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Know your enemy

Some facts about the natural history of Malawi's *Anopheles* mosquitoes and implications for malaria control

D Chavasse

In this article I examine the relevance of environmental control techniques in Malawi in the context of what we know about breeding, resting and feeding habits of the common *Anopheles* species. I hope that this article may help to put to rest some common misconceptions concerning *Anopheles* control as a malaria prevention strategy.

The common types of mosquito in Malawi

There are three main types (or genera) of mosquito in Malawi which bite people. *Anopheles* mosquitoes transmit malaria. They bite late at night (between 10 pm and 4 am) and are most abundant in rural areas. *Culex* mosquitoes are not of major public health significance in Malawi, although they may be involved in transmission of *Wuchereria bancrofti* which causes elephantiasis. They bite in the evening and during the night and are most common in urban areas. *Culex* accounts for more than 90% of all mosquito bites in urban areas. *Aedes* are the least common type of man-biting mosquito and bite during the day and evening. *Aedes* can transmit yellow fever and dengue fever but since these diseases are not common in Malawi they are of no major public health significance here. *Aedes* can be easily recognised by their black and white striped legs.

Anopheles species in Malawi

The principal malaria vectors in Malawi are *Anopheles gambiae* ss., *An. arabiensis* and *Anopheles funestus*. These species are found throughout sub-Saharan Africa and we therefore know a lot about them not just from studies in Malawi but from many other countries in the region.

Mosquito breeding habits

Anopheles mosquitoes breed only in clean, sunlit water which is not organically polluted with faeces, rotting vegetation, garbage etc. They also like to breed in small natural (as opposed to man made) breeding sites. Common breeding sites include animal footprints, small areas of flooded grass, wet rice fields, borrow pits. Since almost all water in the immediate vicinity of human dwellings is polluted, *Anopheles* does not generally breed in this peri-domestic environment. For this reason cleaning or draining puddles around the house has no impact at all on *Anopheles*

density or malaria. Because *Anopheles* needs clean water to breed in, their density is very low in urban areas and very high in rural areas. It is for this reason that malaria transmission is so much higher in rural areas compared to urban areas. Also, because *Anopheles* can breed in tiny amounts of water, as small as an animal's hoof print, it is generally impossible to control them in rural areas through destruction of breeding sites since the sites are simply too many and too dispersed. In some specific circumstances in urban areas where *Anopheles* breeding is restricted to a few small areas of urban cultivation (i.e. where surface water is not polluted) it may be feasible to reduce *Anopheles* density through destroying breeding sites or chemical larval control.

Unlike *Anopheles*, *Culex* loves organically polluted water. The preferred breeding sites include flooded pit latrines, septic tanks, soak-aways and blocked drains. Because there is so much polluted water in urban areas, *Culex* densities are correspondingly very high and *Anopheles* densities very low. Next time you are eaten alive on your "khonde" in Blantyre or Lilongwe at sundown, remember to blame *Culex* and not *Anopheles*.

Aedes mosquitoes are different again in their breeding site preference. They love to breed in the peri-domestic environment but not in large dirty puddles outside the house. They like a mixture of small natural and man-made sites. Natural sites include small amounts of water which collect in certain types of plant, including maize, and man made sites include discarded tyres, tins, jars, scrap metal containers and anything else that will hold a small amount of water.

Mosquito resting habits

To understand mosquito resting behaviour and its significance for control, it is necessary first to understand the stages of the life cycle during which resting takes place. After hatching from the pupa a newly emerged female will mate and almost immediately seek a blood meal. *Anopheles* will travel several kilometres, if need be, (though usually much less) to find a person to bite. *Aedes* and *Culex* tend to breed so close to human dwellings that they never have to fly more than a few hundred meters during their life. After feeding, the mosquitoes need to rest for about 3 days while the blood is digested and the eggs develop. When the eggs are matured they are laid in a suitable breeding site and the female will immediately seek another blood meal. Hence most mosquito resting time is after, not before, a blood meal. All three types of mosquito prefer to rest inside houses whilst their eggs develop. They seek out a quiet secluded place in the house (e.g. in the thatch, behind a curtain etc.) and wait until their eggs are mature. It is because *Anopheles* mosquitoes spend so much time resting in houses that indoor house spraying is one method used to control malaria vectors. However, promoting the cutting of grass and vegetation around the house, as a malaria intervention, is clearly not appropriate since *Anopheles* does not spend significant time resting in such areas and they can fly several kilometres to seek a blood meal. For how far should the grass be cut, several kilometres?

Summary

A knowledge of the biology of *Anopheles* helps us make rationale decisions about vector control through environmental modifications. Some rules of thumb for the entire sub-Saharan region are included below.

- Larval control of *Anopheles* is almost never feasible in rural areas and is only appropriate in select urban situations where

breeding sites are few and easily destroyed. Mobilising communities to clean up their compounds may be justified on public health grounds BUT not specifically for malaria control.

- The cutting of vegetation around houses has no impact on malaria and there is published evidence dating back over years (Ribbands, 1946) to support this. Once again, some may feel that there is public health justification for promoting this behaviour to communities (e.g. reduce the proximity of snakes to houses) but it is important to understand that malaria transmission will remain entirely unaffected by such behaviour.

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Availability and use of sulphadoxine-pyrimethamine (SP) in pregnancy in Blantyre District

A Safe Motherhood and BIMI Joint Survey

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Introduction

In Africa over 24 million pregnancies every year are affected by malaria, with less than 5% of pregnant women able to access treatment or effective interventions (USAID). The Malawi National Malaria Control Programme established by the Ministry of Health and Population (MOHP) implemented a policy that all pregnant women should receive two doses of sulphadoxine-pyrimethamine (SP). This has become known as the intermittent presumptive treatment with SP (IPT-SP) policy. According to the guidelines, the first dose should be given “during the first antenatal visit occurring after the first trimester of pregnancy is complete”, and the second dose “at the beginning of the third trimester (between 28 and 34 weeks)” (MOHP, 1997).

Several studies have been conducted in Malawi to determine the proportion of women receiving IPT-SP according to the policy guidelines. In Blantyre a random sample of 1,080 households yielded 391 recently pregnant women, of whom 76% had taken their first dose of IPT-SP, but only 37% the second dose. This low administration of two doses of IPT-SP occurred despite 88% of women reporting attendance at two or more ANC visits during their pregnancy, and 87% reporting their first visit attendance during the first or second trimester of pregnancy (Holtz et al, 2000). Many of the women interviewed knew of the dangers of malaria in pregnancy and of the importance and benefits of taking SP. A second facility-based research at the Queen Elizabeth Central Hospital in Blantyre (Ngoma, 1999) demonstrated lower proportions of SP use: 51% of women received 1 dose, 14% received 2 doses, and 35% received no SP (n=301). Potential reasons provided by the author for the low uptake of SP were: inadequate drug availability, late presentation of women for ANC visits, certain cultural beliefs, and

clinic staff not following the malaria policy guidelines accurately. We conducted a survey between May 21st and July 18th 2001 in Southern Malawi, in order to determine the level of implementation of the national IPT-SP policy and to explore factors affecting that implementation.

Methods

We visited 19 health centres in Blantyre District, where routine antenatal clinics are conducted. We interviewed all health personnel (n=41) available on the day of the survey, using a topic guide. We interviewed antenatal mothers (n=287) using a separate topic guide and we checked their antenatal cards against their verbal responses. We explored the availability of SP by checking pharmacy stocks and using a simple calculation: this predicted drug requirements according to the patient load expected before the date of the next delivery of drugs. We compared drugs needed against the stock actually available.

We entered quantitative data into EPI-Info 2000 for later analysis by a statistician. Qualitative data were collected, transcribed and grouped into the following themes: health personnel’s knowledge regarding timing of SP, ANC women’s perceptions, beliefs and knowledge regarding the benefits of taking SP, drug availability, compliance, and directly observed therapy (DOT).

Results

General Study Characteristics:

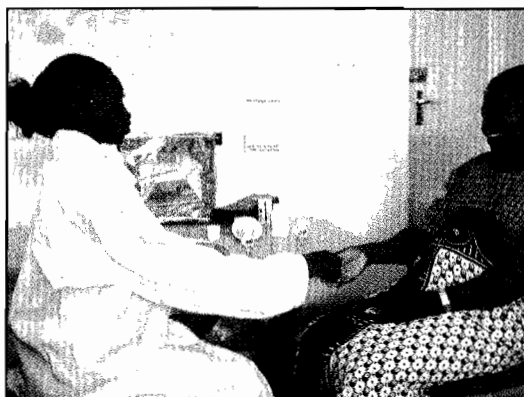
■ Number of ANC attendees	287
■ Number of primigravidae	89
■ Mean gravidity	2.64
■ Mean gest. age at 1st ANC visit	21.6 wks
■ Mean number of ANC visits	4.5

SP availability

- 95% of health centres in Blantyre had adequate stocks of SP; while 79% had enough to treat all antenatal women prophylactically plus extra supplies for treatment of suspected malaria in febrile antenatal women. [Central Medical Stores has since stated that there have been severe shortages of SP since this study was done]
- Of the 41 health personnel interviewed, only 2 said there had been SP shortages over the preceding 6 months.

Compliance

- The majority of ANC women had received their first IPT-SP dose (see figure). Uptake of the second dose was significantly less ($p < 0.005$).



- The ANC fee at CHAM facilities varies (between 75MK to 500MK). This fee only entitles a woman to receive the first dose of IPT-SP – she will have to pay separately for the second