Interventions, surveillance and monitoring of malaria in pregnancy in rural southern Malawi

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Integrated sentinel surveillance of malaria, lymphatic filariasis and neglected tropical diseases in rural southern Malawi

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Abstract

Background: Malaria and lymphatic filariasis (LF) are global priority diseases because of their significant morbidity and mortality. These diseases share vectors presenting an opportunity for integration and co-implementation of effective vector control interventions.

Objective: To establish baseline database for integrated surveillance and monitoring of malaria and LF control in southern Malawi.

Methods: In preparation for the first mass drug administration for the LF elimination programme, a baseline survey was conducted in six sentinel sites in the southern Malawi, amongst adult participants and children aged over five years. A questionnaire was used to obtain data on socio-demographic factors, ownership and use of bed nets and previous ingestion of Ivermectin. Finger prick blood samples were collected between 22:00 hours to 01:00 hours for LF microscopy, malaria smears and haemoglobin estimation. Stool and urine samples were collected for examination of soil transmitted helminths and schistosomiasis.

Results: A total of 1,903 participants were enrolled. Bed net use was lower than ownership (17.4% vs 23.1%) and in some districts less than half of the nets were used. Prevalence of malaria parasitaemia, microfilaraemia, soil transmitted helminths and urinary schistosomiasis were lower than previously reported in the same area. This could be explained by improved ITN coverage and the on going mass drug administration programme for onchocerciasis. Anaemia prevalence was high (19.2%). Promotion of bed net use and interventions aimed at improving nutrition could maximise the benefits of ITN coverage on both malaria and LF in these sentinel sites.

Key words: malaria, lymphatic filariasis, neglected tropical diseases integration, co-implementation, Malawi
Introduction

Malaria lymphatic filariasis co-endemicity

Malaria and lymphatic filariasis (LF) are two of the most common mosquito-borne parasitic diseases worldwide [1-2]. These two diseases are co-endemic in 83 tropical countries with more than 1.2 billion people at risk of infection [3]. Lymphatic filariasis is the second commonest cause of long-term disability after mental illness [2, 3]. One hundred and twenty million people are affected by LF worldwide of whom about 40 million are incapacitated and disfigured by the disease [4]. The common manifestations of LF are hydrocele, lymphoedema and elephantiasis. Globally, malaria causes 300-500 million cases of illness and 1-3 million deaths annually and is a leading cause of morbidity and mortality, especially among the pregnant women and children under the age of five years [5]. Africa accounts for 33% and 90% of the global burden of LF and malaria respectively [5-6].

Malaria lymphatic filariasis co-transmission

In Africa, more than 90% of LF and malaria cases are caused by *Wuchereria bancrofti* and *Plasmodium falciparum* respectively. The remaining 10% is caused by *Brugia malayi* and *Brugia timori* or *Plasmodium malariae*, *ovale*, and *vivax* [7]. The major *Anopheles* species that transmit malaria are also important vectors of LF. The actual *Anopheles* species involved in transmission of the two parasites vary with geographical regions. In most sub-Saharan Africa, *Anopheles funestus* and members of the *Anopheles gambiae* complex are involved in transmission of malaria and Bancroftian filariasis. Lymphatic filariasis is also transmitted by *Culex* mosquitoes [8-10].

Malaria lymphatic filariasis elimination and eradication

Malaria and LF are global priority diseases because of their significant morbidity and mortality. The World Health Organization has established two global initiatives, one to reduce, sustain control and eliminate malaria and the other for LF elimination. These are the Roll Back Malaria (RBM) Programme and the Global Programme to Eliminate Lymphatic Filariasis (GPELF). Malaria elimination means reducing the burden to the level where it is no longer a public health problem (less than 1 malaria case per 1000 population). Roll Back Malaria is aiming to reduce and sustain control by 2015, and achieve elimination by 2025 through the universal coverage of prompt effective case management, intermittent preventive treatment with sulfadoxine-pyrimethamine during pregnancy (IPTp-SP) and effective vector control methods such as insecticide treated bed nets (ITNs) and/or indoor residual spray (IRS) [11-12].

The Global Programme to Eliminate Lymphatic Filariasis aims to eliminate LF (reducing the incidence to less than 1%) by 2020 through the interruption of transmission using mass drug administration (MDA) and caring for those who already have the disease. LF is one of the diseases considered ‘eradicable’ by WHO. Since 1997, the GPELF Programme has been directed to all persons living in at-risk communities by providing once annual oral treatment, using a two drug combination, either Albendazole and Ivermectin, or Albendazole and Diethylcarbamazine (DEC) for the elimination of microfilariae (mf) in the blood and disruption of adult female reproductive capacity [6, 13].
The need for integrated surveillance monitoring and evaluation for malaria and lymphatic filariasis

Sharing of vectors and lack of epidemiologically significant non-human reservoir hosts presents an opportunity for integration and co-implementation of interventions for the control of malaria and LF. Although not a currently recommended strategy, the indoor residual spraying intended for malaria control led to LF elimination in the Solomon Islands and some parts of Papua New Guinea [8]. The effect of (ITNs) on the reduction of LF transmission has also been reported [14-15]. In fact ITNs or long lasting nets (LLNs) may have a greater impact on LF than malaria because transmission of LF is very inefficient. There is no parasite multiplication in the vector, and only continuous exposure to infected mosquitoes can produce a patent infection of *W. bancrofti* [16]. Cost-effectiveness of integration and co-implementation of malaria, LF and other neglected tropical diseases (NTDs) has been reported [17-18].

Integrated surveillance, monitoring and evaluation of malaria, LF and other NTDs has been reported [17-18]. Integrated surveillance, monitoring and evaluation of malaria, LF and other NTDs is even more important now as we move toward elimination of these diseases through universal coverage. Universal coverage of ITNs will be beneficial to both malaria and LF and it is therefore recommended to have baseline data for monitoring and evaluation.

In Malawi, malaria is co-endemic with LF, soil transmitted helminths and schistosomiasis in all the 28 districts and onchocerciasis in six districts [19-26]. Based on the findings of LF mapping, Malawi qualified for free donation of Mectizan® (Ivermectin) and Albendazole from Merck & Co and Glaxo SmithKline (GSK) respectively through the Global Programme to Eliminate Lymphatic filariasis. The Action Plan for elimination of LF was integrated with control of onchocerciasis, schistosomiasis, soil transmitted helminths and malaria. In the first year (2008), integrated malaria and NTD control started in the onchocerciasis endemic districts in order to build on a community based drug distribution system which had been operational for over a decade (since 1997).

The aim of the present survey was to obtain baseline data on ITN ownership and use, prevalence of microfilaria, schistosomiasis, soil transmitted helminths, anaemia and malaria parasitaemia. The survey was conducted in August 2008.

**Materials and Methods**

**Recruitment of participants**

Six sentinel sites were selected in the six onchocerciasis endemic districts in the southern region using WHO guidelines [27]. Adults and children aged over five years were eligible. Recruitment was conducted from 18:00 hours following obtaining informed written consent. Data on socio-demographic features, cultural perceptions of lymphatic filariasis, and ITN ownership and use were collected. A finger prick blood sample for microfilaria was collected between 22.00 hours and 01.00 hours from all the consenting participants (adults and children). In the high risk group; children aged 5 to 14 years of age, in addition to LF microscopy, finger prick blood samples for malaria and haemoglobin, urine for schistosomiasis and stool for soil transmitted helminths examination were collected.

**Laboratory tests**

Blood samples for LF examination were collected into heparinised tubes by trained technicians and transported for processing at the Queen Elizabeth Central Hospital, Blantyre, or the Community Health Services Unit, Lilongwe where counting a
Sedgewick counting chamber method was used. Haemoglobin was measured by HemoCue® (Hb 201+ Angelholm Sweden). Malaria thick smear slides were prepared with Field’s stain A and B and air dried. Urine was centrifuged and examined for schistosoma ova. Wet stool preparation was examined for intestinal helminths.

**Definitions**
A malaria smear was considered negative if no asexual parasites were observed in 100 fields examined. Anaemia was defined as haemoglobin <11.0g/dl.

**Data management**
Data was entered in Microsoft excel®, Epi-Info 2004 (Centres for Disease Control and Prevention, Atlanta, Ga) and SPSS (Chicago IL) was used for data analysis.

**Ethical considerations**
Ethical clearance was granted by the National Health Sciences Research and Ethics Committee.

**Results**

**Characteristics of participants enrolled in the study**
A total of 1, 903 participants were enrolled with sample sizes in sentinel sites between 126 to 477. The proportion of males and females were similar. Ownership of any mosquito net (treated or untreated) was 23.1% (range 10.9% to 37.3%), ITN 19.3% (range 9.2% to 29.3%). Use of ITN was 17.4% (range 8.2% to 29.2%). In Blantyre district, less than half of the people who owned a bed net (any net) used them on the night prior to the survey while in Chikwawa, of those who had bednet almost all used their nets on the night before the survey (table 1).

**Table 1: Prevalence characteristics of participants in the integrated sentinel surveillance baseline survey**

<table>
<thead>
<tr>
<th>District</th>
<th>Number enrolled</th>
<th>Male</th>
<th>Female</th>
<th>Age 5-14 years</th>
<th>Age ≥15 years</th>
<th>Any net ownership</th>
<th>ITN ownership</th>
<th>Net use previous night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blantyre</td>
<td>126</td>
<td>60.3</td>
<td>39.7</td>
<td>43.0</td>
<td>57.0</td>
<td>37.3</td>
<td>29.3</td>
<td>18.4</td>
</tr>
<tr>
<td>Chikwawa</td>
<td>305</td>
<td>50.3</td>
<td>49.4</td>
<td>64.2</td>
<td>35.8</td>
<td>30.8</td>
<td>29.9</td>
<td>29.2</td>
</tr>
<tr>
<td>Chiradzulu</td>
<td>428</td>
<td>43.5</td>
<td>56.5</td>
<td>50.3</td>
<td>49.7</td>
<td>21.0</td>
<td>17.5</td>
<td>14.7</td>
</tr>
<tr>
<td>Mwanza</td>
<td>303</td>
<td>44.6</td>
<td>55.4</td>
<td>43.4</td>
<td>56.4</td>
<td>34.0</td>
<td>25.1</td>
<td>23.8</td>
</tr>
<tr>
<td>Phalombe</td>
<td>264</td>
<td>48.9</td>
<td>51.1</td>
<td>49.2</td>
<td>50.8</td>
<td>20.4</td>
<td>18.8</td>
<td>16.2</td>
</tr>
<tr>
<td>Thyolo</td>
<td>477</td>
<td>46.8</td>
<td>53.2</td>
<td>46.7</td>
<td>53.3</td>
<td>10.9</td>
<td>9.2</td>
<td>8.2</td>
</tr>
<tr>
<td>All</td>
<td>1903</td>
<td>47.5</td>
<td>52.5</td>
<td>49.7</td>
<td>50.3</td>
<td>23.1</td>
<td>19.3</td>
<td>17.4</td>
</tr>
</tbody>
</table>

Key: ITN= insecticide treated net.
Prevalence of malaria and lymphatic filariasis parasitaemia, urinary schistosomiasis and soil transmitted helminths

Table 2 summarises the prevalence of malaria, LF and NTDs. Parasitaemia prevalence of malaria was 8.0% (range 0%- 19.5%), LF 1.5% (range 1.0%- 2.1%). Prevalence of urinary schistosomiasis was 11.0% (range 0.8%- 94.9%), soil transmitted helminths 2.5% (range 0% - 5.2%) and anaemia (Hb<11.0g/dl) 19.2% (range 6.4% - 37.7%).

Knowledge, attitude and perceptions on lymphatic filariasis

Hydrocele had many different local names and these varied from one district to another. Some of the local names were: Mwera (named after Mwera (southern) winds, the perceived cause or mode of spread of the disease), phudzi, kagundu, ufumu (named after chief-like respect accorded to the person with the disease), kapembwe (yao) and tchofu (named after yellow-like fluid thought to be contained in the hydrocele). Of these Mwera, phudzi and kagundu were relatively commonly mentioned in these districts. Lymphoedema had two local names; mtchetcha and matchinjiri with mtchetcha being commonly mentioned.

Knowledge on the cause of hydrocele and lymphoedema was low in all the sentinel sites (16%-42%, 10%-24% respectively). Sexual intercourse with a menstruating woman, bad weather and HIV/AIDS were the common perceived causes of hydrocele.
Table 2: Prevalence of malaria and lymphatic filariasis parasitaemia, urinary schistosomiasis, soil transmitted helminths and anaemia

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blantyre</td>
<td>Masanjala</td>
<td>41</td>
<td>19.5</td>
<td>126</td>
<td>1.6</td>
<td>14</td>
<td>28.6</td>
<td>14</td>
<td>0.0</td>
</tr>
<tr>
<td>Chikwawa</td>
<td>Siseu</td>
<td>181</td>
<td>9.4</td>
<td>342</td>
<td>2.1</td>
<td>140</td>
<td>5.7</td>
<td>89</td>
<td>2.3</td>
</tr>
<tr>
<td>Chiradzulu</td>
<td>Mbalame</td>
<td>200</td>
<td>4.5</td>
<td>391</td>
<td>1.3</td>
<td>178</td>
<td>5.6</td>
<td>97</td>
<td>5.2</td>
</tr>
<tr>
<td>Mwanza</td>
<td>Silota</td>
<td>128</td>
<td>11.7</td>
<td>301</td>
<td>1.0</td>
<td>128</td>
<td>0.8</td>
<td>128</td>
<td>0.0</td>
</tr>
<tr>
<td>Phalombe</td>
<td>Maguda</td>
<td>224</td>
<td>13.0</td>
<td>263</td>
<td>1.5</td>
<td>39</td>
<td>9.4</td>
<td>54</td>
<td>7.4</td>
</tr>
<tr>
<td>Thyolo</td>
<td>Mkaombe</td>
<td>202</td>
<td>0.0</td>
<td>231</td>
<td>1.7</td>
<td>55</td>
<td>1.8</td>
<td>57</td>
<td>0.0</td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>976</td>
<td>8.0</td>
<td>1654</td>
<td>1.5</td>
<td>554</td>
<td>11.0</td>
<td>439</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Brackets: percentage
Discussion
From this study a database for integrated sentinel surveillance, monitoring and evaluation of malaria, LF and other NTDs was established and discrepancies between bed net ownership and use, bed net coverage between districts were highlighted. Bed net coverage could not be considered representative of Districts as only one site per District was studied as per WHO guidelines (one site per 500,000 population, rural/hard to reach area) [27].

In Thyolo sentinel site, only 11% of the participants owned a bed net while in the Blantyre site at least one in three had a net (37%). Thyolo is in a remote rural area which is hard to reach while the site in Blantyre was rural but situated along the main road. The low net ownership in Thyolo may suggest that within the district and between districts there could be an inequality and inequity in bed net coverage. The inequalities and inequities in accessing malaria control interventions between urban and rural, the poor, and more hard to reach or accessible areas have been reported [28-31].

In the Blantyre sentinel site less than half of participants who owned a bed net slept under one during the preceding night (ownership 37.3%, use 18.4%). Malaria programmes have focussed on universal ITN coverage, yet it is essential to consider use and non-use. Factors influencing use and non-use of bednets may be socio-economic and culturally related and therefore need to be considered in the local setting and specific promotional interventions should be accordingly designed [32-33]. Climatic factors such as hot dry weather could be influential, yet may not be generalised as one of the factors necessarily influencing non-use as the discrepancy between ownership and use was lowest in Chikwawa District which was the hottest area.

Prevalence of malaria parasitaemia was uniformly low except for Blantyre (19.5%), which is consistent with the discrepancy between bed net ownership and use in that location. Low and decreasing malaria parasitaemia prevalence in this area has been reported in a longitudinal study of pregnant women [34] and was observed in the community study of IPTp-SP distribution reported in this thesis [35]. Adolescent girls (age 10 to 19 years) from Chikwawa District during the 2005-2006 were reported to experience 3.4% and 5.7% parasitaemia prevalence in the dry and wet seasons [36], also reflecting low prevalence. Improved ITN uptake and use, and IPTp-SP coverage have been considered as contributing factors to reducing exposure [34].

Prevalence of schistosomiasis, soil transmitted helminths and anaemia was variable with prevalence for schistosomiasis ranging from 0.8% in Mwanza to 94.9% in Phalombe District, anaemia (Hb<11.0gl/dl) 6.4% in Chiradzulu to 37.7% in Chikwawa. The sentinel site in Phalombe was along Lake Chilwa (the second largest lake in Malawi) where schistosomiasis prevalence of over 90% among school going children (age 5 to 14 years) previously has been reported [23-24, 37]. The present findings therefore indicated that prevalence of schistosomiasis among school going children along Lake Chilwa was still unacceptably high and urgent action was needed in implementing the WHO recommended strategies of mass drug administration and health promotion.

Prevalence of soil transmitted helminths was low, less than 10% in all the districts and this was consistent with findings from other studies [26]. In this study, the diagnostic method used of wet stool preparation is known to have a relatively low sensitivity and
this could influence the results. In addition, it is likely that the more difficult to diagnose intestinal helminths such as strongyloides and giardiasis were missed by the method. This was a limitation of this study.

In Chikwawa district, nutritional deficiencies (iron and vitamin A) are important risk factors for anaemia in this area [38] and are likely to be present in all areas.

Lymphatic filariasis microfilaria (mf) prevalence of 1% or more in a population indicates that the disease in a public health problem and implementation of elimination strategies are required [13, 27]. The prevalence of mf was 1.5% (1.0% to 2.1%) confirmed that LF was endemic in these Districts, although estimates were lower than previously reported [19]. In the present study, a counting chamber microscopy method was used whereas in the previous study [19] a rapid diagnostic test-immunochromatographic card tests (ICT) test was used. This methodological difference and continued use of Ivermectin for onchocerciasis control could explain the lower prevalence estimates.

Unlike malaria, hydrocele and lymphoedema had no common local names. Hydrocele had six different local names and was called differently from one sentinel site to another. Lymphoedema had two local names. Overall, only 21% and 18% of the participants had knowledge of hydrocele and lymphoedema respectively and misconceptions on the cause and/or transmission of the two conditions were common. Misconceptions, lack of knowledge and specific local names could pose a challenge in community mobilisation and have been reported to be important factors for poor compliance for integrated malaria LF control activities [39-40].

Integrated sentinel surveillance, and monitoring of use and non-use of vector control interventions are essential components for monitoring and evaluation of parasitic disease control activities. WHO recommends that evaluation of integrated vector control and preventive chemotherapy be conducted before 1st, 3rd, 5th mass drug administration (MDA) for LF then, if necessary, before 7th and 9th round until criteria for stopping MDA is met (microfilaria prevalence of less 1% by both microscopy and rapid test in children 2-4 years born after the commencement of the programme) [27]. The inequality of bed net coverage within and between districts, discrepancy between bed net ownership and use, the high prevalence of schistosomiasis in Phalombe and anaemia in Chikwawa, the heterogeneity of malaria and LF parasitaemia prevalence, and the level of community knowledge, attitude and perceptions on LF demonstrated in present study are important findings relevant to assessing programme performance.

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References