementation, and standardize responses. The questionnaire was pretested in July 2011 in two dispensaries, which we excluded from the main data collection exercise.

2.5. Data Collection Process

We collected data in August 2011 through key informant interviews with service providers, including clinical officers, nurses, and midwives. The researcher engaged seven assistants to support data collection activities for the entire study. Two assistants supported with key informant interviews. The researchers developed an itinerary, which was shared with all the sampled health facilities to enable them prepare. We slated interviews with service providers for non-clinic days, depending on the convenience of each facility. At the end of the exercise, 34 interviews were successfully completed.

2.6. Data Processing and Analysis

Data processing involved digitalization of the quantitative data and cleaning for misplaced codes. For some variables, we transformed the scale of measurement to suit the chosen analysis techniques. Quantitative analysis techniques included frequency distributions and cross-tabulations with Chi Square statistic. Detailed description of the design and approaches that were used in this study are available in the following publications: Nachmias and Nachmias [1996], Bryman and Cramer [1997], Wuensch [2006], Rindfleisch et al. [2008].

2.7. Ethical Considerations

The Institutional Research and Ethics Committee (IREC) of Moi Teaching and Referral Hospital and the School of Medicine, Moi University approved the study in July 2011. The Ministry of Education, Science and Technology and the Ministry of Health also approved the study. We observed three ethical principles, including respect for participants, beneficence, and justice. All participants were consented by fully explaining purpose of the study, potential benefits, and the fact that their participation was voluntary. We also informed participants about their right to withdraw consent at any time during the process without a penalty. Since, the study had no clinical components; the risks involved were minimal.

Furthermore, we kept the information sourced confidential and ensured the confidentiality of interviews. We avoided information on personal identifiers, assured participants that we would use the information for research purposes only, with access limited to the investigators only. We assured participants that we would share the report with the Government, Moi University, Moi Teaching and Referral Hospital and other stakeholders to support decisions aimed at enhancing the level of knowledge among health workers in public health facilities to improve the delivery of IPTp services. Lastly, we accorded equal opportunity to participants who consented to participate in the study.

3. Results

This section presents results of the study, which have been organised under two thematic areas, viz. providers' background profile, as well as knowledge of IPTp delivery guidelines. Out of the 12 test items, we have used 10 in the analysis to gauge providers' knowledge. The results show that out of the 34 participants, 10 (29.4%) provided correct responses to all the test items, and were considered to be 'knowledgeable' about IPTp. However, the majority, 24 (70.6%) did not get all the test items correct, and were considered to be 'less knowledgeable'.

3.1. Participants' Background Profile

The results presented in Table 3 show that 9 (26.5%) participants were drawn from the district hospital, 5 (14.7%) were sampled from the sub-district hospital, while health centres and dispensaries contributed 10 (29.4%), each. The table also shows the distribution of providers in terms of performance in the test items across the health facility tiers. Based on the distribution, the analysis obtained a computed χ^2 value of 8.472, with 3 degrees of freedom and a p-value of 0.037, suggesting up to 95% chance that the distribution of knowledgeable and less knowledgeable providers varied significantly across the health facility tiers.

Table 3. Participants' background profile

Background variables	Knowledgeable		Less knowledgeable		Total	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Facility category						
District hospital	3	30.0	6	25.0	9	26.5
Sub-district hospital	4	40.0	1	4.2	5	14.7
Health centre	2	20.0	8	33.3	10	29.4
Dispensary	1	10.0	9	37.5	10	29.4
Total	**10**	**100.0**	**24**	**100.0**	**34**	**100.0**
Gender						
Male	5	50.0	6	25.0	11	32.4
Female	5	50.0	18	75.0	23	67.6
Total	**10**	**100.0**	**24**	**100.0**	**34**	**100.0**
Cadre						
Clinical officers	4	40.0	1	4.2	5	14.7
Nurses	6	60.0	16	66.7	22	64.7
CHWs	0	0.0	7	29.2	7	20.6
Total	**10**	**100.0**	**24**	**100.0**	**34**	**100.0**
Professional experience						
<5 years	0	0.0	5	20.8	5	14.7
5-9 years	5	50.0	10	41.7	15	44.1
10 years+	5	50.0	9	37.5	14	41.2
Total	**10**	**100.0**	**24**	**100.0**	**34**	**100.0**
Duration at the station						
<5 years	1	10.0	11	45.8	12	35.3
5-9 years	8	80.0	7	29.2	15	44.1
10 years+	1	10.0	6	25.0	7	20.6
Total	**10**	**100.0**	**24**	**100.0**	**34**	**100.0**

The participants included 11 (32.4%) men and 23 (67.6%) women. Regarding the level of knowledge by gender, the analysis revealed lack of significant association (computed χ^2 value = 1.035 (corrected for continuity); df = 1 and p-value = 0.309). The results further show that participants included 5 (14.7%) clinical officers, 22 (64.7%) nurses, and 7 (20.6%) community health workers. The results suggest that the distribution of knowledgeable and less knowledgeable providers varied significantly across the cadres, with most clinical officers being knowledgeable and all the CHWs less knowledgeable (computed χ^2 value = 9.128; df = 2 and p-value = 0.010).

Regarding the duration of professional experience, the results show that 15 (44.1%) participants had between 5 and 9 years of experience, 14 (41.2%) stated 10 years or more, while 5 (14.7%) indicated less than 5 years. Based on this, the analysis revealed that the distribution of knowledgeable and less knowledgeable providers did not vary significantly with years of professional experience (computed χ^2 value = 2.462; df = 2 and p-value = 0.292). The results in Table 3 further show that 15 (44.1%) participants had stayed in their stations for between 5 and 9 years, 12 (35.3%) indicated less that 5 years, while 7 (20.6%) stated at least 10 years. However, there was no significant variation in the distribution of knowledgeable and less knowledgeable providers based on the duration of stay at the current workstation (computed χ^2 value = 4.474; df = 2 and p-value = 0.115).

3.2. Knowledge of IPTp Guidelines and Training Status

The results indicated that of the 34 participants, 19 (55.9%) had accessed formal training on IPTp; however, a significant proportion, 15 (44.1%) had not. Among those trained, 12 (63.2%) accessed training provided by the Ministry of Health (MoH), while 7 (36.8%) had accessed training organised by Non-Governmental Organisations (NGOs), including missionary health facilities. For the majority, 13 (68.2%), the training lasted for a period not exceeding one week, while 6 (31.6%) participants trained for a period not exceeding 2 weeks. All the 19 (100.0%) trained participants provided the correct definition of IPTp; however, among those with no training, only 3 (20.0%) were correct. The results in Table 4 show a significant association between providers' training status and ability to state the correct definition of IPTp (computed χ^2 value = 20.118 [corrected for continuity]; df = 1 and p-value = 0.000). The results further show that all the 34 (100.0%) participants correctly stated the recommended drug for IPTp, regardless of the training status.

Table 4. Variation between training and knowledge about IPTp

Test items	Summary of Chi Square Tests		
	Computed χ^2	*df*	*ρ-value*
Definition of IPTp	20.118	1	0.000***
Any three brand names of recommended SP drugs for IPTp	16.694	2	0.000***
Timing of the first IPTp dose ($IPTp_1$)	11.535	1	0.001***
Recommended interval between $IPTp_1$ and $IPTp_2$	4.883	2	0.087*
Whether women on ARVs should be given IPTp	15.126	2	0.000***
Whether HIV positive women on cotrimoxazole should be given IPTp	11.145	2	0.004***
Whether IPTp can be given together with tetanus toxoid	28.226	2	0.000***
Whether IPTp can be given with folic acid	8.916	2	0.012**
Recommended lapse period between IPTp and folic acid	19.804	2	0.000***
Whether IPTp drugs should be taken at the facility or at home	8.494	1	0.004***

*, **, *** show significance at 0.1, 0.05 and 0.01, error margins, respectively

Among the trained providers, 14 (73.7%) stated three correct brand names of sulfadoxine-pyrimethamine (SP) drugs, while 5 (26.3%) mentioned only two correct such brand names. Among the untrained participants, 10 (66.7%) stated two correct names, while 4 (26.7%) indicated only one correct brand name of SP. Based on this distribution, the results in Table 4 show a significant association between providers' training status and knowledge about the brand names of SP drugs (computed χ^2 value = 16.694; df = 2 and p-value = 0.000). Furthermore, 16 (84.2%) trained and only 3 (20.0%) untrained participants correctly stated the timing of the first IPTp dose. As indicated in Table 4, the analysis revealed a significant association between providers' training status and knowledge about the timing of the first IPTp dose (χ^2 value = 11.535 [corrected for continuity]; df = 1 and p-value = 0.001).

Regarding the interval between $IPTp_1$ and $IPTp_2$, 18 (94.7%) trained participants provided correct responses; while, among those with no training, up to 10 (66.7%) were correct. Table 4 shows the existence of marginal association between participants' training status and knowledge about the guideline (computed χ^2 value = 4.883; df = 2 and p-value = 0.087). Furthermore, 12 (63.2%) trained and only 2 (13.3%) untrained participants stated correct responses on whether women on ARVs should be given IPTp. Based on this, Table 4 shows the existence of a significant association between providers' training status and knowledge on whether such women should be given IPTp (computed χ^2 value = 15.126; df = 2 and p-value = 0.000). Among the trained providers, 17 (89.5%) responded correctly about whether HIV positive women on cotrimoxazole should be given IPTp. Contrastingly, only 6 (40.0%) untrained participants were correct about the guideline. Based on this, the results in Table 4 reveals a significant relationship between providers' training status and knowledge about the use of IPTp by HIV positive women on cotrimoxazole (computed χ^2 value = 11.145; df = 2 and p-value = 0.004).

More still 13 (68.4%) trained and none of the untrained participants provided correct responses on whether IPTp should be given together with Tetanus Toxoid (TT) injections. Again, the analysis revealed a significant association between providers' training status and knowledge about the administration of IPTp together with TT (computed χ^2 value = 28.226; df = 2 and p-value =

0.000). The results further show that among the trained participants, 14 (73.3%) responded correctly regarding whether IPTp can be given with folic acid; however, among those with no training, only 5 (33.3%) stated correct responses. Consequently, Table 4 reveals the existence of significant variation in providers' training status and knowledge on whether IPTp should be administered together with folic acid (computed χ^2 value = 8.916; df = 2 and p-value = 0.012).

Regarding the recommended lapse period between IPTp and folic acid uptake, the results show that among the trained participants, 12 (63.2%) were correct; while among those who had not accessed training, none was correct about the guideline. Table 4 shows a significant association between providers' training status and knowledge about the recommended lapse period between the uptake of IPTp and folic acid (computed χ^2 value = 19.804; df = 2 and p-value = 0.000). Lastly, all the trained participants, 19 (100.0%) and 8 (53.3%) untrained participants correctly affirmed that IPTp tablets should be taken under the direct observation by health providers at the facilities. Based on this, the results in Table 4 suggest the existence of significant relationship between providers' training status and knowledge about Directly Observed Therapy (χ^2 value = 8.494 [corrected for continuity]; df = 1 and p-value = 0.004).

3.3. Knowledge of IPTp Guidelines Across the Cadres

All the clinical officers, 5 (100.0%) provided correct definitions of IPTp; among the nurses, 15 (68.2%) were correct; while among the CHWs, only 2 (28.6%) stated correct definitions. Based on this, the analysis obtained a computed χ^2 value of 6.846, with 2 degrees of freedom and a p-value of 0.033, suggesting up to 95% chance that the knowledge of IPTp definition varied significantly across cadres of the providers involved in the study. The results further show that all the clinical officers, 5 (100.0%) stated three correct brand names of SP drugs; among the nurses, 10 (45.5%) mentioned three correct brand names, while only 3 (42.9%) CHWs stated two correct brand names. Based on this, the results in Table 5 suggest the existence of a significant relationship between knowledge of the SP brand names and providers' cadres (computed χ^2 value = 24.816; df = 4 and p-value = 0.000).

Table 5. Variation of IPTp knowledge across the cadres

Test items	Summary of Chi Square Tests		
	Computed χ^2	*df*	*ρ-value*
Definition of IPTp	6.846	2	0.033**
Any three brand names of recommended SP drugs for IPTp	24.816	4	0.000***
Timing of the first IPTp dose ($IPTp_1$)	6.081	2	0.048**
Recommended interval between $IPTp_1$ and $IPTp_2$	18.135	4	0.001***
Whether women on ARVs should be given IPTp	6.691	4	0.153
Whether HIV positive women on cotrimoxazole should be given IPTp	11.337	4	0.023**
Whether IPTp can be given together with tetanus toxoid	9.873	4	0.043**
Whether IPTp can be given with folic acid	5.067	4	0.280
Recommended lapse period between IPTp and folic acid	6.384	4	0.172
Whether IPTp drugs should be taken at the facility or at home	7.668	2	0.022**

*, **, *** show significance at 0.1, 0.05 and 0.01, error margins, respectively

Again, all the clinical officers, 5 (100.0%) correctly stated the timing of the first IPTp dose; and so were 12 (54.5%) nurses and 2 (28.6%) community health workers. In this regard, Table 5 shows a significant association between the providers' knowledge about the timing of the first IPTp dose and their cadres (computed χ^2 value = 6.081; df = 2 and p-value = 0.048). Mores still, all the clinical officers were correct about the recommended interval between $IPTp_1$ and $IPTp_2$. As for the nurses, 21 (95.5%) were correct, while among the CHWs, again only 2 (28.6%) were correct. Based on this Table 5 shows that providers' knowledge about the recommended interval between $IPTp_1$ and $IPTp_2$ significantly associates with their cadres (computed χ^2 value = 18.135; df = 4 and p-value = 0.001).

Among the clinical officers, 3 (60.0%) provided correct responses on whether women on ARVs should be given IPTp. As for the nurses, 10 (45.5%) provided correct responses and so was only 1 (14.3%) community health worker. Table 5 shows lack of significant variation in providers' knowledge across the cadres (computed χ^2 value = 6.691; df = 4 and p-value = 0.153). The results show that all the clinical officers were correct on whether HIV positive women on cotrimoxazole should be given IPTp. Among the nurses, 16 (72.7%) were correct, while among the CHWs only 2 (28.6%) were correct. Based on this, Table 5 shows that knowledge on whether such women should be given IPTp varied significantly across the cadres (computed χ^2 value = 11.337; df = 4 and p-value = 0.023).

Of the 5 clinical officers, 3 (60.0%) were correct about whether IPTp can be given together with TT; and so were 10 (45.5%) nurses and only 1 (14.3%) community health worker. Consequently, Table 5 indicates significant variation in knowledge about the indicator across the cadres (computed χ^2 value = 9.873; df = 4 and p-value = 0.043). More still, 3 (60.0%) clinical officers, 14 (63.6%) nurses and 2 (28.6%) CHWs provided correct responses on whether providers can give IPTp together with folic acid. However, Table 5 shows lack of significant association between providers' knowledge and their cadres (computed χ^2 value = 5.067; df = 4 and p-value = 0.280).

About the recommended lapse period between IPTp and folic acid, 3 (60.0%) clinical officers, 9 (40.9%) nurses and none of the CHWs stated correct responses. The results in Table 5 further show lack of significant variation in providers knowledge about the recommended interval between IPTp and folic acid across the cadres (computed χ^2 value = 6.384; df = 4 and p-value = 0.172). Lastly, the results showed that all the 5 (100.0%) clinical officers stated correct responses about whether patients

should take IPTp at the facility or at home. Among the nurses, 19 (86.4%) were correct, while among the CHWs, only 3 (42.9%) provided correct responses. Again Table 5 suggests the existence of significant association between providers' knowledge and their cadres (computed χ^2 value = 7.668; df = 2 and p-value = 0.022).

3.4. Knowledge of IPTp Guidelines across Health Facility Tiers

All the participants drawn from the district hospital, 9 (100.0%) and the sub-district hospital, 5 (100.0%) provided the correct definition of IPTp. For health centres, 6 (60.0%) were correct, while at the dispensaries, only 2 (20.0%) provided the correct definition. Table 6 shows that the knowledge of IPTp definition varied significantly across the health facility tiers (computed χ^2 value = 16.485; df = 3 and p-value = 0.001). More still, at the district hospital, 5 (55.6%) participants stated three correct brand names of SP drugs recommended for IPTp and so were all the 5 (100.0%) participants at the sub-district hospital. In health centres, 3 (30.0%) participants provided three correct brand names, while at the dispensaries; only 2 (20.0%) participants stated three correct responses. As indicated in Table 6, the analysis obtained a computed χ^2 value of 11.233, with 6 degrees of freedom and a p-value of 0.081, suggesting up to 90% chance that the knowledge of SP brand names varied significantly across health facility tiers.

Regarding the timing of first IPTp dose, the results show that 6 (66.7%) participants at the district hospital stated the correct response, while at the sub-district hospital, all the 5 (100.0%) participants were correct. At the health centres, 6 (60.0%) were correct, and so were only 2 (20.0%) participants at the dispensaries. Based on this, the results in Table 6 suggest the existence of a significant relationship between providers' knowledge about the timing of the first IPTp dose and health facility tiers (computed χ^2 value = 9.663; df = 3 and p-value = 0.022). In addition, all the participants drawn from the district and sub-district hospitals, 9 (100.0%) and 5 (100.0%), respectively correctly indicated the recommended duration between $IPTp_1$ and $IPTp_2$. At the health centres, up to 7 (70.0%) participants were correct and so were another 7 (70.0%) participants at the dispensaries. The analysis obtained a computed χ^2 value of 10.200, with 6 degrees of freedom and a p-value of 0.116, suggesting lack of significant variation in knowledge about the guideline across the health facility tiers.

Table 6. Variation of IPTp knowledge across health facility tiers

Test items	Summary of Chi Square Tests		
	Computed χ^2	*df*	*ρ-value*
Definition of IPTp	16.485	3	0.001***
Any three brand names of recommended SP drugs for IPTp	11.233	6	0.081*
Timing of the first IPTp dose ($IPTp_1$)	9.663	3	0.022**
Recommended interval between $IPTp_1$ and $IPTp_2$	10.200	6	0.116
Whether women on ARVs should be given IPTp	14.171	6	0.028**
Whether HIV positive women on cotrimoxazole should be given IPTp	12.706	6	0.048**
Whether IPTp can be given together with tetanus toxoid	20.287	6	0.002***
Whether IPTp can be given with folic acid	18.567	6	0.005***
Recommended lapse period between IPTp and folic acid	30.240	6	0.000***
Whether IPTp drugs should be taken at the facility or at home	6.476	3	0.091*

*, **, *** show significance at 0.1, 0.05 and 0.01, error margins, respectively.

Again, at the district hospital, 4 (44.4%) out of 9 participants provided correct responses about whether women on ARVs should be given IPTp. At the sub-district hospital, all 5 (100.0%) participants were correct. However, at the health centres and dispensaries, only 3 (30.0%) and 2 (20.0%) participants, respectively provided correct responses. Based on this, the results in Table 6 suggest the existence of significant variation in providers' knowledge about the guideline across health facility tiers (computed χ^2 value = 14.171; df = 6 and p-value = 0.028). Additional results show that at the district hospital, 7 (77.8%) participants indicated correct responses on whether HIV positive women on cotrimoxazole should be given IPTp. At the sub-district hospital all the 5 (100.0%) participants were also correct; and so were 8 (80.0%) and 3 (30.0%) participants at the health centres and dispensaries, respectively. As presented in Table 6, the analysis obtained a computed χ^2 value of 12.706, with 6 degrees of freedom and a p-value of 0.048, suggesting up to 95% chance that knowledge about the guideline varied significantly across the health facility tiers.

Furthermore, 5 (55.6%) participants at the district hospital, 4 (80.0%) at the sub-district hospital, 2 (20.0%) at the health centres and 2 (20.0%) at the dispensaries stated correct responses on whether IPTp can be given together with TT injections. The results in Table 6 show that knowledge about the guideline varied significantly across the health facility tiers (computed χ^2 value = 20.287; df = 6 and p-value = 0.002). Again, at the district hospital, 5 (55.6%) participants were correct on whether providers can give IPTp together with folic acid. At the sub-district hospital, all the participants, 5 (100.0%) stated correct responses and so were 7 (70.0%) participants at the health centres and 2 (20.0%) at the dispensaries. Based on this, the results presented in Table 6 suggest that knowledge about this guideline also varied significantly across the health facility tiers (computed χ^2 value = 18.567; df = 6 and p-value = 0.005).

Regarding the recommended time lapse between IPTp and folic acid, 5 (55.6%) participants at the district hospital, 3 (60.0%) at the sub-district hospital and 2 (20.0%) at the health centres and dispensaries, each, stated correct responses. Again Table 4 shows the existence of a significant relationship between knowledge of the recommended time lapse between IPTp and folic acid and health facility tiers (computed χ^2 value = 30.240; df = 6 and p-value = 0.000). About DOTs, all the participants at the district and sub-district hospitals, 9 (100.0%) and 5

(100.0%), respectively, provided correct responses. At the health facilities, 6 (60.0%) participants and 7 (70.0%) at the dispensaries were also correct. Based on this, Table 6 shows that the analysis obtained a computed χ^2 value of 6.476, with 3 degrees of freedom and a p-value of 0.091, suggesting up to 90% chance that knowledge about DOTs varied significantly across the health facility tiers.

4. Discussions and Conclusions

We conducted the study to among other objectives, assess service providers' knowledge of IPTp delivery guidelines in Bungoma East District. Only one-third (29.4%) of the participants provided correct responses to all the test items; hence, were considered to be 'knowledgeable' about the guidelines. Besides, slightly more than one-half (55.9%) of the participants had accessed some training on IPTp. Based on this, a significant variation in providers' knowledge of all the IPTp guidelines used in the study emerged between trained and untrained providers (Table 4). In this regard, trained providers were likely to be more knowledgeable on the guidelines than their untrained counterparts were. This implies that trained providers were likely to be providing better quality services than those with no training. Nonetheless, with more than two-thirds (70.6%) of the providers failing to provide correct response for all the test items, one can safely deduce that the level of providers' knowledge on IPTp guidelines remains low.

Low levels of knowledge may have significant implications on the quality of IPTp services and may be due to various factors, including lack of regular updates on newly recommended guidelines at the facility level, and budgetary constraints. This prevents regular training as well as wider dissemination of national guidelines for service providers. Whatever the case may be, there is no doubt that low levels of knowledge among providers may be a key factor constraining the quality of IPTp services, not only in Bungoma East District, but also in other malaria-endemic regions of the country; and certainly in other developing countries.

Low levels of IPTp knowledge among service providers has also been documented by various studies, including Thiam, et al. [2013] who talked of incorrect knowledge of IPTp recommendations in a number of SSA countries, including Malawi, Senegal and Zambia, among others. Diala et al. [2013] also noted that ANC providers in Nasarawa and Cross River States of Nigeria lacked the necessary knowledge to provide the recommended prevention and treatment interventions for malaria in pregnancy, or to inform women about them. Again, in Nigeria, Oyedunni and Okereke [2012] reported that only 24.5% health workers could adequately explain the concept of IPTp, while only 23.1% reportedly observed pregnant women take SP drugs at the facility. In the same country, Onyeaso and Fawole [2007] also reported knowledge gaps of malaria prevention strategies in pregnancy among healthcare providers studied.

As the Kenya strives to achieve the RBM target of 80% $IPTp_2$ coverage by 2015, there is no doubt that service providers are at the centre of this aspiration, particularly in terms of service quality. The Ministry of Health and various partners, such as Johns Hopkins Programme for International Education in Training and Reproductive Health (JHPIEGO) have been in the frontline with in-service training for IPTp providers. Scaling-up such initiatives in terms of geographical scope and frequency to all providers in public health facilities remains a crucial programmatic intervention that deserves attention not only in Bungoma East District but also in other malaria-endemic regions of the country.

Training on simplified IPTp guidelines should form part of the extended Focused Antenatal Care (FANC) training of service providers to change IPTp delivery practices and ensure a high level of SP efficacy in preventing malaria during pregnancy. Improving providers' knowledge is also likely to enhance IPTp efficacy and ensure effective management of malaria in pregnancy; thus, save the lives of many pregnant women and fetuses. As the national and global health authorities continue revising IPTp policy guidelines, training remains a logical component for effective implementation of such new guidelines; thus, necessitating budgetary considerations by governments and development partners. Training should be go hand-in-hand with regular supervisory visits, monitoring, and evaluation to ensure proper implementation and that health workers translate knowledge into practice. Training should also couple with the dissemination of simplified IPTp guidelines within the framework of FANC.

We also noted significant variation in providers' knowledge of most guidelines across the cadres. More specifically, variation was emerged in terms of definition of IPTp; any three brand names of SP drugs; timing of the first IPTp dose ($IPTp_1$); as well as interval between $IPTp_1$ and $IPTp_2$. Providers' knowledge also varied in terms of whether HIV positive women on cotrimoxazole should be given IPTp; whether IPTp can be given with TT, as well as whether IPTp drugs should be taken at the facility or at home (Table 5).

Furthermore, providers' knowledge of most IPTp guidelines also varied significantly across health facility tiers. More specifically, we noted variation in terms of IPTp definition; any three brand names of SP drugs; timing of the first IPTp dose ($IPTp_1$); and whether women on ARVs should take IPTp. Variation also emerged in terms of whether IPTp can be given together with TT, whether IPTp can be given with folic acid; recommended lapse period between IPTp and folic acid; as well as whether IPTp drugs should be taken at the facility or at home (Table 6).

It needs no emphasis that scaling-up training for providers and dissemination of relevant information countrywide will definitely have significant financial implications, which in turn, may necessitate prioritization in resource-poor contexts. Under such circumstances, lower level cadres such as nurses and CHWs should have greater opportunities for training and access to necessary IPTp information, as the results suggest that clinical officers may be better off in terms of IPTp knowledge. CHWs remain a key link between communities and tier two health facilities, within the Community Health Strategy (CHS) framework. In facilities with serious staff shortage, CHWs play an important role by filling the staffing gap to ensure continuation of services, particularly in hard-to-reach areas.

More still, lower tier facilities, including health centres and dispensaries should have more training and information because the results suggested that the level of IPTp knowledge was higher among providers at the district and sub-district hospitals. Prioritization will ensure investment of the resources in the best way possible to improve providers' knowledge about IPTp and synergize efforts towards realization of the RBM and national $IPTp_2$ coverage targets.

Equally important is that training for service providers should not be a one-time event, rather it should be a regular intermitted process aimed at refreshing experienced providers and orientating rookies. More importantly, continuous training initiatives should be able to take care of natural attrition and skill erosion. This necessitates a sustainable mechanism for resource mobilization at the county level to avoid delays and budgetary deficits, which often characterize resources provided by central governments. In Kenya, health is one of the functions devolved to county governments; hence, County Health Management Teams should set aside adequate resources to ensure that in-service training of health workers, including IPTp providers becomes an intermittent process. This should be coupled with regular supervisory visits to ensure adherence to the IPTp guidelines; as well as removal of other facility level constraints such as stockouts, infrastructural challenges and inadequacy of equipment.

Limitations of the Study

Understaffing is a key challenge in Kenya's public health facilities, which in turn, limited the sample size used in this study. This challenge may have affected the robustness of descriptive results presented in this article. The study focused on the level of providers' knowledge, but did not go to the extent of showing the influence of such knowledge on service delivery practices. Future studies should focus on this area.

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Conflict of Interest

The findings of this study supported ACN to earn a Master of Public Health Degree from Moi University in 2012. ACN involved a colleague, TO for technical support in data processing, quality control, interpretation, and analysis. We declare no conflict of interest.

Authors' Contributions

ACN conceptualized, planned, and implemented the study with the support of University Supervisors, a team of 7 research assistants and a data quality control technical person. ACN and TO processed and analyzed the data, with the guidance of the Supervisors. Both authors participated in the interpretation of results. ACN developed the initial draft manuscript, which TO reviewed, validated interpretations and provided further input. ACN had full access to all the data, mooted the idea of publication, and had the final responsibility to submit the manuscript for publication. Both the authors read and approved the draft manuscript.

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