Intermittent preventive treatment for malaria in infants: a decision-support tool for sub-Saharan Africa

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Objective To develop a decision-support tool to help policy-makers in sub-Saharan Africa assess whether intermittent preventive treatment in infants (IPTi) would be effective for local malaria control.

Methods An algorithm for predicting the effect of IPTi was developed using two approaches. First, study data on the age patterns of clinical cases of *Plasmodium falciparum* malaria, hospital admissions for infection with malaria parasites and malaria-associated death for different levels of malaria transmission intensity and seasonality were used to estimate the percentage of cases of these outcomes that would occur in children aged < 10 years targeted by IPTi. Second, a previously developed stochastic mathematical model of IPTi was used to predict the number of cases likely to be averted by implementing IPTi under different epidemiological conditions. The decision-support tool uses the data from these two approaches that are most relevant to the context specified by the user.

Findings Findings from the two approaches indicated that the percentage of cases targeted by IPTi increases with the severity of the malaria outcome and with transmission intensity. The decision-support tool, available on the Internet, provides estimates of the percentage of malaria-associated deaths, hospitalizations and clinical cases that will be targeted by IPTi in a specified context and of the number of these outcomes that could be averted.

Conclusion The effectiveness of IPTi varies with malaria transmission intensity and seasonality. Deciding where to implement IPTi must take into account the local epidemiology of malaria. The Internet-based decision-support tool described here predicts the likely effectiveness of IPTi under a wide range of epidemiological conditions.

Une traduction en français de ce résumé figure à la fin de l'article. *Al final del artículo se facilita una traducción al español.* الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

Introduction

The burden of severe forms of *Plasmodium falciparum* malaria is concentrated in young children and a recent pooled analysis showed that this is even more pronounced for malaria leading to death than for less severe forms of the disease.[1] The targeted provision of insecticide-treated nets to pregnant women[2] and children under 5 years of age[3] has helped protect those at an increased risk. Measures that target the very young may provide a useful additional strategy for malaria control.

Intermittent preventive treatment involves the administration of a therapeutic dose of an antimalarial drug at predefined times regardless of an individual's infection status. The effect of administering intermittent preventive treatment in infants (IPTi) at the time of routine vaccination delivered through the Expanded Programme on Immunization (EPI) has been evaluated in several randomized controlled trials.[4–10] A pooled analysis of the results of the first six trials of sulphadoxine-pyrimethamine[4–9] showed an overall protective efficacy of 30% (95% confidence interval, CI: 20–39) against clinical malaria, 38% (95% CI: 13–56) against hospital admission for infection with malaria parasites, 23% (95% CI: 10–34) against all-cause hospital admission and 21% (95% CI: 8–33) against anaemia in the first year of life.[11] One trial in an area of very high drug resistance to sulphadoxine–pyrimethamine showed that such treatment had no effect, although the long-acting drug mefloquine had a protective efficacy of 38% against clinical malaria.[10] The strategy of administering IPTi using an efficacious, long-acting antimalarial drug therefore has merit. A recent World Health Organization (WHO) consultation document recommended that IPTi with sulphadoxine–pyrimethamine (IPTi-SP) be considered under certain epidemiological conditions in which the drug combination is effective.[12]

There has been some debate about where IPTi should be introduced because the burden of clinical malaria extends beyond infancy and, in some settings, infection is concentrated in only a few months of the year.[13–15] It is not feasible to carry out large-scale randomized controlled trials to determine the effectiveness of IPTi against severe outcomes in a wide range of different settings. Alternative methods are therefore needed to determine where IPTi is likely to be most beneficial. In this study, we attempted to solve this problem using two approaches: a secondary analysis of existing research data and a stochastic mathematical model.

As the epidemiology of malaria is complex and heterogeneous and even varies over small distances, it is difficult to develop a universal malaria control policy that is appropriate to all situations in a given country. Nevertheless, to simplify logistics, malaria control programme managers plan their activities at a national or subnational level, taking into account local variations in malaria epidemiology where possible.

Here we present evidence from our research into the applicability of IPTi under a range of epidemiological conditions. These findings have been developed as a decision-support tool (available at: http://ipti.lshtm.ac.uk) to help policy-makers decide where to implement IPTi.

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Methods

Age pattern analysis

A pooled analysis of available data on the age pattern of outcomes of *P. falciparum* malaria was undertaken and has been described elsewhere.[1] In brief, a systematic literature review was used to determine the age distribution of patients with clinical malaria, of those admitted to hospital with malaria parasites (i.e. those in whom malaria infection was confirmed after hospital admission for severe symptoms) and of those whose death was diagnosed as due to malaria by verbal autopsy. Data were collected in 21 sub-Saharan African countries from a total of 61 research sites. Each site was categorized as having a low, medium or high intensity of malaria transmission according to whether the entomological inoculation rate (EIR) was < 10, 10–100 or > 100 infective bites per person per year, respectively, as determined from temporally matched and georeferenced data, or whether the georeferenced prevalence of malaria parasites in children aged under 5 years was < 25%, 25–60% or > 60%, respectively. Each site was also categorized according to whether or not malaria transmission was markedly seasonal: the cut-off criterion was that at least 75% of clinical episodes occurred within a period of 6 months or less throughout the year, as previously described.[16] Where local data were unavailable, experts with local knowledge were consulted.

For each study, the age distribution of patients aged 0–10 years with each malaria-related outcome was calculated. Data from sites classified as being in the same intensity and seasonality categories were grouped together to form a 3 × 2 matrix. The five principal and most widely used continuous probability distributions were fitted to the age distributions for each outcome and each of the six malaria transmission categories using maximum likelihood methods. The probability distribution that best fitted the data was taken to represent the age profile of the outcomes, and was presented graphically.[1]

The percentage of cases of each malaria-related outcome in children under 10 years of age (excluding neonates among those whose death was diagnosed as due to malaria) that would be targeted by IPTi was calculated by integrating the area under the probability distribution curve for infants between 3 and 12 months of age. This was done because this age range covers those children who would be most likely to receive IPTi-SP in practice, since, in all the trials, IPTi-SP was administered with the third dose of the diphtheria–tetanus–pertussis combined vaccine (DTP3) and with measles immunization to children approximately 3 and 9 months of age, respectively. The range was extended to 12 months to take into account variations in the actual age at which IPTi-SP was given and because its protective effect has been reported to last 1 to 2 months after each dose.[17,18]

Stochastic model

A stochastic mathematical model was developed to predict the impact of IPTi because research data on some malaria-related outcomes and epidemiological settings were incomplete: in particular, none of the IPTi-SP trials discussed above was powered to detect an effect on mortality, and EPI coverage and health-system functioning were relatively good in the trial settings, but not necessarily elsewhere. Moreover, IPTi may have consequences for the development of immunity over time. The model developed here was used to predict the likely impact of IPTi-SP in different settings up to 10 years after its introduction.

A comprehensive, individual-based, stochastic model of malaria epidemiology had been developed previously.[19] Briefly, malaria-related outcomes in a simulated population are updated in 5-day time steps in a process that takes into account variables representing new infections, parasite density (i.e. the number of parasites per microlitre of blood), acquired immunity to malaria, uncomplicated and severe episodes of malaria, direct and indirect malaria-related mortality and infectivity to mosquitoes (i.e. the likelihood that a mosquito feeding on an infected human will itself become infected). The model also took into account the action of sulphadoxine-pyrimethamine, as determined by Hastings and Watkins,[20] and the final model was validated[21] using the results of the six IPTi-SP trials.[4–9]

The model was used to explore factors that influence the effectiveness of IPTi. Since applying the model required substantial computer processing time, only a limited number of scenarios was modelled for each estimated age pattern. The aim was to predict the number of cases of each malaria-related outcome that could be averted in each scenario for use in an Internet-based decision-support tool. The intensity of malaria transmission explored in the scenarios used EIRs of 1, 10, 100 and 200 infective bites per person per year, and the numbers of cases averted are presented in overlapping ranges for low (EIR = 1–10), medium (EIR = 10–100) and high (EIR = 100–200) transmission intensity. It was assumed that antimalarial drug doses were given with DTP2, DTP3 or measles vaccinations in infants under 12 months of age according to national EPI schedules in countries in sub-Saharan Africa.[22] The following assumptions were made for all settings: 4% of clinical cases[23] and 48% of severe cases[24] (i.e. cases that should be admitted to hospital) were treated effectively in each 5-day interval; the drug combination used was sulphadoxine-pyrimethamine, and the prevalence of the *dhfr* double and triple mutations, which are markers for sulphadoxine-pyrimethamine drug resistance, was low at 10% and 10%, respectively. Since IPTi is expected to have the greatest impact when a long-lasting effective drug is administered,[21] in line with trial findings,[10] model values for treatment effectiveness lay towards the upper bound of what could be expected.

Decision-support tool

An algorithm for predicting the effect of IPTi-SP was developed using the results of the two approaches described above (Fig. 1). First, when using the tool, the country and the first administrative level (i.e. the highest subnational administrative division) are selected from a comprehensive list of all countries in sub-Saharan Africa. The intensity and seasonality of malaria transmission are then categorized using published data, if available. In addition, the user can alter the data presented, thereby enabling the decision-support tool to incorporate alternative or additional information. Next, the IPTi-SP administration schedule is selected from the DTP2, DTP3 and measles infant immunization schedule for the country concerned.[22] Where available, recent national and subnational estimates of the percentage of infants receiving three doses of DTP vaccine[25–27] are presented as a proxy measure of how well the EPI is functioning. Finally, the user enters the expected level of IPTi coverage and the effectiveness of IPTi is estimated as a direct proportion of the effectiveness of 100% coverage.

For the scenario specified by the user, the decision-support tool provides graphical information on the predicted

age distributions of patients with clinical malaria, of those admitted to hospital with malaria parasites and of those who will die due to malaria. In addition, the percentage of cases of each malaria-related outcome in children under the age of 10 years that would be targeted by the IPTi strategy is estimated. Further, the stochastic model produces estimates of the predicted number of cases of each malaria-related outcome that would be averted if IPTi-SP were implemented, while taking into account the expected treatment programme coverage and using the assumptions about health-system coverage, the effectiveness of treatment and the level of drug resistance described above.

Results

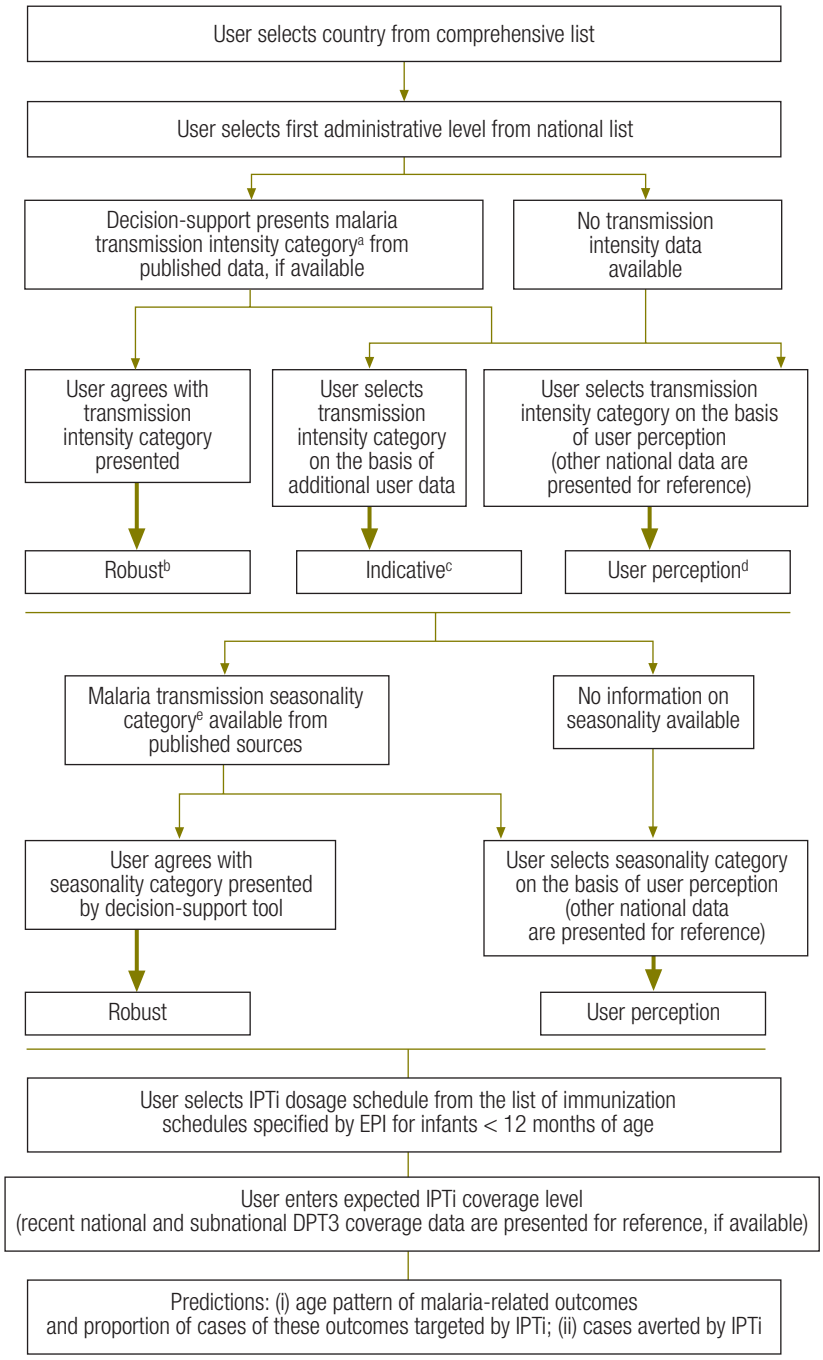
Age pattern analysis

The percentage of cases of malaria-related outcomes occurring in children aged under 10 years that would be targeted by IPTi was estimated from the age patterns of clinical *P. falciparum* malaria cases, of hospital admissions with malaria parasites and of deaths diagnosed as due to malaria observed in sub-Saharan Africa. Episodes of clinical malaria are fairly evenly distributed throughout childhood and IPTi could be expected to target 2–17% of these episodes, depending on the transmission setting. Given the pooled estimate of 30% for the protective efficacy of IPTi-SP against clinical malaria,[11] IPTi-SP could prevent approximately 3–5% of childhood cases of clinical malaria where the intensity of transmission is high (i.e. EIR > 100 infective bites per person per year).

Typically, the age distribution of patients admitted to hospital with malaria parasites is skewed towards younger children and this becomes more pronounced as the intensity of transmission increases. Consequently, IPTi could target 9–29% of these cases, depending on the transmission setting. Given the pooled estimate of 38% for the protective efficacy of IPTi-SP against this outcome,[11] IPTi could prevent 3–11% of admissions with malaria parasites during childhood, depending on the epidemiological setting.

Deaths diagnosed as due to malaria were heavily concentrated in very young children and, although no data were available to predict the age pattern with a low intensity of transmission, there appeared to be a shift towards younger ages as the intensity of transmission increased. Consequently, IPTi could target 17–41% of all childhood deaths diagnosed as due to malaria in settings with a medium-to-high intensity of transmission. To date, the protective efficacy of IPTi against death due to malaria or any other cause is unknown, so we were unable to estimate the percentage of deaths that could be averted by IPTi.

Fig. 1. **Flowchart illustrating the use of a decision-support tool for predicting the effect of intermittent preventive treatment in infants (IPTi) for malaria in different scenarios in sub-Saharan Africa**



DTP3, third dose of diphtheria–tetanus–pertussis combined vaccine; EPI, Expanded Programme on Immunization.
[a] Malaria transmission intensity is categorized as low, medium or high according to whether the entomological inoculation rate is < 10, 10–100 or > 100 infective bites per person per year, respectively.
[b] The selected data are described as "robust" when based on screened epidemiological data.
[c] The selected data are described as "indicative" when based on additional unscreened data provided by the user.
[d] The selected data are described as based on "user perception" if not based on epidemiological data.
[e] Malaria transmission is categorized as seasonal when at least 75% of clinical episodes occur within a period of 6 months or less.

Stochastic model

The results of the stochastic model have been presented in detail elsewhere.[21] The model predicted that the number of episodes of malaria averted by IPTi would increase when IPTi coverage increased, when treatment coverage by the local health system decreased and when drugs that were more effective or had a longer prophylactic period were introduced.[21] In addition, the number of cases averted was higher when IPTi doses were timed so that the prophylactic periods did not overlap. When the model was run to predict the number of cases averted in infants aged under 12 months with the assumptions and conditions described above, the predictions concurred with estimates derived from the analysis of the age distribution of cases reported in studies and indicated that the impact of IPTi would be proportionately greater on more severe outcomes. There was very little impact on the intensity of transmission, suggesting that the age pattern of malaria cases would not change as a direct result of implementing IPTi. Further, IPTi was predicted to have a beneficial effect in all scenarios: 85–1382 cases of clinical malaria could be averted per 1000 infant–years with 100% IPTi coverage, depending on the dosing schedule and the intensity and seasonality of malaria transmission. Correspondingly, 4–61 hospital admissions for infection with malaria parasites and 1–19 deaths in individuals with malaria could be averted per 1000 infant–years with 100% IPTi coverage. The predicted impact of IPTi increased linearly with coverage (data not shown).

Decision-support tool

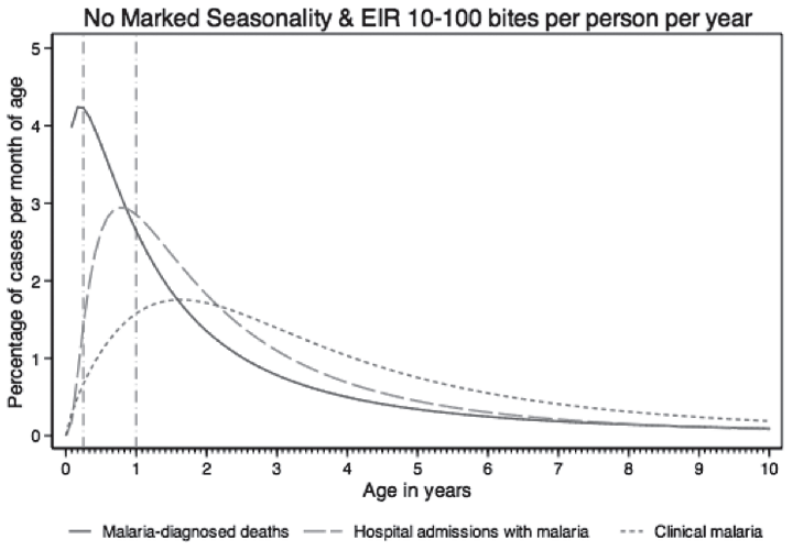
The decision-support tool provides predictions for each specified scenario in two parts. The first is a graph of the expected age pattern of clinical malaria cases, cases admitted to hospital with malaria parasites and deaths diagnosed as due to malaria for the one category of the six intensity and seasonality categories derived from study data, that best matches the specified scenario (Fig. 2). In addition, the percentage of cases of each malaria-related outcome that would be targeted by IPTi is listed. The second part is a table derived by the stochastic model detailing the predicted number of cases of each outcome that could be averted in infants aged under 12 months in the specified scenario, that is, according to the specified epidemiological setting

Fig. 2. **Example of a graph of expected malaria-related outcomes in children produced by a decision-support tool[a] for predicting the effect of intermittent preventive treatment in infants (IPTi) for malaria in different scenarios in sub-Saharan Africa**

Medium intensity (EIR 10–100 bites per person per year) (Robust – based on published EIR data)

No marked seasonality (Robust – based on MARA or published data)

Age pattern of *P. falciparum* malaria outcomes in this transmission setting



(NOTE: the vertical grey lines on the graph indicate the intended target age group of IPTi (3–12 months). The area under each outcome curve that lies between these two lines is the proportion of cases that would be targeted by IPTi)

In a setting with these epidemiological characteristics approximately 9% of clinical cases of malaria, 24% of hospital admissions with malaria and 32% of malaria-diagnosed deaths in under-10s would be targeted by implementation of IPTi [1]. However, it is important to remember that the actual number of cases or deaths that could be prevented depends upon the coverage of the Expanded Programme of Immunisation (EPI) as the delivery strategy for IPTi.

EIR, entomological inoculation rate; MARA, Mapping Malaria Risk in Africa.

[a] Decision-support tool and references presented in this screenshot are available at: http://ipti.lshtm.ac.uk

Fig. 3. **Example of a table produced by a decision-support tool[a] for predicting the effect[b] of intermittent preventive treatment in infants (IPTi) for malaria in different scenarios in sub-Saharan Africa[c]**

Predicted cases averted by IPTi for this transmission category

By introducing 3 doses of IPTi with routine infant vaccinations (at the time of DPT2, DPT3 and measles), the following ranges of cases averted have been estimated over the first 10 years of IPTi implementation [2]:

	Number of cases averted per 1000 infants per year	
	Assuming IPTi coverage of 70% [3]	Assuming IPTi coverage of 100%
Cases of clinical malaria	566 at the lower EIR, 823 at the higher EIR	809 at the lower EIR, 1177 at the higher EIR
Hospital admissions with malaria	27 at the lower EIR, 35 at the higher EIR	39 at the lower EIR, 50 at the higher EIR
Malaria-attributable deaths	7 at the lower EIR, 10 at the higher EIR	10 at the lower EIR, 15 at the higher EIR

Please note that these are not confidence intervals, but represent the range of cases averted for the given range of transmission intensity.

DTP2, second dose of diphtheria–tetanus–pertussis combined vaccine; DTP3, third dose of diphtheria-tetanus-pertussis combined vaccine; EIR, entomological inoculation rate.

[a] Decision-support tool and references presented in this screenshot are available at: http://ipti.lshtm.ac.uk

[b] In terms of the number of cases of malaria-related outcomes in children that could be averted by treatment.

[c] The epidemiological scenario considered corresponds to moderately intense malaria transmission (i.e. an EIR of 10–100 infective bites per person per year) with no marked seasonality of transmission. The lower EIR is 10 infective bites per person per year and the higher EIR is 100 infective bites per person per year.

and IPTi dosing schedule and coverage and using the underlying assumptions described above (Fig. 3).

Discussion

The intensity of transmission is known to influence the age pattern of severe *P. falciparum* malaria cases and there is evidence that it also affects other malaria-related outcomes.[1] In addition, there is increasing evidence that this pattern changes as the intensity of transmission declines,[13,28] though malaria-related deaths still tend to be concentrated in the very young.[29] The changing epidemiology of malaria makes it difficult to predict the potential impact of new control strategies. Moreover, as transmission intensity declines, the heterogeneity of malaria infection is likely to increase and the need for subnational policy-making will grow. The decision-support tool described here is intended to meet that need by enabling malaria control programme managers in sub-Saharan Africa to assess the potential benefits of IPTi under different epidemiological conditions and with varying levels of treatment coverage.

The methodologies used to produce the predicted age pattern of malaria-related outcomes and the predicted number of cases averted have several limitations, which have been discussed separately elsewhere by Carneiro et al.[1] and Ross et al.,[21] respectively.

Predictions for low-transmission settings (i.e. an EIR of 1–10 infective bites per person per year) are particularly uncertain. In this situation, local foci of malaria transmission are common and the overall age distribution of infected individuals depends on whether malaria occurs in small pockets with a high intensity of transmission or more uniformly across the population. In addition, EIR estimates are notoriously imprecise, especially below 5 infective bites per person per year.

Where the intensity of transmission is very high (i.e. an EIR > 200 infective bites per person per year), the stochastic model predicts that the burden of disease averted decreases as the EIR increases. The factors contributing to this unexpected trend are currently being investigated. Possible factors include the relationships between the disease rate and age and the intensity of transmission in the data sets[30,31] initially used in devising the model.[32,33] However, this trend will have little effect on decisions about the effectiveness of IPTi because predicting the impact of treatment at low EIRs is more critical.

The main limitation of the decision-support tool lies in the difficulty in determining the appropriate category for the intensity of transmission in the selected first administrative level in a specific country, since the EIR varies significantly over space and time and few robust data are available for most settings. We also used the parasite prevalence in children, which has a log-linear relationship with the EIR,[34,35] to classify the intensity of transmission. Broad categories for the intensity of transmission were used in both the analyses and the decision-support tool to avoid giving the impression that intensity could be determined precisely for a given site while still allowing some general and consistent patterns to be discerned. Given these caveats, the decision-support tool was designed to be sufficiently flexible to allow the user to incorporate local knowledge or temporal changes by including additional data on the EIR or parasite prevalence or by altering the categories allocated by the tool for the intensity and seasonality of transmission. Work is ongoing on improving the accuracy of the allocated intensities of transmission using parasite prevalence maps from the Malaria Atlas Project.[36,37] Another limitation is that the model predictions took into account only a selected number of input variables for each setting. Variations in factors such as the level of drug resistance and health system coverage will also have an influence. Future development of the decision-support tool will enable users to alter the prevalence of drug resistance and local health system costs.

Although none of the trials on the administration of chemoprophylaxis to infants[38–42] and none of the IPTi trials were powered to detect an effect on mortality in infants, one chemoprophylaxis trial in the Gambia reported a statistically significant reduction in mortality in children with malaria aged 1–4 years ($P = 0.03$).[38] Our stochastic model predicted that 1 to 19 deaths associated with malaria could be averted per 1000 infant-years over a range of different epidemiological settings under the conditions defined above and given 100% coverage with IPTi. The higher figure in the range is indicative and will be affected by changes in IPTi coverage, dosing schedule, health system coverage and the level of drug resistance but is likely to represent the upper bound of what could be expected. It is difficult to compare this estimate of deaths averted with estimates of the deaths linked to other interventions as different age groups and denominators are often used. However, the number of infant deaths due to acute lower respiratory infection averted by pneumonia case management has been estimated to be 10.7 per 1000 live births per year,[43] and the number of all-cause child deaths averted by the use of insecticide-treated bednets, at 5.5 per 1000 protected children aged under 5 years per year.[44]

The number of indirect deaths and, to a lesser extent, the number of severe malaria episodes predicted by the model partly rely on functions that represent the age-dependent risk of comorbid conditions. Comorbidity is assumed to weaken the host so that clinical malaria becomes severe. In the model, an indirect death was defined as a death that would not have occurred in the absence of prior malaria exposure but that was associated with a terminal illness which would not have been diagnosed as malaria by a competent physician.[32] In settings where health-care provision is good, the pattern of comorbid conditions may be quite different from that assumed in our model.

Both the percentage and number of cases that could be averted by IPTi estimated by the model will be lower than comparable estimates for similar interventions that target children over a wider age range. The strategy of seasonally administering intermittent preventive treatment in children aged under 5 years (IPTc) provides almost continuous chemoprophylaxis during the period of peak transmission and has proven highly effective against clinical malaria.[45–48] However, the main concern with IPTc, and with any extension of IPTi beyond infancy, is the logistical complexity of delivering treatment in a sustainable and cost-effective manner. Studies of the efficacy of IPTc indicate that the cost would be considerably higher than for IPTi, which can take advantage of the health-care infrastructure that already exists for EPI and hence be a highly cost-effective addition to existing malaria control interventions.[49] It is unclear whether IPTi and IPTc must be mutually exclusive or whether they can be complementary in

areas with highly, but not exclusively, seasonal transmission.

Recently, there has been a move away from targeting specific age groups towards universal coverage for malaria interventions.[50] While our data support this trend for areas where the intensity of transmission is low, there is clearly still a role for targeting infants using interventions that can reduce the number of malaria-associated deaths. Consequently, IPTi may still form a highly cost-effective component of malaria control strategies in large swathes of Africa where access to curative services is poor at present and will remain so for years to come. ■

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الملخص

المعالجة الوقائية المتقطعة للملاريا عند الأطفال: أداة لدعم القرار في البلدان الواقعة جنوب الصحراء الأفريقية

الهدف إعداد أداة لدعم القرار لمساعدة أصحاب القرار السياسي في البلدان الواقعة جنوب الصحراء الأفريقية على تقييم ما إذا كانت المعالجة الوقائية المتقطعة للملاريا عند الأطفال ستكون فعَّالة في مكافحة الملاريا على الصعيد المحلي.

الطريقة أعدّ الباحثون خوارزمية للتنبؤ بتأثير المعالجة الوقائية المتقطعة للملاريا عند الأطفال باستخدام أسلوبين؛ في الأسلوب الأول تدرس المعطيات حول أنماط العمر للحالات السريرية للملاريا الناجمة عن المتصورة المنجلية، وحالات الإدخال في المستشفى بسبب العدوى بطفيليات الملاريا والوفيات المصاحبة للملاريا، وذلك في المستويات المختلفة لسراية الملاريا من حيث الكثافة والتوزُّع الفصلي (الموسمي)، واستخدمت هذه المعطيات للحصول على تقديرات للنسبة المئوية للحالات التي انتهت بهذه الحصائل والتي ستحدث في الأطفال لعمر دون عشر سنوات ممن استهدفوا بالمعالجة الوقائية المتقطعة للملاريا عند الأطفال. أما الأسلوب الثاني فهو استخدام نموذج رياضي للتغيُّر العشوائي أعد سابقاً للمعالجة الوقائية المتقطعة للملاريا عند الأطفال، بُغْيَة التنبؤ بعدد الحالات التي يحتمل تفاديها عند تنفيذ المعالجة الوقائية المتقطعة للملاريا عند الأطفال تحت ظروف وبائية مختلفة. وتستخدم أداة دعم القرار المعطيات المستمدة من الأسلوبين السابقين، والتي تكون أكثر ملاءمة للسياق الخاص بالمستخدم.

الموجودات أشارت الموجودات التي أسفر عنها الأسلوبان أن النسبة المئوية للحالات المستهدفة بالمعالجة الوقائية المتقطعة للملاريا عند الأطفال قد زادت مع وخامة الحصائل التي نتجت عن الملاريا، ومع كثافة السراية. وتـتوافر أداة دعم القرار هذه على الإنترنت، وتقدم تقديرات للنسبة المئوية للوفيات المصاحبة للملاريا، ولحالات الإدخـال للمستشفيات وللحالات السريرية التي ستستهدف بالمعالجة الوقائية المتقطعة للملاريا عند الأطفال في سياق معين، وعدد هذه الحصائل التي يمكن تفاديها.

الاستنتاج تختلف مدى فعالية المعالجة الوقائية المتقطعة للملاريا عند الأطفال باختلاف كثافة سارية الملاريا والتوزُّع الفصلي (الموسمي) لها. وينبغي أن يأخذ القرار بتنفيذ المعالجة الوقائية المتقطعة للملاريا عند الأطفال بالحسبان السمات الوبائية المحلية للملاريا. وتعطي الأداة المتوافرة على الإنترنت لدعم القرار حول ذلك والتي تصفها هذه المقالة تنبؤاً باحتمال فعالية المعالجة الوقائية المتقطعة للملاريا عند الأطفال ضمن طيف واسع من الظروف الوبائية.

Résumé

Traitements préventifs intermittents de la malaria pour les nourrissons: un outil d'aide à la prise de décision pour l'Afrique subsaharienne

Objectif Développer un outil d'aide à la prise de décision pour aider les responsables politiques en Afrique subsaharienne à évaluer si un traitement préventif intermittent des nourrissons (IPTi) serait efficace pour contrôler la malaria.

Méthodes Un algorithme pour prédire l'effet de l'IPTi a été développé au moyen de deux approches. D'abord, des données d'étude sur les profils d'âge de cas cliniques de malaria causée par le *Plasmodium falciparum*, les admissions en hôpital pour infection aux parasites de la malaria et les décès associés aux différents niveaux d'intensité de transmission de la malaria et son caractère saisonnier, ont été utilisées pour évaluer le pourcentage de cas de ces résultats qui se produisent chez des enfants de moins de 10 ans visés par l'IPTi. Ensuite, un modèle mathématique stochastique, développé avant l'IPTi, a été utilisé pour prévoir le nombre de cas pouvant être évités en appliquant l'IPTi sous différentes conditions épidémiologiques. L'outil d'aide à la prise de décision utilise les données les plus pertinentes des deux approches dans le contexte spécifié par l'utilisateur.

Résultats Les résultats des deux approches indiquent que le pourcentage de cas visés par l'IPTi augmente avec la sévérité des résultats de la malaria et avec l'intensité de la transmission. L'outil d'aide à la prise de

décision, disponible sur Internet, fournit des évaluations du pourcentage de décès, d'hospitalisations et de cas cliniques associés à la malaria, qui seront visés par l'IPTi dans un contexte spécifié et du nombre de cas qui pourraient être évités.

Conclusion L'efficacité de l'IPTi varie avec l'intensité de la transmission de la malaria et son caractère saisonnier. Pour décider où appliquer l'IPTi, on doit prendre en considération l'épidémiologie locale de la malaria. L'outil d'aide à la prise de décision sur Internet ici décrit l'efficacité possible de l'IPTi avec une large gamme de conditions épidémiologiques.

Resumen

Tratamiento preventivo intermitente de la malaria en lactantes: una herramienta de apoyo a las decisiones para el África subsahariana

Objetivo Desarrollar una herramienta de apoyo a las decisiones para ayudar a los encargados de la formulación de políticas en el África subsahariana a evaluar si el tratamiento preventivo intermitente en lactantes (TPIL) sería eficaz en el control local de la malaria.

Métodos Se creó un algoritmo para pronosticar el efecto del TPIL utilizando dos métodos. En primer lugar, se utilizaron datos del estudio relativos a patrones de edad de los casos clínicos de malaria por *Plasmodium falciparum*, ingresos hospitalarios por infección con parásitos causantes de la malaria y fallecimientos asociados a malaria para distintos grados de intensidad y estacionalidad de la transmisión de la malaria, con el fin de calcular el porcentaje de casos con estos desenlaces que se producirían en niños <10 años que serían objeto del TPIL. En segundo, lugar, se utilizó un modelo matemático estocástico desarrollado previamente para pronosticar el número de casos que sería probable que se evitaran mediante la implementación del TPIL en distintas condiciones epidemiológicas. Esta herramienta de apoyo a las decisiones utiliza los datos obtenidos con estos dos métodos que sean más pertinentes para el contexto especificado por el usuario.

Resultados Los resultados obtenidos con estos dos métodos indicaron que el porcentaje de casos objeto del TPIL aumenta al hacerlo la gravedad del desenlace de la malaria y la intensidad de la transmisión. La herramienta de apoyo a las decisiones, disponible en Internet, proporciona estimaciones del porcentaje de fallecimientos, hospitalizaciones y casos clínicos asociados a la malaria que serán objeto del TPIL en un contexto determinado, así como de la cantidad de estos desenlaces que se podría haber evitado.

Conclusión La eficacia del TPIL varía en función de la intensidad y la estacionalidad de la transmisión de la malaria. A la hora de decidir dónde implementar el TPIL habrá que tener en cuenta la epidemiología local de la malaria. La herramienta de apoyo a las decisiones disponible en Internet y descrita en este trabajo pronostica la eficacia probable del TPIL en una gran variedad de condiciones epidemiológicas.

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