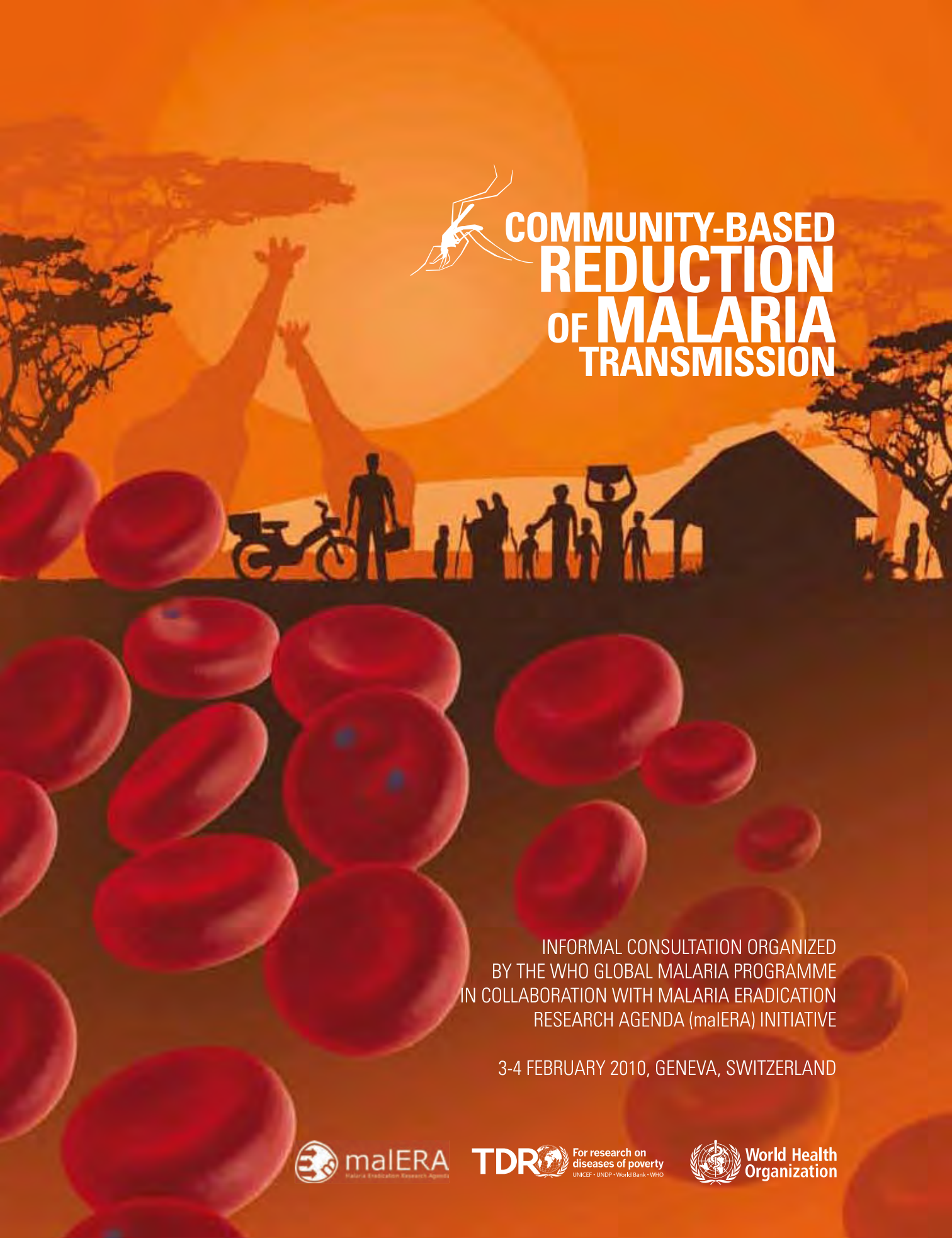

COMMUNITY-BASED REDUCTION OF MALARIA TRANSMISSION

INFORMAL CONSULTATION ORGANIZED
BY THE WHO GLOBAL MALARIA PROGRAMME
IN COLLABORATION WITH MALARIA ERADICATION
RESEARCH AGENDA (malERA) INITIATIVE

3-4 FEBRUARY 2010, GENEVA, SWITZERLAND

malERA
Malaria Eradication Research Agenda

TDR For research on diseases of poverty
UNICEF • UNDP • World Bank • WHO

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Abbreviations

ACT	artemisinin-based combination therapy
EIR	entomological inoculation rate
FSAT	focused screening and treatment
G6PD	glucose-6-phosphate dehydrogenase
HiFSAT	highly focused screening and treatment
IPTc	intermittent preventive treatment of malaria in children
IPTp	intermittent preventive treatment during pregnancy
LLIN	long-lasting insecticidal net
MDA	mass drug administration
MSAT	mass screening and treatment
PCR	polymerase chain reaction
RBM	Roll Back Malaria
RDT	rapid diagnostic test
WHO	World Health Organization

Foreword

To date, efforts at malaria control in highly endemic areas of Africa have focused on scaling-up proven existing malaria control interventions – long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS) with insecticides, intermittent preventive treatment during pregnancy (IPTp), diagnostic testing, and treatment of confirmed uncomplicated malaria using artemisinin-based combination therapy (ACT). *The World Malaria Report 2010* found that the increase in international funding commitments had allowed a massive scale up of malaria control interventions in many countries, along with sometimes dramatic reductions in malaria burden.

However, there is lack of evidence, and thus uncertainty, about how best to move forward with consolidating these gains, particularly in high transmission areas in sub-Saharan Africa. Sustaining high coverage with interventions in the face of a low malaria incidence will pose a serious challenge to countries which have reduced their malaria burden. Despite the increased political commitment for accelerated malaria control towards elimination, there are as yet no proven operational strategies for how to sustain the gains in malaria control – or reach elimination – in high transmission areas, much less strategies on how to maintain malaria elimination if it were achieved. Even if malaria elimination is not currently attainable – with today's tools – in most sub-Saharan African settings, it will become more feasible in the medium to long term in selected settings. It is imperative, therefore, to develop the strategies needed to consolidate gains made through successful scale-up – and move control with available tools towards elimination in appropriate situations. Otherwise, endemic countries may find themselves in the potentially perilous situation of waning population immunity combined with high transmission potential.

To rapidly move towards malaria elimination, there is a need for large scale, innovative interventions at all levels – both of preventive and curative nature – that will allow to reach all populations at risk and dramatically reduce malaria transmission. Once transmission drops to low levels and becomes increasingly patchy (or 'focal'), national level commitment to malaria as a public health problem risks dropping as well. A community-based approach will enable governments to match resources to local burden, and allow remaining affected communities to take a more aggressive approach to lowering and ultimately eliminating transmission in these malaria hotspots.

In February 2010 the WHO Global Malaria Programme, in collaboration with Malaria Eradication Research Agenda (malERA) initiative, organized an informal consultation of malaria experts to develop a strategy to achieve reduction of malaria transmission through community-based interventions (Geneva, 3-4 February 2010). The present document summarizes discussions and presents the strategy as developed during the two-day meeting.

Robert D. Newman
Director, Global Malaria Programme
World Health Organization

1. Background

Malaria control in highly endemic areas of Africa has so far been based on proven interventions: use of LLINs, IRS with insecticides (where appropriate and feasible), IPTp and prompt diagnosis and treatment of malaria with ACT. *The World Malaria Report 2010* indicated that increased international funding (from US$ 730 million in 2006 to US$ 1.8 billion in 2009) had resulted in a dramatic increase in malaria control in several countries, with measurable reductions in the malaria burden in those with well-functioning surveillance systems. In Eritrea, Rwanda, Sao Tome and Principe, Zambia and Zanzibar (United Republic of Tanzania), the numbers of recorded cases and deaths due to malaria have fallen by 50% or more, accompanied in some cases by steep declines in the number of deaths from all causes among children under 5 years of age. These early successes must be consolidated and programmes devised for eventual elimination and global eradication of malaria.

The limited experience in malaria-endemic African countries with a progressive reduction in malaria transmission raises questions about how best to move forward. Sustaining high coverage with interventions when the incidence of malaria is low is a challenge for both countries and donors. Despite increased political commitment to accelerate malaria control in Africa with a view to elimination (Shah, 2010), there are no proven operational strategies for sustaining the gains in malaria control, achieving elimination in high-transmission areas, or maintaining elimination once it has been achieved. How can countries maintain and expand the current gains in malaria control? How should countries prepare for the next phase of malaria control when malaria transmission is increasingly focal and population immunity is waning? Elimination is the long-term goal in countries of sub-Saharan Africa. If this is to become feasible in the medium term, strategies are needed to maintain and expand the gains made. This is especially important for endemic countries that are in the potentially perilous situation of waning population immunity combined with an intrinsically high transmission potential. Even though there are new tools in development, such as a malaria vaccine, the development of the next strategies for further reducing malaria transmission should proceed based on existing malaria control tools.

2. Justification for community-based reduction of malaria transmission

While many countries have been successful in achieving rapid improvements in malaria control, the burden is still unacceptably high, particularly in underserved rural areas in Africa. Once transmission drops to low levels and becomes patchy or focal, national commitment to malaria as a public health problem may drop as well, paradoxically at a time when national or subnational elimination goals might actually be achievable. As malaria transmission decreases, the responsibility for malaria control should increasingly be taken on at more peripheral administrative levels, even with communities. A community-based approach could ensure that the remaining affected communities take a more aggressive and appropriately tailored approach to lowering and ultimately eliminating transmission in active foci. Investment in health delivery at the community level has been successful in countries in Africa, the Americas and Asia. These include nationwide community health worker systems, such as the Anganwadi Workers (now the Accredited Social Health Activists) in India, midwives in Sri Lanka, social health workers in Indonesia, health extension workers in Ethiopia and the community health and planning services approach being used in Ghana, all of which are based on national staff cadres established at community level within ministries of health or social welfare. Furthermore, since 2001, community-based case management of malaria, a strategy formerly known as 'home management of malaria', in which antimalarial treatment is made available close to the home by community health workers has been a cornerstone of the WHO-recommended strategy to improve access to prompt, effective malaria treatment, especially in remote, underserved areas with high malaria transmission. Community-based case management of malaria has been shown to be effective in reducing mortality and morbidity (Kidane & Morrow, 2000; Sirima et al., 2003; WHO, 2009a; Lemma et al., 2011).

Community-based case management of malaria could be a useful addition to achieve and improve sustained malaria control, a prerequisite for malaria elimination. In addition, rapid malaria elimination in areas of high transmission potential will require large-scale, innovative preventive and curative interventions that will reach all populations at risk. Investing in helping communities to help themselves and increasing demand for malaria control in affected communities could improve the sustainability of the required high coverage with key interventions. In addition, the creation of well-coordinated community-based control in the remaining foci of continued malaria transmission could improve a country's chances of eventual elimination. A community-based approach could help governments to match resources to the local burden and to actual needs for control. To achieve this end, real-time, high-quality surveillance data, based on parasitological confirmation of infection, will be required to inform local and central decision-making and resource allocation.

3. Context

In sub-Saharan Africa, several preventive and curative malaria control activities are already conducted at community level. Community case management of malaria, a strategy that was originally based on presumptive treatment of all cases of suspected malaria, is widely practiced. On the basis of results of pilot studies in Ethiopia (Lemma et al., 2010), Zambia (Yeboah-Antwi et al., 2010; Chanda et al., 2011), Burkina Faso (Tiono et al., 2010), and Ghana (Anyorigiya et al., 2010), community case management of malaria is now being redefined to include the use of malaria rapid diagnostic tests (RDTs) by community health workers to confirm a diagnosis of malaria before dispensing treatment. In some countries, this has led to adoption of a strategy that includes management of acute respiratory infections, diarrhoea, and malaria in a package known as 'integrated community case management' or iCCM. Other countries have adopted community-directed interventions for neglected tropical diseases (Remme et al., 2010) or community health councils (or similar institutions) to oversee the distribution of LLINs and provide behaviour change communication messages on the importance of consistent use of LLINs. Effective community case management of malaria may increase the proportion of people presenting to health facilities with severe disease. The scope of work and skills of health staff and the treatments available at health facilities may therefore have to be reviewed.

4. Proposed approach

To achieve sustained, widescale malaria control and to consolidate gains at community level, a package of interventions and a strategy can be formulated for countries that already have a system of community-based health workers who are linked to and supervised by staff at the nearest government health facility. The responsibility is therefore not that of the community in isolation. Instead, community-based activities can become the cornerstone of a malaria control programme that is firmly embedded within the health system.

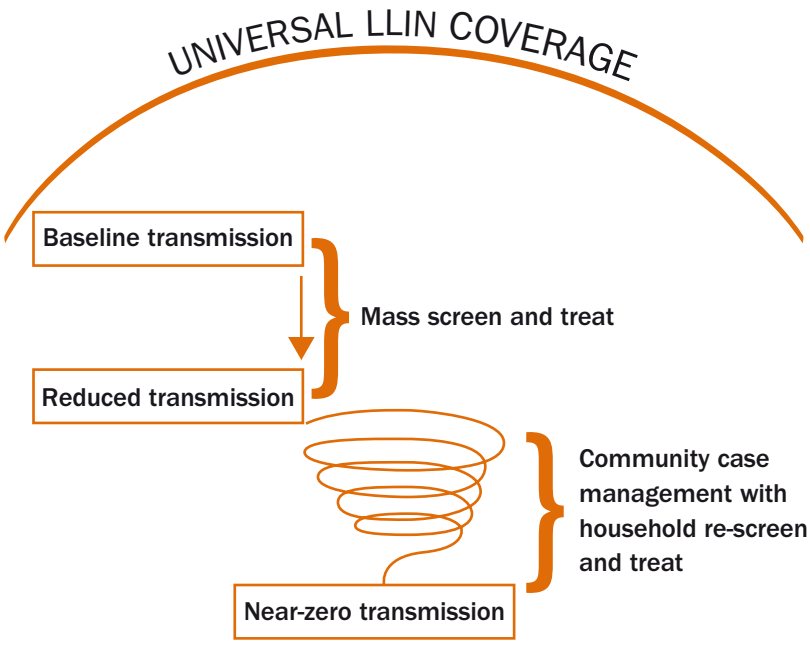
A community-based approach for reducing transmission of malaria makes it possible to reach the population at highest risk and to take advantage of existing systems that reach a large number of people. The critical additional components in the community-based approach for reducing transmission of malaria are: population-wide or focused screening and treatment (FSAT) of all infected individuals (most of whom are asymptomatic); and active detection of malaria cases (symptomatic) or of infections (asymptomatic) in households, re-screening of the neighbouring population, treatment of all infected persons and targeted focal vector control activities. These combined interventions are expected to further substantially reduce the transmission of malaria at community level. Malaria control (moving towards malaria elimination) can be considered as a series of vertically arranged platforms connected by spiral staircases (Figure 1).

Areas of low-to-moderate malaria transmission, which already have universal or very high coverage with LLINs, are ideal for starting community-based reduction of malaria transmission. In these areas, the national malaria control programme, through the district health management team, should assess the baseline malaria transmission intensity and undertake activities, like periodic mass screening and treatment (MSAT), to substantially reduce transmission. These activities need the involvement of the community to ensure good participation but are generally led by the district. Once malaria transmission intensity is reduced, full community-based activities can be used to achieve near-zero transmission. The health information system should be enhanced to monitor progress of transmission reduction.

A major conceptual change in the move from malaria control to transmission reduction is the transition from diagnosing and treating clinical cases of malaria among people seeking health care to actively seeking malaria ‘infections’ for radical cure in order to limit transmission. While the aim is always to provide the best possible case management of patients with symptoms of malaria in order to reduce the clinical consequences of the disease, the emphasis in transmission reduction programmes is the elimination of parasites in people who carry and can transmit them in order to prevent infection of others, regardless of whether the person has infection-related symptoms. The implications and challenges of this change are several. Actively seeking infections implies greater involvement of the health system at all levels, including health facilities and communities, as asymptomatic people do not present spontaneously to health workers. An intense communication campaign must be put in place to convey to the community the public health benefit of treating all infected persons, regardless of their symptoms.

Furthermore, an efficient information system is needed to keep track of all infections, which is increasingly important as the transmission level is reduced.

Figure 1. Driving transmission to near-zero level



LLIN, long-lasting insecticidal net.

5. Preparation

5.1 ASSESSING TRANSMISSION

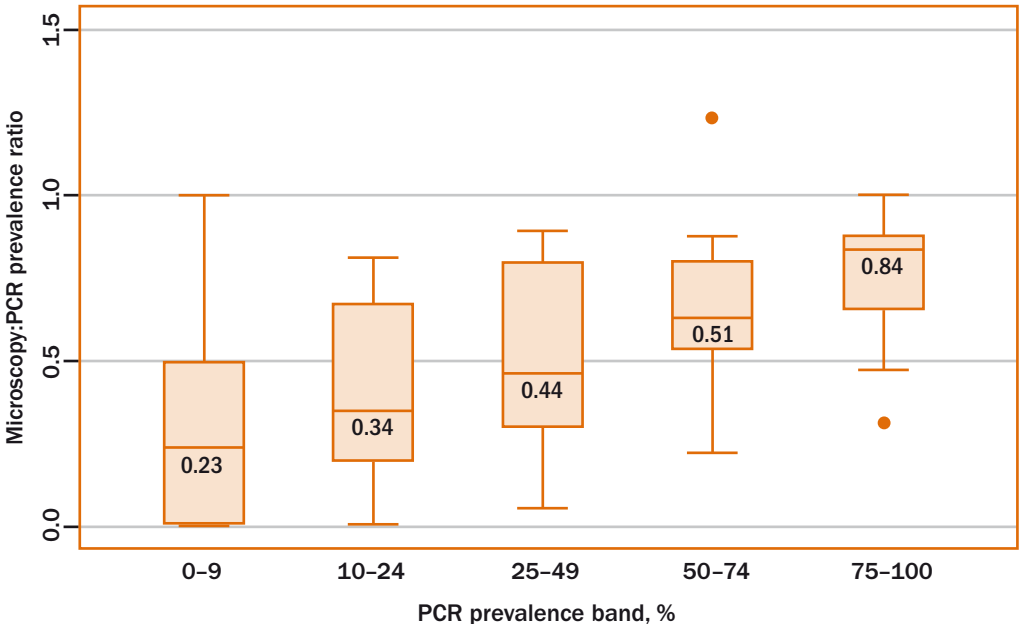
A key prerequisite for elimination is a reliable measure of malaria transmission intensity. Various measures may help identify the different 'platforms' in Figure 1 and the most appropriate packages of interventions to move to a lower 'platforms', but none can be considered absolutely reliable (Reyburn et al., 2005; Greenwood, 2008; Hay, Smith, & Snow, 2008). At high intensity, the entomological inoculation rate (EIR), the parasite prevalence, the frequency of cases and the multiplicity of infection (multi-strain infections detected molecularly) may be useful in classifying the setting and monitoring transmission reduction. As the intensity of transmission decreases, these measures become less sensitive, and clinical, molecular and serological measures may be more appropriate. At all transmission intensities, it is important to measure the number of cases of confirmed malaria presenting to health facilities and, as far as possible, the proportion of symptomatic infections. The relation between the incidence of symptomatic malaria and the prevalence of asymptomatic infections in a population (called the 'reservoir') is not fully understood: it depends on several factors, the main one probably being the speed at which malaria transmission decreases. When the decrease in transmission is more rapid than loss of immunity in the population, the reservoir of asymptomatic carriers can be significant and mass screening is potentially appropriate: 3% prevalence by microscopy and 7% by polymerase chain reaction (PCR) in Cambodia (WHO, 2009b). When transmission has decreased over many years, however, most people with parasitaemia are symptomatic because they have no immunity (no tolerance), and the reservoir is minimal: prevalence of 0% by microscopy, 0.5% by PCR for *Plasmodium falciparum* and 1.5% by PCR for *P. vivax* in the Brazilian mountains outside Amazonia (Cerruti et al., 2007); prevalence of 0% by PCR in two districts in Sri Lanka (Rajakaruna et al., 2010). In this situation, mass screening will probably not be effective.

These differences indicate that some stratification of malaria transmission intensity is required in preparation for community-based activity. The EIR is often considered the 'gold standard' for measuring malaria transmission intensity; however, it is laborious and time-consuming, is not suited for obtaining rapid or repeated estimates and is particularly imprecise when the intensity of transmission is very low (one to five bites per person per year) (Hay et al., 2000). The prevalence rate of parasitaemia in the population is also associated with malaria transmission intensity; however, the sensitivity of its relation with intensity varies as transmission is reduced (Smith et al., 2004). As efforts to introduce diagnosis gather momentum, the incidence of confirmed malaria cases could provide a further indirect measure of transmission intensity, particularly in a context of decreasing transmission, when people gradually lose immunity and become less able to tolerate an infection without symptoms. Temporal changes in the rates of parasitaemia in asymptomatic people, however, imply that using parasitaemia as an indicator of malaria transmission intensity is relevant in only some situations. Furthermore, if the incidence of disease is used to assess the intensity of transmission, careful consideration must be given to where cases are identified. In some settings, the

majority of patients seek care from drug shops, and these cases must be included in the overall assessment of transmission intensity. Therefore, an expanded health information system will be needed to capture cases presenting elsewhere than in health facilities and standard community outreach systems.

Diagnostic techniques with higher sensitivity will be increasingly important as transmission levels decrease. The poor sensitivity of blood slides and RDTs for identifying the low-density infections frequently found in people with asymptomatic infections means that a large proportion will be missed. Techniques with higher sensitivity are being developed (e.g. the loop-mediated isothermal amplification method); currently, standard or nested PCR is probably the most sensitive diagnostic test available. Determining the prevalence of infection by performing PCR assays on filter papers collected during household surveys increases the number of infections identified, depending on the prevalence of low-density infections: the lower the overall prevalence in the population, the higher the number of additional infections found by PCR than by microscopy (Figure 2). Because PCR techniques currently require access to a specialized laboratory, there are logistic limitations to their widescale application; furthermore, PCR cannot generally provide an immediate on-site result for deciding whether to treat a patient.

Figure 2. Prevalence rates of *Plasmodium falciparum* infection measured by microscopy and by polymerase chain reaction (PCR), by PCR band (excluding gametocyte-specific estimates)



From Okell et al., 2009[1].

[1] Reproduced with permission from the Oxford University Press.

Another way of potentially measuring malaria transmission intensity is by detecting serum antibodies to malaria and deriving sero-conversion rates from data on the prevalence of antimalarial antibodies (i.e. the proportion of people who become seropositive for antimalarial antibodies over time and are therefore assumed to have been exposed recently to specific *Plasmodium* antigens) (Corran et al. 2007; Stewart et al., 2009). Use of such tests in the field or even at community level could be facilitated by using eluted RDT samples as a source of immunoglobulins (Williams et al., 2009).

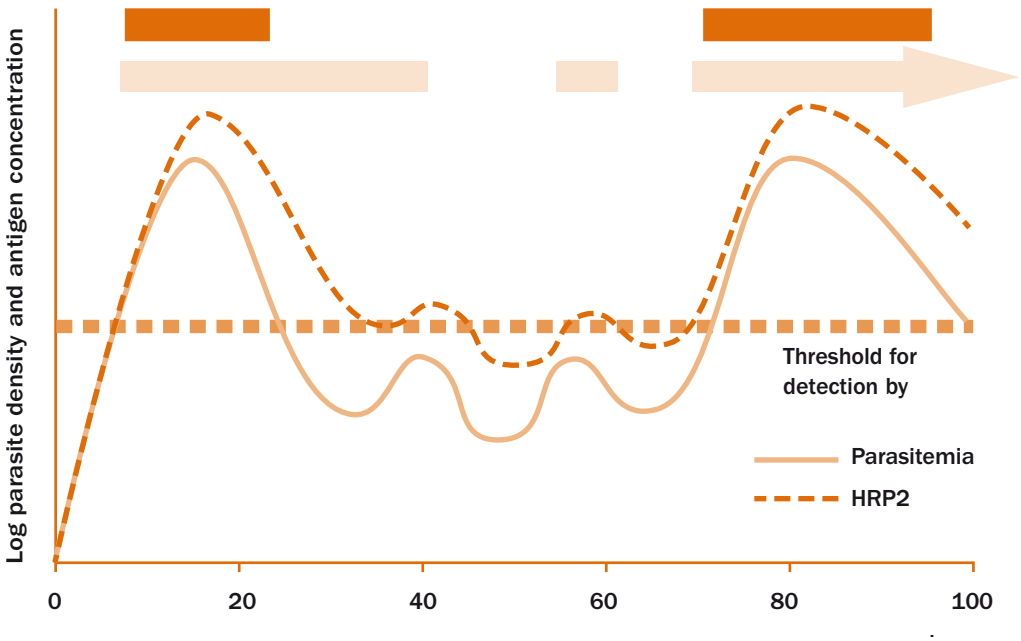
5.2 INTERVENTION PACKAGES FOR COMMUNITY-BASED REDUCTION OF MALARIA TRANSMISSION

A key aspect of the concept of community-based reduction of malaria transmission is ensuring high rates of vector control with insecticide-treated nets (and/or IRS where appropriate) and then further reducing transmission with techniques that include mass drug administration (MDA), MSAT, FSAT and highly focused screening and treatment (HiFSAT). The level of evidence for the effectiveness of these techniques varies: focused screening is most strongly based on evidence and has been widely used, although not always fully documented (Macauley, 2005). Furthermore, the direct health benefit (the main aspect perceived by the population) is highest for FSAT; however, the burden and costs for the health system tend to increase with the more complex interventions.

The type of test to be used depends on the strategy. For the management of symptomatic cases, RDT and microscopy are sensitive enough at any level of malaria transmission, and PCR is not necessary. The most sensitive test for screening an asymptomatic population is presently PCR. In Cambodia for example, in a national survey in 2007 in which the populations of 76 villages were screened, 13 more villages with malaria cases were identified with PCR than with microscopy (WHO, 2009b). During screening and treatment in Pailin, Cambodia, in 2008-2009, use of PCR with feed-back and treatment of positive cases made it possible to treat 86 asymptomatic carriers (*P. vivax* in most cases) among the 928 people screened, instead of six when only RDT was used. Because of absenteeism during the survey (40% of the population), however, about 70 carriers were probably missed (S. Hoyer, personal communication).

PCR has several logistic limitations, as mentioned above, and the experience in Pailin concluded that MSAT with PCR should be replaced by FSAT. In areas where transmission has been low for a long time and the reservoir of asymptomatic carriers is almost nonexistent, microscopy and RDT might be sufficient, as illustrated by previous (Gabaldon & Berti, 1954) and more recent studies. In the Yanomani area of Brazil, monthly mass blood surveys were carried out successfully with RDTs or a blood smear rather than PCR, and symptomatic and asymptomatic positive cases were treated (Macauley, 2005). This resulted in a reduction in malaria incidence of 45% within 3 years. Highly performing RDTs have several advantages that make them the preferred test in population screening surveys: the result is available on site, allowing immediate treatment if positive; and, because they detect antigens which persists in infected persons longer than parasitaemia, they can indicate latent infections, not detectable by standard microscopy (Figure 3). Therefore, most people who test positive with a RDT but negative with blood slides during a survey are infected with *Plasmodium* (positive by PCR) (Bell, Wilson &

Figure 3. Greater sensitivity in the field of a rapid diagnostic test (RDT), which relies on detection of a persistent antigen, than microscopy



HRP2, histidine rich protein 2.
From Bell, Wilson & Martin, 2005[2].

Martin, 2005; Dal-Bianco et al., 2007). They are real positives and, in the context of an intervention to reduce transmission, should be treated.

5.2.1 Mass drug administration

MDA is administration of an antimalarial drug or drug combination to an entire population at risk, whether or not they are infected, at one or more specified times. No attempt is made to identify people who are infected. In the context of a transmission reduction strategy, mass treatment should ideally be done with drugs that kill both asexual-stage parasites and gametocytes. The aim is to reduce the size of the parasite reservoir in humans and thereby interrupt, or reduce, transmission of malaria for the benefit of the population as a whole rather than to cure individual cases. Mass treatment is not a new concept: it was used in the malaria eradication campaign of the 1960s. It can temporarily reduce the prevalence of infection; however, if the reduction is to be maintained, additional control activities will be required. It can also be used as a 'last push' when the prevalence of infection has been reduced to a low level but there is still transmission. It is being considered for use in two settings (DFID, 2010):

In high-transmission settings before the start of the malaria season or when malaria is common: The initial results were not encouraging (von Seidlein et al., 2003). More recently, however,

[2] Reproduced with permission from The American Journal of Tropical Medicine and Hygiene.

repeated doses of antimalarial agents given as part of intermittent preventive treatment of malaria in children (IPTc) were shown to be effective in reducing malaria incidence (Cisse et al., 2006; Sokhna et al., 2008). More effective gametocytocidal drugs, such as primaquine, might have a greater effect, but risks are associated with treating otherwise well people, including women in early pregnancy and people with conditions such as glucose-6-phosphate dehydrogenase (G6PD) deficiency, who are susceptible to haemolysis when given primaquine.

In low-transmission settings where the aim is elimination of malaria: The most extensive example is the attempt to reduce malaria incidence in Cambodia to as close to zero as possible in the area of artemisinin resistance. A pilot study of one round of MDA in 17 villages showed a decrease in parasite prevalence rate from 52% in 2003 to 3% in 2006 (Song et al., 2010). This did not, however, interrupt transmission; failure was attributed to immigration of infected people from malaria-endemic areas. Similarly, in Comoros, MDA by village volunteers every 10 days did not eliminate malaria from the island. Nevertheless, although primaquine was used, no haemolysis was observed among the approximately 60 000 people treated.

MDA for malaria elimination should still be considered experimental. Most randomized controlled trials have shown no lasting benefit; although many operational (non-trial) studies have shown large effects, they are difficult to separate from those of other, concurrent measures. Furthermore, the feasibility of MDA as a community-based approach is still to be demonstrated (von Seidlein et al., 2003).

5.2.2 Mass screening and treatment

When the transmission is below a certain level, it may be more cost-effective to undertake MSAT, in which everyone is screened and only those found to be infected with *Plasmodium* are treated. It is important to ensure that appropriate instructions are given to communities so that people understand why they should have a test when they are not sick, as poor compliance with mass screening threatens the approach. The sensitivity of the screening test used is of critical importance. In Pailin on the Cambodia-Thailand border in 2008, MSAT was found to be extremely demanding in terms of human resources; furthermore, only part of the population could be tested and treated because of the large mobile population. The conclusion of this feasibility study was that MSAT, at least in this context, was impractical and unsustainable (WHO, 2011). After a single round was carried out in Bioko, Equatorial Guinea, in 2006, in which 31% of the people tested were positive, a survey 9 months later showed no impact (I. Kleinschmidt, personal communication). The prerequisites for MSAT therefore appear to be: several rounds at regular intervals, concurrent use of other transmission reduction measures, well-organized health services, a stable population with no major influx of migrants from malarious areas, and community consent and commitment. The optimal frequency, spatial scale (village, district or province) and timing of MSAT remain to be established.

Another decisive factor is the type of screening test used. On the Cambodia-Thailand border, a field team of nearly 1000 planned to screen and treat about 150 000 people in 3 weeks, with access to a high-throughput PCR laboratory. They reached only about 60% of the target population, indicating that MSAT with an

off-site laboratory test presents major operational challenges.

5.2.3 Focused screening and treatment

As malaria transmission intensity is often heterogeneous, FSAT might be an option. For example, during activities to contain artemisinin resistance on the Cambodia-Thailand border, three of 109 villages accounted for 49% of cases, and 77% of cases were from 10 of the 109 villages. Giving priority to communities with the greatest numbers of symptomatic malaria cases could be a rational initial approach.

5.2.4 Highly focused screening and treatment

As the cost per infection detected increases as transmission decreases, there comes a point at which the yield from screening makes both MSAT and FSAT very expensive. At this stage, it may be more appropriate to identify confirmed 'index cases' of malaria, when people present to health facilities, community health workers and drug shops. HiFSAT, also known as 'active case detection' in some settings (or 'active detection of infections', which would be more appropriate), could be done, consisting of screening and treating other members of the index case's household (i.e. putative contacts, whether they are symptomatic or not) and also screening households in the immediate vicinity of the index household. The definition of 'immediate vicinity' should be agreed upon the basis of local epidemiology and local research but might, for example, include all households within a 100-m radius. Members of the households in the target area would be listed, offered the screening test and, if positive, treated. When infected people are found, screening continues in a new extension of the target area (e.g. additional households within a 100-m radius of the newly identified infection), and the process continues until no new infections are identified. During the malaria 'eradication' campaign in Venezuela in the 1950s, a similar strategy was used, consisting of screening and treating all suspected cases within a radius of 5-10 km around the village of the index case, entomological inspection and spraying of houses not sprayed within the previous 3 months (Gabaldon & Berti, 1954). Other campaigns of HiFSAT (Taiwan in the 1950s; China, India, Oman and the Philippines in the 1990s) probably contributed to a reduction in malaria transmission. In India, however, this strategy was not successful in the long run: owing to constant re-introduction of infection by the influx of migrant labourers, the region in which HiFSAT was used is still hyperendemic (Macauley, 2005). In malarious provinces of South Africa, active case finding and treatment in the neighbourhood of confirmed cases has been practiced for decades; although it has been effective for control, it did not lead to elimination, again probably due to the influx of asymptomatic migrant carriers.

Proper documentation will be important to assess the effectiveness of HiFSAT. Cases identified with RDTs by health workers, community health workers or shopkeepers should be followed-up by health workers in the community, so that a mechanism will be required to alert the health workers to identified cases. Focal vector control in places where positive cases have been identified is also essential. Regardless of the initial approach to transmission reduction, HiFSAT are important during follow-up to reduce transmission further.

5.2.5 Designing the intervention

As malaria control improves, the set of activities at each site should evolve to another,

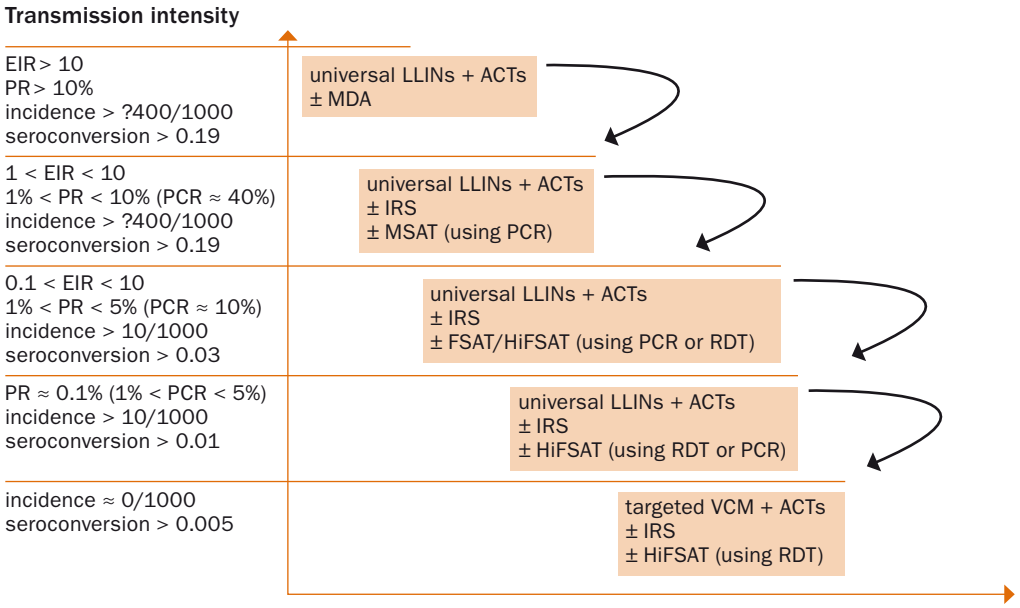
appropriate set. These can be visualized as moving down a staircase, to arrive at the next transmission 'platform' (Figure 4). Different combinations of activities are appropriate for different malaria transmission intensities; hence, the combinations of interventions required to move from one platform to another must be defined, and adequate monitoring to ascertain arrival at the next platform must be in place.

5.2.6 Universal coverage with effective malaria control measures

All the intervention packages for community-based reduction of malaria transmission are recommended for use in conjunction with complete coverage with effective malaria control measures. These include effective vector control with LLINs and IRS where appropriate, and universal access to diagnostic testing and ACTs to treat clinical episodes of malaria. MDA, MSAT, FSAT and HiFSAT are components of appropriate intervention packages, as determined by the malaria transmission intensity in the setting, and are implemented in addition to the other control measures.

LLINs are the mainstay of preventive malaria control in most settings; they should be used by every person in every sleeping space, every night. For communities that have recently been

Figure 4. Activities for community-based reduction of malaria transmission at different intensities of malaria transmission



ACT, artemisinin-based combination therapy; EIR, entomological inoculation rate; FSAT, focused screening and treatment; HiFSAT, highly focused screening and treatment; IRS, indoor residual spraying; LLIN, long-lasting insecticidal net; MDA, mass drug administration; MSAT, mass screening and treatment; PCR, polymerase chain reaction; PR, parasite rate; RDT, rapid diagnostic test; VCM, vector control management[3].

[3] The rationale for the use of different diagnostic tests at different levels of transmission intensity is discussed in section 5.2.

'malaria endemic', where the risk for transmission is ever-present, use of this form of prevention should be encouraged during all phases of control, at least until near-zero transmission is achieved. No indicator is yet available that would determine when universal coverage can be reduced to targeted vector control. In the context of community-based interventions, LLINs are easy to use as part of a package; IRS has a role in settings where transmission is highly seasonal and where the programme is oriented towards elimination. Few studies have been conducted on the combined effect of LLINs and IRS, but they suggest an additive benefit. Other methods, such as source reduction and housing modifications, might be used but should be based on entomological and epidemiological indicators and population behaviour. Larval control has been shown to reduce mosquito populations in some settings, particularly urban and peri-urban areas (Geissbühler et al., 2009).

Optimal use of campaigns and continuous distribution of LLINs by health facilities should be implemented together with innovative community-based distribution and supervision to achieve and maintain universal coverage with LLINs. Communities should be mobilized to maximize use of nets and ensure continuity and appropriate use. Mechanisms should be found to ensure that the needs of communities are reported to the health system and that coverage is monitored. Maintenance of high net coverage should be measured routinely at community level, by simple surveys or routine door-to-door enquiries. This requires links between the community and formal health information systems, with adequate frequency and completeness of reporting. Both public health and commercial supply channels should ensure the regular supply of LLINs. Sustained advocacy on the use of LLINs will be required, with evolution of the messages to highlight successes and also to target non-users. Efforts should be made to extend universal coverage beyond the home to relevant public institutions such as hospitals, prisons and schools.

Additional mechanisms to facilitate attainment and maintenance of universal coverage with vector control measures include linkage with community development agencies that support poverty alleviation programmes. Interactions with other programmes might also be useful, such as those for HIV/AIDS, lymphatic filariasis and onchocerciasis. As control tightens, innovative school programmes could be used to map breeding places and facilitate source reduction; cooperation with local builders and house-building organizations should be explored to adapt housing for malaria prevention. The inclusion of community members in IRS teams might improve the acceptability and sustainability of this approach to vector control.

Visitors to low-transmission settings, who may harbour parasites, should sleep under LLINs to prevent transmission. People who spend nights away from home in areas of malaria risk should also sleep under LLINs in order to remain protected. These messages should be reinforced at community level.

When diagnostic test results indicate *P. falciparum* infection, both symptomatic and asymptomatic patients should be treated with an ACT. In the context of malaria elimination, there are theoretical reasons for adding a gametocytocidal drug such as primaquine to an ACT for the treatment of symptomatic cases (as currently recommended by WHO); this is also recommended in the context of MSAT, FSAT and HiFSAT to reduce potential subsequent transmission (White, 2008; Griffin et al., 2010). In all settings, use of primaquine is contraindicated

for pregnant women, children under the age of 4 and people with G6PD deficiency. The role of primaquine in transmission reduction and its safety in various populations require further research. A field-ready rapid test for G6PD deficiency could increase the usability of primaquine in community-based transmission reduction programmes.

6. A supportive environment

6.1 AN ENHANCED HEALTH INFORMATION SYSTEM

An enhanced health information system should be the basis for decision-making at community level, with data from a variety of sources. Community health workers, district health management teams and national malaria control programme officers are responsible for different aspects of information collection and management. Terms of reference, standard operating procedures, communication strategies and coordination mechanisms should be established to ensure that the responsibilities of all those involved are clear and that there is adequate supervision. Generic guidance should be given by WHO that can be adapted by national malaria control programmes, with specific additional amendments made at the level of the district health team. Data collection should be limited to the essential, to maximize the quality of the data for measuring appropriate indicators on the basis of the agreed strategies. Novel approaches, e.g. short message service (SMS) sent by mobile phone, can increase the use of data by community and other health workers, such as for reporting drug availability and stock-outs.

A minimal community-based demographic information system would allow for tracking and mapping of infections and interventions. The district health team would be responsible for the system, but community health workers would take the lead in obtaining the relevant information. Within the context of such an information system, MSAT can be considered, potentially providing valuable information on the prevalence of infection, an opportunity to treat *Plasmodium* infections in order to reduce transmission. Such a 'longitudinal' demographic information system could be complemented by censuses, the periodicity and timing of which would require further research. A baseline census with MSAT is likely to be appropriate in most settings and can help to ensure that community health workers are trained in diagnosis and treatment.

While data collection at the local level is the most critical aspect of an information system, assimilation of data at higher administrative levels can reveal foci of transmission (or lack of transmission) in many communities across administrative boundaries. For example, effective control of malaria in parts of South Africa required control of malaria in bordering regions within Mozambique. When data across administrative areas are compiled, it is important to ensure feedback to lower levels, such that information flows from community health workers up the health system, and products (such as RDTs, ACTs, LLINs) and information flow from the health system to community health workers. Record-keeping should be done from the outset so that communities can monitor their progress.

6.2 A FUNCTIONING SUPPLY SYSTEM

A functioning supply system is needed to ensure that important commodities are sent from district level to community health workers. This usually involves extension of the normal supply chain to community health workers; however, as stock-outs would be particularly serious in the context of community-based reduction of malaria transmission, buffer stocks of LLINs, IRS materials, RDTs, ACTs and other commodities will be required.

6.3 AN EFFICIENT SUPERVISION SYSTEM

At health facility level, standard operating procedures for diagnosis and treatment of malaria should be available, and the way in which health facility staff interact with community health workers should be formalized. The frequency, content and location of meetings between health workers and community health workers should be agreed.

The extent of record-keeping and the information provided from follow-up of individual cases to the formal health system should be clear and supervised. Indicators for use of external services, such as entomological laboratories or epidemiological investigations, should be identified.

Generally, the national malaria control programme should be responsible for measuring transmission, as it has the capacity to draw information from different sources and ensure that it is systematically processed. District health teams should be responsible for mapping infections, to determine where further transmission reduction is needed. This should include evaluating population movements, to obtain adequate understanding of the roles of migration and immigration in malaria transmission.

6.4 SUITABLE SETTINGS

The characteristics listed below will ensure the suitability of an area for community-based activities:

- malaria diagnostic capacity available at all levels of the health system (including community level);
- low-to-moderate malaria transmission intensity and burden of disease;
- availability of a community health worker cadre strong enough to assume disease control, including malaria-specific activities;
- a health system that includes community health workers in an integrated strategy;
- adequate supply chain (minimal stock-outs);
- capacity at health facilities for supervising community health workers;
- well-functioning health information system; and
- low rates of migration and immigration.

If these characteristics are not all present, they should be addressed during the intervention.

7. Engaging communities and maximizing the sustainability of community-based reduction of malaria transmission

Implementation of all the elements of the proposed package for community-based reduction of malaria transmission – universal coverage with LLINs, IRS (where appropriate), diagnostic testing, ACTs, MDA, MSAT, FSAT or HiFSAT and a health information system – will require the engagement of communities, to various degrees. For instance, the collaboration of community members will be essential for tracing index cases in HiFSAT, in mapping infections and in collecting information for monitoring and evaluation; community participation will be important in maximizing adherence to MDA, MSAT or FSAT and universal use of LLINs; it will have mainly a supportive role in the context of IRS campaigns. Overall, community engagement will be important to ensure coordination with other health and social programmes (e.g. for HIV, tuberculosis and nutrition) and to engender a sense of ownership for malaria elimination in the community, which is necessary for its success. Table 1 indicates the potential role of the community in each element of the proposed package.

Engagement of communities requires continuous interaction with their members and involving them in planning and decision-making. The most important aspect of the strategy is the community health worker, whose performance, outputs and, even more importantly, continuity in service depend on the remunerative and supervisory structures in place. This in turn is related to the support for these workers from, and the engagement and interaction with, the communities they serve and the health system of which they are a part. Sustaining these workers as a public health good requires commitment at all levels, from the government to the communities. This is most likely to be achieved if malaria activities are integrated into other disease control programmes (e.g. for acute respiratory infections and diarrhoea), if malaria control programmes are open to collaboration with other community-based activities, and if the community health worker is regarded and appreciated as part of the health service delivery system. It might be useful to engage community extension workers in the education and agriculture sectors and with other integrated efforts (e.g. for integrated management of childhood illness or integrated community case management). Remuneration of community health workers is increasingly recognized as a prerequisite for a successful programme, to motivate them and maximize their performance and retention (Global Health Workforce Alliance, 2010). The responsibility for financing them may lie with the health system, the community or innovative public–private partnerships.

Supportive supervision and appropriate regulation of the activities of community health workers is necessary. Before implementation of community-based reduction of malaria transmission, a working group should be convened

Table 1. Potential roles of the community in each element of the malaria control package

Element	Expected contribution of the community
Vector control Long-lasting insecticidal nets Indoor residual spraying Larval source control (where appropriate) Environmental management (where appropriate)	Community sensitization Distribution of commodities Participation Supervision of use
Mass drug administration	Community sensitization Participation
Mass screening and treatment	Community sensitization Participation in drug administration Follow-up of cases
Focused screening and treatment	Community sensitization Participation in drug administration Follow-up of cases
Highly focused screening and treatment	Community sensitization Identification of index cases Screening and treatment of households in the vicinity Follow-up of cases
Monitoring and evaluation	Information collection and management Participation in tracking and mapping infections Evaluation of population movements
Overall	Coordination and collaboration at community level with other health and social programmes (e.g. for HIV, tuberculosis and nutrition)

to agree how the programme will operate in the light of the malaria and community health worker situation. This group should, for instance, ensure that a regulatory or legal environment is adopted that allows community health workers to use RDTs and dispense ACTs. The group, other stakeholders and people directly involved in implementing the programme should receive feedback from monitoring of process and output indicators.

Important elements of sustainability include political stability and firm national financial commitment, good organizational and technical infrastructure, reasonably well-functioning general health care services, a population that understands and supports the programme and a stable system for remuneration of community health workers.

Understanding the factors that motivate certain behaviour relevant to reduction of malaria transmission may be important, including those that affect LLIN use, travel and migration patterns and the relations between community health workers and the community they serve.

8. Operationalization

The different phases of community-based reduction of malaria transmission should be implemented in a stepwise manner. The overall approach and each phase should be discussed with the community, whose contribution and adherence are essential for the success of the operation. After a baseline assessment of the situation and identification of the appropriate intervention package, measures should be applied both to strengthen general malaria control measures and to implement the interventions outlined in this report.

8.1 TASKS OF COMMUNITY-BASED HEALTH WORKERS

Community health workers in the area where reduction of malaria transmission is to be implemented may already have tasks in curative or preventive health services, which must continue. Their specific tasks in reducing malaria transmission will depend on the package to be used.

8.1.1 Maximizing ownership and use of nets and other vector control activities

- Create an inventory of LLINs in the community.
- Ensure that there is an LLIN over each sleeping space in each house and that LLINs are provided to everyone who stays overnight in the community (i.e. potential 'imported' cases).
- Educate community members about the importance of nightly use of LLINs and about prompt reporting of all cases of fever to the community health worker.
- Participate in other vector control activities (e.g. larval control, environmental management, IRS, entomological monitoring) as appropriate for the site.

8.1.2 Community screening and case management

- If MSAT or FSAT are considered to be the appropriate initial transmission reduction strategies on the basis of local transmission intensity, screen each member of the community with a RDT, regardless of age, gender or the presence of malaria symptoms. Consult the local health facility to determine the respective roles of facility personnel and community health workers in the activities.
- Treat anyone with a positive malaria RDT (regardless of symptoms) with the first-line antimalarial medicines provided, in line with the national treatment policy (taking the necessary precautions for children weighing <5 kg, pregnant women in their first trimester and people with a known allergy to antimalarial medicines).
- If MDA is considered to be the appropriate initial transmission reduction strategy, consult the local health facility to determine the respective roles of facility personnel and community health workers in the campaign. At a minimum, community health workers are involved in community mobilization, identification of target households and individuals and record-keeping, including documentation of adverse events.

8.1.3 Case management, active case detection and highly focused screening and treatment

- Perform an RDT on all febrile patients (suspected malaria) and all household members of patients with a positive RDT (household active case detection).
- Treat all persons with a positive RDT in line with national policy.
- Undertake active household case detection for malaria patients identified at the local health facility and drug shops.
- Treat or refer non-malarial febrile illnesses in line with national policy and district practice.
- Screen and test all people in an agreed area around the home of an index case if HiFSAT is being done.
- Investigate each person with a positive RDT, using a standardized case investigation form (see WHO 2007, Annex 7: http://whqlibdoc.who.int/publications/2007/9789241596084_eng.pdf for an example).
- Look in the surrounding area for obvious sources of vectors that could be destroyed, and check that every household owns the appropriate number of LLINs in good condition. Discuss the appropriateness of targeted IRS and other vector control measures.

8.1.4 Community sensitization, record-keeping and decision-making

- Participate in community mobilization to achieve universal coverage beyond homes.
- Ensure the link between the community and the formal health system.
- Record all tests and treatments administered.
- Send a weekly report to the supervising health facility, consisting of:
  - an inventory of commodities (LLINs, RDTs, treatment doses), and
  - a record of tests performed, treatments administered and case investigation forms.
- Report overall results to community leaders.

Surveillance data collected by community health workers should be sent each week to district health management teams, for review of secular trends and projection of the needs for commodities. Given the importance of timely reporting as malaria transmission intensity drops, novel approaches such as the use of cell phones for weekly reporting of confirmed malaria cases should be considered. Weekly reporting also facilitates timely responses at district level to any surge in malaria cases.

8.2 KITS FOR COMMUNITY-BASED REDUCTION OF MALARIA TRANSMISSION

In order to perform their tasks in community-based reduction of malaria transmission, community health workers should be given kits, containing supplies for:

- implementing the LLIN programme in the entire population:
  - educational materials (pictorial flip charts) for both community health workers and community members on hanging and using LLINs,
  - LLINs, and
  - materials to hang LLINs;
- other vector control activities (e.g. larval control, environmental management);
- screening and community case management of uncomplicated falciparum malaria:
  - RDTs,
  - sharps disposal containers, and
  - first-line antimalarial medicines in line with the national treatment policy; and
- malaria surveillance:
  - books for record-keeping, and

- ministry of health forms for community malaria surveillance.

The initial volume of material in the kits would be based on the size of the community and existing coverage with LLINs and/or IRS. Each community health worker should be responsible for a defined catchment area (estimated at 50 households but depends on existing national models).

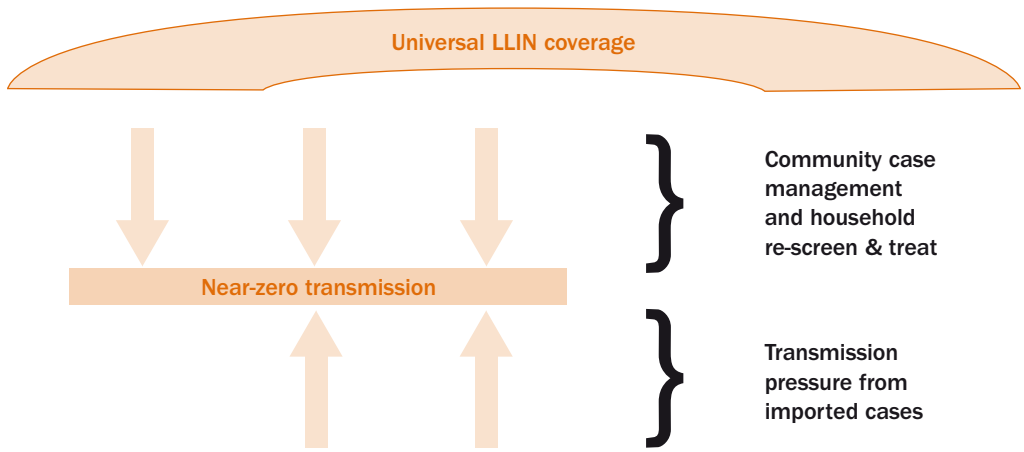
9. Sustaining community-based reduction of malaria transmission

The global malaria community is committed to achieving and maintaining universal coverage with LLINs as well as access to diagnosis and treatment with an ACT. In the context of sustained high coverage with vector control methods, the community-based approach for reduction of malaria transmission, by adding MSAT, active household case detection, and re-screening and treatment, may help to reduce local transmission to nearly zero in communities in rural areas. The additional costs that will be incurred by continuing household re-screening and treatment may be offset by the overall reduction in ACT use at both community and health facility level.

By maintaining universal coverage with LLINs and empowering communities to continue case management with the added component of household re-screening and treatment, malaria transmission should be maintained at very low levels, even in areas with efficient malaria vectors and thus continued high transmission potential.

Communities should be taught to record malaria cases carefully and communicate unusual surges in cases promptly, as they may represent a significant transmission event or a change in local vector ecology. When transmission is nearly zero, each case is a surge and merits investigation. District health authorities might need external assistance to confirm and manage such outbreaks. This 'steady state' is represented in Figure 5.

Figure 5. Maintaining near-zero transmission of malaria



LLIN, long-lasting insecticidal net.

10. Monitoring community-based reduction of malaria transmission

Careful consideration of the components of the programme will make it possible to determine a parsimonious set of appropriate indicators of process and outcome to assess the extent to which community-based reduction of malaria transmission is being implemented and having an effect. A conceptual framework can facilitate this process. Useful data may include:

- number of people presenting to health-care providers (in health facilities, at drug shops or to community health workers) with illness;
- number of people tested with a RDT;
- number of positive RDTs;
- number of patients with positive RDT who were followed up and for whom the following data are available:
  - LLIN use,
  - risk factors,
  - place of residence, and
  - household contacts:
    - number of contacts tested with a RDT,
    - number of contacts with a positive RDT, and
    - place of residence of contacts.

An example of a form to assess index cases in health facilities and to determine household contacts used during community follow-up in Zambia is given in Annex 1.

11. Evaluating community-based reduction of malaria transmission

Although none of the component interventions of community-based reduction of malaria transmission is new, the package has not been widely tested or implemented. Therefore, a basic evaluation framework is recommended. The main effect measure that is proposed is the difference in parasite prevalence 12 months after the start of the programme when compared with the baseline. This measure would be obtained with RDTs, blood films and PCR on a simple random sample of people in the community, who would also respond to a household survey on LLIN ownership and use and risk factors for malaria. Extended follow-ups with the same technique would be done at 18 and 24 months.

Additional data should be collected on outcome or process measures and cost. Outcome measures should be reported monthly and should include the proportions of:

- the population screened or tested,
- the population initially screened or tested with a positive RDT (by age <5 and ≥ 5),
- people with a positive RDT who are symptomatic and asymptomatic,
- people with a positive RDT at screening who receive antimalarial treatment,
- patients with symptoms of severe malaria referred to a health centre,
- people tested during household re-screening who have a positive RDT,
- households with an LLIN over each sleeping space, and
- households in which each person slept under an LLIN the previous night.

The primary calculated outcome measure would be the incidence of clinical malaria.

The costs for scaling-up of this strategy should be calculated. The changes in health facility costs associated with the diagnosis and treatment of malaria should also be calculated, as some of the costs of community-based reduction of malaria transmission are likely to replace those currently incurred by health facilities. As part of any household surveys conducted, changes in household expenditure on malaria and lost work days should also be measured.

In order to better understand the potential effect of community-based activity on vector ecology, entomological monitoring should be conducted by the district health management team under the guidance of the national malaria control programme, which should ideally include anopheline biting and resting behaviour in select locations.

Information should also be collected on acceptability (by community health workers, community members, health workers, drug shop keepers) and community demand for malaria control.

12. Additional research

Community-based reduction of malaria transmission is an innovative approach with a solid scientific rationale. It must, however, be tested and evaluated rigorously, with a number of specific research questions. As suggested in the Roll Back Malaria (RBM) *Global Malaria Action Plan*, continued research is needed to improve and expand work so as to achieve malaria elimination (Figure 6).

Many research questions are still open and must be addressed during experience with community-based reduction of malaria transmission. A non-exhaustive list might include:

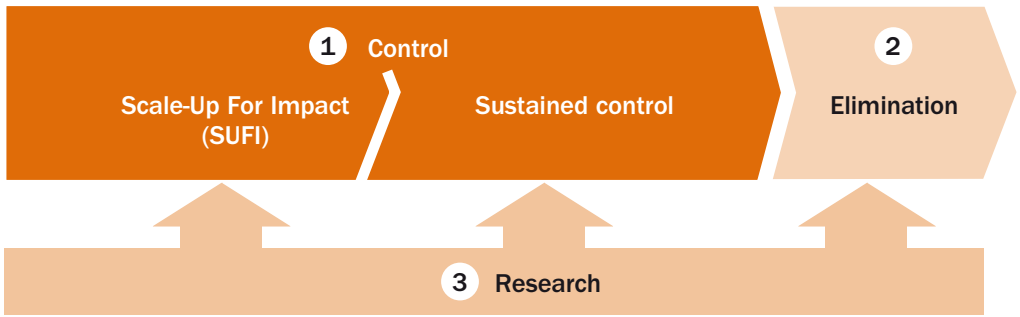
12.1 RESEARCH TO REFINE THE ELEMENTS OF COMMUNITY-BASED REDUCTION OF MALARIA TRANSMISSION

- What is the most effective initial approach for transmission reduction (MDA, MSAT, FSAT or HiFSAT) in different transmission settings?
- What is the optimal frequency, scale and timing of MDA, MSAT and FSAT in different transmission settings?
- At what level of transmission does one transmission reduction approach become more cost-effective than another?
- What are the relations between EIR, parasite rate in health facilities, parasite rate in the community and serology at low-intensity transmission?
- What is the appropriate radius for active detection of infections around an identified index case?
- What are the best strategies for identifying asymptomatic infected migrants?

12.2 RESEARCH ON DIAGNOSTIC TESTS TO BE USED IN COMMUNITY-BASED REDUCTION OF MALARIA TRANSMISSION

- How sensitive and specific must diagnostic tests be to reduce transmission to zero?
- Are diagnostic methods based on serology feasible for use at community level?
- Are new or existing methods required for use in the community (e.g. loop-mediated isothermal PCR, hand-help PCR, RDT for G6PD deficiency, RDTs that detect gametocytes)?

Figure 6. Three components of the global strategy



From RBM, 2008.

12.3 RESEARCH ON COMMUNITY HEALTH WORKERS' PERFORMANCE AND RETENTION AND APPROACH OF THE COMMUNITY

- What are the best approaches for recruiting, retaining and assuring the quality of the work of community health workers?
- What motivates community health workers, why does it motivate them, and how can it be sustained?
- How can the current health information system be improved and enhanced for community-based reduction of malaria transmission?
- What are the most sustainable approaches for involving communities?

12.4 RESEARCH ON ISSUES RELATED TO THE USE OF DRUGS

- What is the additional benefit of adding primaquine as part of community-based reduction of malaria transmission?
- Does the addition of primaquine to initial approaches to transmission reduction (MDA, or MSAT, FSAT and HiFSAT) reduce malaria transmission more rapidly?
- What is the ideal gametocytocidal dose of primaquine?

Some countries may consider that they are ready to start using community-based reduction of malaria transmission and consider this approach relevant. We recommend that these countries first identify a set of districts in which to apply this approach. Then, they should undertake appropriate investigations to address open research questions, enhance local work and allow for wider adoption and adaptation. WHO and other partners in malaria control and research are available to assist them in their work.

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Annex 1.
Index case form used in Zambia

Date*		Health facility				

* please list all dates as Day/Month/Year e.g. 20/02/2011

Patient identity					
Surname	First name	Common name	OPD register number	Date* of birth	Sex (circle one)
					M
					F

Diagnostics and treatment								
** please label RDT cassettes and blood slides								
Microscopy			**Rapid diagnostic test (RDT)**					
Microscopist			Performed by					
Result (+/-)			Result (+/-)					
Slide label**	Serial # Name Date*		RDT label**	Serial # Name Date*				
Treatment provided today (tick)	Coartem				Fansidar	Quinine tablets	Quinine injection	Other (specify)
	6 tablets/ pack	12 tablets/ pack	18 tablets/ pack	24 tablets/ pack				

Travel history (in last 1 month)		
Date left Lusaka*	Length of travel (days)	Place(s) visited

Any previous malaria instance (withing last 1 month)?								
Date*		Health facility attended						
Diagnosed by (tick all that apply)		RDT		Microscopy		Clinical examina-tion		
Symptoms (tick all that apply)								
Fever	Headache	Cough	Diarrhoea	Vomiting	Problems breathing	Chest pain	Other specify	
Treatment taken	Coartem	Fansidar	Quinine	Other specify				

Patient household location and contact information			
Physical address		Residential area	
		Telephone number	
Zone and description	(Health facility wall map)	Other information to assist team to locate house	(Landmarks, other directions)

Annex 2. List of participants

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