

Report on the

**Intercountry meeting of national malaria
programme managers from Horn of Africa
countries and malaria endemic countries in
the Arabian peninsula**

Sana'a, Republic of Yemen
1–4 June 2008



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1. INTRODUCTION

A meeting of national malaria programme managers was held in Sana'a, Yemen, from 1 to 4 June 2008. The meeting was organized by the WHO Regional Office for the Eastern Mediterranean for programme managers from countries in the Horn of Africa and from malaria endemic countries in the Arabian peninsula. The objectives of the meeting were to:

- review the progress made and problems encountered in the implementation of malaria control strategies
- update countries with new developments on malaria prevention and management
- review results of drug efficacy studies and plan the future activities of HANMAT
- review the epidemiological data and finalise falciparum risk maps
- agree on the methodology for estimation of malaria burden.

Dr Gholam Popal, WHO Representative in Yemen delivered a message on behalf of Dr Hussein A. Gezairy, WHO Regional Director for the Eastern Mediterranean. In his message the Regional Director note that of the total population of Eastern Mediterranean Region, 54% still resided in areas at risk of malaria transmission. Data from community surveys conducted in malaria endemic countries in the Region during 1985–2007 had shown that falciparum prevalence was below 10% in 87% of the surveys. Hence malaria in most areas of the Region was hypo-endemic and elimination was feasible. He emphasized the urgent need for reliable data about the burden of malaria morbidity and mortality to monitor progress towards the stated goals. Given the weakness of the malaria surveillance and information system in most high burden malaria countries, it was important to develop reliable estimates. Also, important were rational use of available limited number of malaria prevention and treatment tools, particularly artemisinin-based combination therapies (ACTs), and monitoring the efficacy of the first-line and second-line antimalarial medicines as well as new potential medicines.

The meeting programme and list of participants are attached as Annexes 1 and 2, respectively. A plan for drug efficacy monitoring 2008–2009 is included as Annex 3.

2. GLOBAL MALARIA PROGRAMME IN 2007

2.1 Global perspective on malaria control and elimination

Dr Andrea Bosman, WHO/HQ

The global malaria distribution has progressively been reduced since the mid 19th century, especially from 1945 to 1977, when 37 countries were freed of malaria thanks to the efforts of the global eradication programme. Success in malaria elimination occurred mainly in countries in Europe and North America, where malaria transmission was lower. Even today, the 11 countries which are aiming at malaria elimination have low malaria transmission and are placed at the limits of the global map of malaria distribution. There has been no experience, so far, of interruption of malaria transmission in areas with high transmission.

In January 2008 WHO convened a technical review on global malaria control and elimination to review the feasibility of malaria elimination, in relation to the intensity of

malaria transmission and outline the directions that countries should take over the next few years, at the end of an intensified phase of malaria control. The feasibility of malaria eradication with the available tools and the gaps in knowledge and research priorities for the next phase of malaria control were identified. The full report of this consultation will be available on WHO/Global Malaria Programme website.

The recent impact of malaria control interventions, showing in multiple countries over a few years over 75% reduction in malaria cases with high coverage of effective treatment and vector control, has renewed global interest in malaria elimination and eradication. All countries with low, unstable transmission should be encouraged to proceed to malaria elimination, taking into account overall feasibility and the malaria situation in neighbouring countries. Countries with high transmission that have achieved a marked reduction in malaria burden, should introduce a consolidation period, in which the achievements are sustained, the health services adapt to the changing clinical and epidemiological situation and the surveillance system is strengthened. Malaria control today relies heavily on a limited number of tools, notably artemisinin-based combination therapies (ACTs) and pyrethroid insecticides, which may be lost to resistance. The development of new tools and sustained investments in human development, health services, malaria control and development are essential to attain malaria elimination in more countries and this will make malaria eradication a possibility in the long term.

2.2 Regional vision for malaria elimination by 2020

Dr Hoda Atta, WHO/EMRO

Malaria is endemic in nine countries of the WHO Eastern Mediterranean Region, with low intensity of transmission in most areas. High and stable transmission is limited to the southern zone of Somalia and southern Sudan, which represent only 5% of the population at risk for malaria in the Region. Falciparum malaria is the dominant species in Saudi Arabia, Yemen and the sub-Saharan countries of the Region (Djibouti, Somalia and Sudan), while in Afghanistan, Islamic Republic of Iran and Pakistan, both *P. falciparum* and *P. vivax* are transmitted, with *P. vivax* as the predominant species.

Since the launch of the Roll Back Malaria Initiative in the Region in 1999, and particularly in the past few years, malaria control has intensified in endemic countries and resulted in a reduction of the malaria burden. With the availability of new tools for case management and prevention, improvements in communication technology, availability of financial resources from the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM) and other sources, and the global interest in elimination, it is considered feasible to accelerate efforts to eliminate malaria in low transmission areas by 2020. In high transmission areas in the southern zone of Somalia and southern Sudan, substantial reduction of transmission could be achieved with full-scale deployment of the available tools. Commitment and support to the remaining endemic areas should be maintained in order to consolidate the achievements and proceed towards elimination in the remaining areas and foci.

An elimination programme can be started in the whole country or in a specific area (province, state or district). The national malaria programme can be reoriented from control to

a pre-elimination phase and elimination, and finally to prevention of reintroduction based on certain milestones. In countries of the Region with both species (Afghanistan, Islamic Republic of Iran and Pakistan), elimination could be planned sequentially, with priority given to falciparum malaria first as the more severe problem.

Sustained political commitment with adequate funding, strong leadership and skilful management are crucial requirements until the elimination goal is achieved. Malaria elimination requires, and will contribute to, strengthening of the health system including local competence and infrastructure. It requires full involvement of the private sector, nongovernmental organizations and community-based programmes to ensure universal access to effective tools for diagnosis, treatment and prevention, including expatriates and refugees, free of charge. A strong information and surveillance system is of high priority to monitor and evaluate the progress. The malaria situation in neighbouring countries will have to be taken into consideration and functional intercountry cooperation mechanisms should be in place.

Combating malaria is included in the Millennium Development Goals. Malaria elimination is expected to bring substantial benefits in terms of socioeconomic development, improvement of the living standards of the population and increase in local and international tourism. Investment in malaria elimination will help other public health programmes to achieve their goals, including prevention and control of neglected tropical diseases. Once elimination is achieved, malaria control will rely mainly on vigilance and surveillance as part of the general public health services, thus saving the huge expenses related to treatment and prevention methods for other public health priorities.

2.3 Progress implementation of integrated vector management for scaling up vector control interventions

Dr Abraham Mnzava, WHO/EMRO

In terms of progress in the implementation of the integrated vector management (IVM) approach – the endorsed regional strategy for the control and prevention of vector-borne diseases in countries of the Eastern Mediterranean Region, 9 of the 12 disease endemic countries have IVM plans and have established national intersectoral coordination mechanisms and 4 have a vector control unit responsible for all vector-borne diseases. A regional initiative to strengthen capacity in medical entomology and vector control has been established to ensure that countries have the appropriate capacity to implement IVM. In view of this, an MSc course will be launched in August 2008 in Sudan. Two other courses in collaboration with WHO will be launched in the Islamic Republic of Iran and in Pakistan in January 2009.

Where long lasting insecticidal nets (LLINs) are a strategy for malaria control and prevention, countries have made good progress in scaling up this intervention. Over the past three years, the number of people accessing this intervention in the Region has increased from 3.6 million in 2005 to about 18 million people in 2007. The projection for 2008 is about 30 million people given the availability of resources and WHOPES-approved LLIN products. Countries are also encouraged to apply for Round 9 of GFATM grants, with the goal of universal coverage with LLINs.

Reports of pyrethroid resistance in parts of central Sudan have not only reduced the number of available arsenals to fight malaria and other vector-borne diseases, but also pointed to the need to strengthening capacity to monitor and manage vector resistance. There is also need to assess the potential epidemiological impact of the resistance as well as the identification of resistance mechanisms in the framework of the current TDR network. Based on studies elsewhere, pyrethroid resistance reduces the impact of insecticides on transmission control as well as for personal protection. Strengthening capacity in pesticide management through intersectoral coordination with other relevant sectors is crucial. Pesticide management is a complex issue and has to be approached from the life cycle of pesticides i.e. from manufacturing, importation, registration, use/application, storage, to disposal. During the discussions, participants expressed the need for guidelines from WHO on the disposal of LLINs after their residual life span.

Data on vector species, their survival, biting and sporozoite rates, vector behaviour vis a vis resting (indoor/outdoor) and biting (humans/other hosts – indoor/outdoor) preferences might be collected during the conduct of malaria prevalence surveys, if feasible. Monitoring of insecticide resistance is crucial and should be continuous in well chosen representative sentinel sites. This will not only provide guidance on the choice of insecticides for interventions but also update the geographical distribution of the local vectors.

2.4 Progress report of 2007 activities of the Regional Office

Dr Ghasem Zamani, WHO/EMRO

In 2007, the Regional Office supported the first regional training course on malaria microscopy, conducted at the regional centre of excellence in Oman. All malaria falciparum endemic countries, except Yemen, are now implementing an updated treatment policy using ACTs. Some malaria-free countries have updated their treatment guidelines for treating imported falciparum cases with ACTs, which are provided as required from the small stock in the Regional Office. To increase community access to reliable diagnosis and treatment, the Regional Office supported two pilot projects on home management of malaria in Afghanistan and Sudan. National malaria control programmes will use the results of these studies to roll out a strategy to cover those without access to health services and the population in difficult-to-reach areas. The Regional Office supported Pakistan in its efforts to ban manufacturing of oral artemisinin monotherapy and produce ACT instead. Implementation of the strategy of insecticide-treated nets is being scaled up in endemic countries with the support provided by the GFATM. Collaboration with the Islamic Development Bank and the Iran Export Development Bank was established to provide financial support for expansion of the Khartoum and Gezira malaria-free initiative to two other states in Sudan.

In 2007, the Regional Office supported 6 operational research projects in the field of malaria, including a multi-country project between Afghanistan, Islamic Republic of Iran and Pakistan on *P. vivax* molecular markers in collaboration with the Pasteur Institute of the Islamic Republic of Iran. Participants were briefed about the trend of malaria-related proposals accepted by the WHO Special Programme on Research and Training in Tropical Diseases (TDR) Small Grants Scheme from 2000 to 2007. Participants agreed with a timeline

and plan of action for increasing the number and quality of accepted malaria proposal in the next TDR call for proposals.

Activities for monitoring the efficacy of antimalarial medicines using the established sentinel surveillance sites were supported in Afghanistan, Pakistan, Somalia, Sudan and Yemen. The Regional Office provided training and technical support to the Islamic Republic of Iran, Pakistan, Sudan and Yemen for submission of malaria proposals to the GFATM in round 7, all of which were approved. A proposal for malaria control through the basic development needs approach in Nangarhar province, Afghanistan was submitted to the International Islamic Relief Organization and approved.

3. MALARIA CONTROL IN HIGH BURDEN COUNTRIES: PROGRESS, CHALLENGES AND LESSONS LEARNT

3.1 Djibouti

In 2007, total reported malaria cases were 4708 and only 210 of them were confirmed. 4498 of cases were among children under 5 years of age. From February to March 2008, large scale distribution of LLINs was started with children under 5 years and pregnant women with objective of reaching 70% coverage of at risk population. Implementation of a new antimalarial drug policy started form February 2008. In 2007, the malaria programme received US\$4 484 615 from different sources, including GFATM, WHO and national funds.

Strengthening supervision and monitoring and evaluation of malaria case management, decentralization and improving of vector control interventions, strengthening epidemiological and entomological surveillance and development and implementation of communication strategy are the main priorities for the malaria programme in the coming year.

3.2 Eritrea

Malaria is endemic in Eritrea. It is highly seasonal, focal and unstable, and about two-thirds of the population is at risk. The most widely spread malaria parasite is *P. falciparum* followed by *P. vivax* while *An. arabiensis* is the main vector in the country.

The Government of Eritrea endorsed the Roll Back Malaria (RBM) Initiative in 1998 as the starting point to address the problem. This was followed by the development of a five-year strategic plan (2000–2004) with the participation of all stakeholders. The main objective of the plan was to reduce malaria morbidity and mortality by 80% compared to that 1999 levels. Comprehensive and integrated malaria prevention and control interventions were introduced.

The success of the malaria control programme in Eritrea is greatly attributed to the involvement of community health agents (CHAs) who are regularly provided with refresher training courses before the beginning of the transmission season each year. CHAs are well equipped to manage all uncomplicated suspected cases of malaria at community level. The decision to use CHAs was made to bring the services closer to the population, strengthen the

linkage with health facilities and ensure community empowerment, ownership and sustainability of the programme.

The second contributing factor for the success of malaria control in Eritrea is the high level of political commitment which was translated into tax exemption on all malaria control commodities and the free distribution of bed nets to vulnerable groups including children under five, pregnant women and internally displaced populations.

Regular operational research is conducted on drug/insecticide efficacy to assist the Ministry of Health to take major policy change decisions. A technical working group, consisting of Ministry of Health experts and partners, on antimalarial drug treatment is in place charged with the responsibility of advising the government on malaria treatment issues. Thus, the emergence of resistance to chloroquine resulted in the treatment policy change to chloroquine plus sulfadoxine–pyrimethamine (SP) as an interim measure during the period 2001–2006. This was later replaced by artesunate plus amodiaquine in August 2007.

Other interventions frequently used by the Ministry of Health include; promotion of effective application of various channels of communications for positive behavioural change, regular supportive supervision, implementation of monitoring and evaluation framework and strong coordination of all stakeholders. Eritrea has succeeded in achieving the applicable Abuja targets and even beyond. These include malaria mortality (85%), case fatality reduction (85%) reduction of morbidity (85%) and proportion of population in malarious areas with insecticide treated nets (ITNs) (79%). As a result of these achievements, the country is now moving towards the malaria pre-elimination phase.

3.3 Ethiopia

75% of the land mass and 68% of the population in Ethiopia is affected by malaria. Areas below 2000 metres above sea level are prone to malaria. The dominant species are *P. falciparum* and *P. vivax*, which are 60% and 40% respectively. Malaria transmission is seasonal and unstable. The main vectors are *An. arabiensis* and *An. pharoensis*.

Before 2005, malaria was the leading cause of outpatient consultations, admissions and death, but in 2006 and 2007 mortality and morbidity due to malaria decreased dramatically. The decrease could be attributed to interventions such as use of ACT (Coartem[®]), mass distribution and utilization of ITNs (20 million nets in three years time for 10 million households at a rate of 2 nets per household) and relatively better indoor residual spraying coverage. The management of the diseases has been decentralized down to the household level using 24 753 health extension workers.

Some of the challenges are sustaining the distribution and coverage of the ITNs, low shelf life and high cost of Coartem[®] and rapid diagnostic tests (RDT), difficulties in stock management and unpredictability of malaria epidemics in space and time and lack of adequate preparedness and response.

3.4 Saudi Arabia

Saudi Arabia is situated in the area of transition between the Palearctic and Afrotropical eco-epidemiological types of malaria. Palearctic malaria, which formerly occupied the eastern, central and northern parts of the country, was eliminated at the beginning of the 1970s. The Afrotropical type of malaria; with *P. falciparum* as the prevailing parasite and *An. arabiensis* as the main vector; occupies the southwestern part of the country at altitudes below about 2000 metres. Malaria is still endemic in parts of this area, especially in its southern part (Jazan). The population living in relatively high risk areas is 1.04 million (about 5% of the country's population). During 2007, a total of 2864 confirmed cases were reported, out of which 467 were locally transmitted. In the malaria-free areas, only imported cases were reported.

The Ministry of Health has taken the initiative to strengthen malaria control activities in the country, which is timely and concordant to the global initiative for malaria elimination. More support and strength have been provided to those working in areas with Afrotropical malaria. During recent years the national malaria treatment policy was updated, appropriate training material was developed, medical and paramedical staff were trained on the new medicine policy and artemisinin-based combination therapies (ACTs) and usage of the new antimalarial drug started. This year the national seminar on malaria was conducted on 14 May, under the slogan "malaria elimination should be everybody's business".

Situation analysis and review of the current vector control activities and plans were done. New forms for epidemiological investigation for each and every single case of malaria were developed and a new weekly form of notification and monitoring of climate changes was introduced, and epidemic-prone areas identified.

Cooperation between Yemen and Saudi Arabia was revitalized in 2001, coinciding with the re-establishing the national malaria control programme in Yemen. Biannual cross-border meetings have been conducted since April 2001 to plan the joint malaria control activities in border areas. Technical sub-committees were formed to implement, supervise, monitor and evaluate the planned activities. Saudi Arabia provides support to indoor residual spraying and field supervision at the border areas. Continuous communication and exchange of information, advocacy, health education and community participation are other areas of cross-border cooperation.

Future emphasis will be on developing an early warning system for malaria outbreaks based on a thorough understanding of malaria epidemiology, information on land-use patterns and climate at the Saudi–Yemeni border area using GIS, and elimination of residual malaria foci through strong, time-limited attack measures.

3.5 Somalia

Malaria still poses a major health risk, mainly in the southern zone of Somalia, affecting particularly pregnant women and children under five. The Roll Back Malaria (RBM) programme initiated activities, during the period under review, to reduce vector density, improve response to outbreaks and ensure early diagnosis and prompt treatment. Other

preventive and curative interventions include rolling out on a large scale measures that protect pregnant women and children from malaria infective bites with insecticide-treated bed nets (ITNs) and the use of antimalarial medicines.

In 2007, refresher training was given to malaria microscopists for accurate parasite detection and identification, malaria microscopy sentinel sites increased in the northeast and northwest zones and refresher training on new anti-malaria treatment guidelines was conducted for enhancing health professional skills on malaria disease treatment. More than 30 health facilities are now producing regular malaria microscopy data, and WHO is performing quality control at regular intervals, with laboratory supplies and reagents provided by WHO.

The main planned activities supported by WHO in 2008–2009 include: training on malaria microscopy and its quality control in referral and peripheral laboratories; training of 3 entomology technician in MSc course in Sudan; establishing 4 referral laboratories providing continuous supplies to 60 peripheral laboratories; supporting operational research in 3 zones; and monitoring efficacy of antimalarial medicines.

Malaria control faces a number of challenges, most prominently the changing security situation in parts of the country that delays the carrying out of activities. In addition human capacity is inadequate to carry out malaria control activities to cover all districts in Somalia.

3.6 Sudan (north)

During 2007, the estimated number of malaria cases was 3.4 million. A total of 2 677 199 uncomplicated malaria cases were reported and treated free of charge with ACTs, and 42 495 severe malaria patients were treated in 42 hospitals (free of charge). Total reported malaria related deaths were 1254, a reduction of 55.7% from 2001 (2252).

A total of 3845 (74%) health facilities were enrolled in dispensing free ACTs for treatment. None of the health facilities reported any stock out. Implementation of the home management of malaria strategy (HMM) started in 105 villages covering 130 000 people. Assessment of the area before and after the implementation of the project shows that the number of deaths attributed to febrile illness decreased from 61 to one death, which was not malaria attributed.

The number of pregnant women receiving intermittent preventive treatment (IPT) reached 57 508 (66%) of the targeted centres and 830 000 LLINs were distributed through UNICEF and Global Fund contribution. Indoor residual spraying conducted as planned in selected areas with coverage of 98%.

According to the work plan, a total of 658 health personnel including medical doctors and medical assistants actively participated in the training workshops conducted last year with particular emphasis on appropriate use and strict adherence to the treatment protocol. Supportive supervision visits were held regularly; all states were visited on quarterly basis to strengthen and improve the quality of health services.

The malaria programme conducted orientation sessions for more than 1000 community leaders and disseminated information to nomadic communities. Strong partnership was developed with private sector to make the LLINs available to the general public at an acceptable price.

To strengthen capacity for control of malaria epidemics, a contingency plan was developed, rapid assessment and response teams were trained in five states and morbidity and mortality data were analysed in 122 sentinel sites. During the period 2000–2007, the malaria programme conducted 31 operational research studies in different fields, 20 of which have been published.

An important achievement was attaining a high score (A+) in the assessment of the Global Fund in Round 2. This assessment was conducted by the Global Fund team together with the UNDP, and this success reflects the efforts of all partners, especially WHO and UNICEF, who made the medicines available for the programme. The malaria control programme faces several challenges in maintaining this high performance, including weak health infrastructure at local level, weak monitoring and evaluation and uncertain sustainability of free of charge prevention and treatment.

For the coming year, the programme will continue to: invest in human resources development, particularly at peripheral level; scale up malaria service delivery down to the community with available effective prevention and treatment tools; improve and expand diagnosis; expand malaria-free zones; and strengthen connectivity for electronic reporting and selective operational research.

3.7 Sudan (south)

The yearly report on disease morbidity including malaria has been produced by UNICEF since 2003. These data were collected from outpatient dispensaries supported by nongovernmental organizations receiving regular essential medicine kits from UNICEF. The malaria data in these reports are either by county or state. The number of reported malaria cases decreased from 620 000 in 2003 to 101 000 in 2007, mainly due to lack of reports from a substantial number of health facilities. The other source of information on malaria in southern Sudan is from reports written by Global Fund round 2 and ECHO sub-recipient nongovernmental organizations operating in limited areas.

In 2007, 704 000 LLINs were distributed and if we consider the bed nets distributed in 2005 and 2006, approximately four million people are covered by bed nets. According to the Sudan Household Health Survey, 18.1% of households have at least one insecticide-treated net and 27.8% of children are sleeping under the bednet.

Main challenges for the malaria control programme in scaling up malaria control measures are: weak health system; limited trained human resources within the programme; weak coordination of partners at different levels; country-wide shortage of commodities (ACT and RDTs); inadequate monitoring and evaluation capacity at all levels; weak drug

procurement and supply management system; weak laboratory network system and quality control and quality assurance.

These challenges can be effectively addressed if all partners put their efforts towards assisting the Ministry of Health in health system strengthening. Main priorities in the coming year will be a campaign for training a large number of different cadres of health workers at national and state levels and strengthening monitoring and evaluation and integrated health information systems.

3.8 Yemen

The greatest burden of malaria in the Arabian peninsula occurs in Yemen. In an effort to reduce the burden of malaria in the country, the national malaria control programme has implemented an integrated malaria control strategy of case management, integrated vector control including long-lasting insecticide nets, indoor residual spraying (IRS) and larviciding and community health education. 725 285 LLINs have been distributed since 2006, which means at least 1.5 million people are protected with this effective vector control tool.

The NMCP has also identified as one of its aims the elimination of malaria from Socotra Island. Reliable knowledge of national malaria burden is essential for informed decision-making on the national control strategy and target the limited resources to the most vulnerable populations. However, the accuracy of these data are highly variable, often based on reports from febrile patients with no or unreliable parasitological diagnosis. As a complementary source of information, Yemen has also conducted school-based parasite prevalence surveys, which since 2000 have been undertaken in 62 districts across the country. The overall prevalence of *P. falciparum* infection was 8.8% during this period. However, in many areas control efforts have dramatically reduced infection rates. Strikingly, in Socotra Island, no local cases of malaria have been reported since 2006. To further help the targeting of control efforts Ministry of Education and Ministry of Health has developed a computerized School Health Atlas which, using geographic information systems (GIS) technology, collates available survey data in a single database with the aim of describing health and disease across the country and highlighting areas for which further information is required. To help fill in the remaining information gaps, a population-based malaria survey is planned for the end of 2008.

4. MALARIA RISK MAPPING AND ESTIMATION OF BURDEN

4.1 Incidence estimates from routine case reports

Dr Richard Cibulskis, WHO/HQ

WHO, along with other development partners, recommends that the number of malaria cases should be used as a core indicator by all malaria endemic countries. However, the number of cases reported by countries does not always provide a good guide to the true number of cases occurring in a country because: i) not all malaria cases reported are confirmed by slide examination or rapid diagnostic test; hence there may be considerable

over-diagnosis of malaria in a country; ii) irregularity in reporting from health facilities and districts to central levels can influence trends in morbidity and mortality such that they are more likely to reflect variation in reporting rates rather than disease incidence; iii) routine reporting systems do not consider patients attending private clinics or other non-government facilities or morbidity treated at home; hence incidence estimated from routine reports can underestimate the true number of malaria cases.

A procedure for making improved estimates of malaria case incidence using data from routine case reports was described. This involves estimating the total number of parasite positive cases attending health facilities covered by a Ministry of Health's health measurement information system (HMIS); this is given by the confirmed malaria cases plus the probable cases multiplied by the slide positivity rate. The estimate of confirmed cases is adjusted to take account of missing HMIS reports; by dividing by the health facility reporting completeness fraction. The revised estimated number of confirmed cases attending health facilities in the HMIS is then adjusted to take into account the propensity of fever cases to use health facilities not covered by the HMIS (e.g. those going to the private sector) or not to seek treatment at all; information on treatment-seeking behaviour is derived from nationally representative household surveys such as DHS and MICS. The procedure was used in the preparation of the World Malaria Report 2008 for all countries outside Africa and selected countries in Africa. For most countries it yields estimates of disease incidence than are more consistent with country and regional knowledge than incidence estimates derived from malaria transmission models. The advantages of using routinely reporting information to provide information on malaria case incidence are several. Firstly, routine case reports are often available for all geographical units in a country. Secondly, incidence estimates can be obtained continuously over time and will be responsive to changes in climate and implementation of interventions. Thirdly, they can be readily incorporated into country managerial processes. There is still, nevertheless, a need for other methods of assessment based on community surveys, or mathematical modeling to help calibrate and validate estimates obtained from routine reporting systems.

4.2 The Malaria Atlas Project: A geographic tool to define populations at malaria risk and track progress toward its control and elimination worldwide

Professor Robert Snow, WHO Temporary Adviser

The Malaria Atlas Project goal is to create a dynamic, evidence-based cartography of malaria risk worldwide. For *Plasmodium falciparum* risk mapping, the project has a number of iterative steps. First, medical intelligence from international travel advisories, national malaria control programme reports and maps and administrative unit reports of *P. falciparum* cases between 2003 and 2006 are used within a GIS platform to identify the areas of the world where there is no reported risk of locally acquired infection. Second, the climatic determinants of sporogony are used for all sub-regionally dominant malaria Anopheline vectors to define the temperature criteria for transmission interruption and a global interpolated temperature map is used to mask 5x5 km areas where malaria cannot be supported biologically. Third, the effects of extreme aridity on transmission are used to down-regulate the possibility of stable malaria transmission to unstable at a global scale using remotely sensed imagery. This combination of methods has resulted in a recently published

map of stable (> 1 Pf case per 10 000 people) and unstable transmission (< 1 Pf case per 10 000 people) across 87 Pf malaria endemic countries worldwide (Guerra et al, 2008). This has been used to estimate the numbers of people at risk of Pf transmission in 2007: 0.9 billion people were at risk of unstable transmission and an addition 1.4 people were at risk of stable transmission. The national estimates of malaria risk have also been used to compute the international and domestic per capita-at risk annualized commitments to malaria control (Snow et al, 2008). These estimates demonstrate that while there has been an increased investment in malaria funding, many countries where stable falciparum risk affects large numbers of people remain under-funded for a modest control agenda. Those countries hoping to aim for elimination are probably grossly under-funded.

In 2008 the MAP team will complete the assembly of over 6000 geo-coded data on malaria infection prevalence standardized to an age range of 2–10 years. These data will be used in a geo-statistical model to interpolate a malaria risk surface to delimit the spatial extents of high (PfPR₂₋₁₀ $> 40\%$), moderate (PfPR₂₋₁₀ 5%–39%) and low (PfPR₂₋₁₀ $< 5\%$) transmission intensities that affect the 1.4 billion people worldwide. These criteria represent useful benchmarks of what might be achieved in terms of transmission and disease burden reduction with the scaling up of universal ITN coverage and ACT access over the next 5 years (Hay et al, 2008). This mapping effort, funded by The Wellcome Trust, United Kingdom, is the first attempt to define the spatial distribution of malaria risk for over 40 years. These final MAP products will be made publicly available as a resource to plan effective disease control priorities at regional and international levels and provide the basis for better estimation of the malaria burden worldwide. As well, the dynamic nature of the models (allowing the inclusion of new information with time) will serve as the vehicle to track progress toward internationally agreed targets for malaria control and elimination through to 2015.

4.3 Malaria risk mapping: Somalia

Dr Abdisalam M. Noor, WHO Temporary Adviser

Maps of malaria distribution are vital for optimal allocation of resources. There is a general lack of reliable malaria maps in endemic countries in sub-Saharan Africa. This problem is particularly evident in low malaria transmission countries such as those located in the Horn of Africa.

Data from a national malaria cluster sample survey in 2005 and routine cluster surveys in 2007 were assembled for Somalia. Rapid diagnostic tests were used to examine the presence of *Plasmodium falciparum* parasites in finger-prick blood samples obtained from individuals across all age-groups. Bayesian geo-statistical models, with environmental and survey covariates were used to predict continuous maps of malaria prevalence across Somalia and define uncertainty around predictions. Regional level population for 2004 were used to estimate population at risk across three endemicity classes: $< 5\%$; 5%–39%; and $\geq 40\%$. Using estimates of clinical incidence and malaria mortality rate specific to each endemicity class estimates of annual morbidity and mortality incidence were derived.

Most of the country had a predicted prevalence of $< 5\%$ and areas with $\geq 5\%$ prevalence were predominantly in the south of Somalia. Approximately 5.8 million persons were

estimated to live in areas with < 5% parasite prevalence; 1.5 million in people in areas 5%–39%; and 7300 people in areas \geq 40%. Annual clinical incidence of malaria was estimated to about 490 365 [inter-quartile range 186 525–982 720] and annual cases of death among children 0–4 years old were estimated to be 2239 [inter-quartile range 1378–6897].

The maps showed that malaria transmission in Somalia varied from hypo- to meso-endemic. However, even after including the selected covariates in the model, there still remained a considerable amount of unexplained spatial variation in parasite prevalence, indicating the effect of other factors not captured in the study. Because there has been no census for over 30 years in Somalia, the reliability of the estimates of population distribution in Somalia cannot be quantified. In addition the morbidity and mortality rates used are derived from studies outside of Somalia due to lack of relevant studies in the country. These limitations notwithstanding, the estimates presented here provide the best-available information on malaria burden in Somalia.

4.4 Malaria burden in Yemen

Dr Simon Brooker, WHO Temporary Adviser

The greatest burden of malaria in the Arabian Peninsula occurs in Yemen. WHO estimates that 800 000 cases of malaria occurred in Yemen in 2005. In an effort to reduce the burden of malaria in the country, the national malaria control programme has implemented an integrated malaria control strategy of case management, long-lasting insecticide nets, integrated vector management, including indoor residual spraying (IRS) and larviciding, and community health education. The programme has also identified as one of its aims the elimination of malaria from Socotra Island. To help inform the national control strategy and target the limited resources to the most vulnerable populations, it is essential to obtain accurate knowledge of national malaria distribution. Currently, Yemen assembles information on the number of malaria cases attending local health facilities and provides summary data by governorate. This information is presented as the number of malaria cases per 1000 people per year, termed annual parasite incidence (API). However, the accuracy of these data are highly variable as estimates are often based on reports from febrile patients with no or unreliable parasitological diagnosis. As a complementary source of information, Yemen has also conducted school-based parasite prevalence surveys, which since 2000 have been undertaken in 62 districts across the country. Overall, surveys were undertaken in 273 separate schools in nine governorates between 2000 and 2007. The overall prevalence of *P. falciparum* infection was 8.8% during this period. However, in many areas control efforts have dramatically reduced infection rates. Strikingly, in Socotra Island, no local cases of malaria have been reported by passive case detection since 2006. To further help the targeting of control efforts, the Government of Yemen (Ministry of Education and Ministry of Public Health and Population) has developed a computerized School Health Atlas which, using a geographic information system, collates available survey data in a single database with the two-fold aim of describing, where possible, health and disease across the country and highlighting areas for which further information is required. To help fill in the remaining information gaps, a national school-based malaria survey is planned for the end of 2008.

5. HANMAT MEETING

5.1 Where do we stand in HANMAT?

Dr Ahmed A. Adeel, WHO Temporary Adviser

The initial two HANMAT meetings were mostly devoted to monitoring antimalarial drug resistance. In the third meeting, HANMAT started to extend its technical area of work to include the quality control of medicines and pharmacovigilance systems. The meetings served as a forum for discussions between the national malaria control programme and officials and experts from WHO, CDC, the United States Pharmacopoeia (USP) and USAID.

The main problem with the network has been the difficulty in securing sufficient funds for administrative activities and meetings. The continuity of the network will depend on its ability obtain sustainable financial support for running administrative costs and funding for future meetings. Proposed future activities of HANMAT include the following.

- The network will seek to play a major role in strengthening the capacity for malaria diagnosis , both microscopy and RDTs, to enable proper use of ACTs. This should be a high priority since most of the areas in the HANMAT countries are low-moderate transmission where diagnosis confirmation is highly needed.
- HANMAT will also seek to enhance the capacity of its members for estimating requirements of ACTs and RDTs.
- HANMAT will also seek to promote drug resistance monitoring in view of the reduction of malaria due to implementation of control activities.
- HANMAT will probe the possibility of establishing a mechanism for sharing of information on stock-outs and over-stocks of ACTs in the different countries of the network, which may be useful to guide re-deployment of ACTs during emergencies/epidemics.
- A common project proposal on quality control and pharmacovigilance will be developed by the HANMAT secretariat in collaboration with WHO, to be revised and approved by all members and submitted for funding to international donors.

5.2 Drug efficacy studies

Dr Pascal Ringwald, WHO/HQ

Prompt and effective case management remains one of the major means of reducing malaria morbidity and mortality due to malaria. The success of this strategy relies on the ability of ministries of health in affected countries to provide access to antimalarial drugs with proven high efficacy. Malaria control programmes and other concerned institutions therefore need to be able to evaluate antimalarial drug efficacy in a way that provides timely, relevant, reliable and comparable information. With such information, ministries of health can better

ensure efficacious management of clinical cases by detecting changing patterns of resistance early and modifying national malaria treatment policies accordingly.

From a programmatic point of view, data on the therapeutic efficacy and safety of an antimalarial drug or drug combination are the most useful in deciding whether or not the current first-line treatment in a country is still appropriate. Therapeutic efficacy testing (also known as *in vivo* testing) involves the repeated assessment of the clinical and parasitological status of patients treated with a particular drug over a fixed period of time. Reappearance or persistence of malaria parasites with or without accompanying symptoms and signs of clinical malaria is used as an indicator of reduced parasite sensitivity with that medicine. When such evaluations are conducted consistently over time in a reasonable and representative selection of sites, national malaria control programmes should be able to monitor drug efficacy in a way that will allow changes in treatment recommendations or policies to be made early enough to minimize the impact of a failing treatment regimen.

Standard guidelines for *in vivo* testing of antimalarials have been developed by the World Health Organization. These guidelines were later revised to make them relevant to areas of both high and low-to-moderate malaria transmission. In 2005, these guidelines were further modified to emphasize achievement of both 'clinical' and 'parasitological' cure (that is, elimination of both clinical symptoms and parasitaemia) among treated patients, rather than aiming for only a 'clinical' cure, which until recently has been the standard in areas of high malaria transmission.

This new WHO document on the assessment of antimalarial drug efficacy for the treatment of uncomplicated falciparum malaria has been developed to assist national malaria control programmes in carrying out standardized drug efficacy studies as simply and cost-effectively as possible. The full details of the principles and methodological considerations of drug efficacy testing are described in the WHO document *Assessment and monitoring of antimalarial drug efficacy for the treatment of uncomplicated falciparum malaria* (document WHO/HTM/RBM/2003.50).

The fundamental design of this protocol is intended to evaluate the therapeutic efficacy of a wide range of registered antimalarial medicines used for treating uncomplicated falciparum malaria, providing the minimum information required for programmatic decision-making. Studies that follow this basic design, when conducted periodically in a number of appropriately selected sentinel sites, can form the basis of a surveillance system capable of monitoring change in drug efficacy over time. Programmes will probably wish to evaluate more than one medicine. For example, it is common for programmes to evaluate both the current first-line and second-line treatment as well as one or more potential replacement treatments. However, the protocol is not designed for either the evaluation of new or experimental medicines or the direct comparison of the efficacy of one medicine with another. Such studies usually require design, ethical, and statistical considerations that are beyond the scope of this protocol.

The design is a simple, one-arm, prospective evaluation of the clinical and parasitological response to directly observed treatment for uncomplicated malaria.

Modifications to the protocol that do not change its fundamental design or intended purpose (such as when measuring blood levels of the medicine, combining with assessments of in vitro sensitivity and/or molecular markers for drug resistance, or extending the period of follow-up) can be made and, when technically and logistically feasible, are even encouraged.

In all areas, regardless of the intensity of malaria transmission, the evaluation of antimalarials for uncomplicated malaria should emphasize treatment efficacy in children <5 years old with clinically apparent malaria. The rationale for this requirement is that, even in populations with low level of acquired immunity (as it occurs in areas of low or highly seasonal malaria transmission), younger children often have a less favourable therapeutic response to antimalarial medicines than do older children and adults. In areas of low malaria transmission, exclusive enrolment of children <5 years old is likely to pose logistic difficulties because of the relative infrequency of malaria infection in this age group. In such cases, or in settings where young children are at substantially lower risk of infection than adults, for example, with occupational exposure in some south-east Asian countries, patients of all ages can be enrolled. Nonetheless, wherever possible, it is recommended that a sufficient number of patients be enrolled to allow for stratification of results based on age (<5 years and ≥5 years old).

To be able to interpret and compare efficacy results within and between regions, and to follow trends over time, efficacy tests must be conducted with similar procedures and standards. Therefore, The World Health Organization (WHO) has placed emphasis on standardizing the available methods. In spite of its limitations, the WHO therapeutic efficacy test remains the gold standard for determining antimalarial drug efficacy from a programmatic point of view, because it provides decision-makers with a straightforward, readily understandable indicator of the efficacy of an antimalarial drug or combination treatment in a given population at risk. The therapeutic efficacy test, however, is not sufficient in its own to confirm true drug resistance, why other methods including measurement of antimalarial drug levels in the blood, in vitro drug sensitivity assays and detection of molecular markers of resistance are therefore needed.

To facilitate entry and interpretation of data and results from therapeutic efficacy tests, WHO/GMP has developed a programme running under Excel®, which can be downloaded free of charge from the website of WHO (<http://www.who.int/malaria/toolsformonitoring.html>). The programme supports double-entry of data, and enables users to be instantly informed by about the evaluation criteria for the study of a patient.

Reported local cases of treatment failure with a given drug regimen are important early indicators of growing rates of resistance. From a policy perspective, however, summary estimates of the general level of treatment failure in a given geographical area and population over time are required to adequately update national malaria treatment policy, and such estimates need to be based on comparable and standardized data from different sentinel sites. To facilitate the use of such standardized assessments, a comprehensive database of published and unpublished efficacy studies has been established by WHO. The aim of this database is to assess the situation of antimalarial drug efficacy and drug resistance, and to compile all relevant information to assist countries in deciding if and how best to revise their antimalarial

treatment policy. The first estimates on the global levels of drug resistance in the period from 1996 to 2004, taking advantage of coherent analyses of the results in the WHO database was published.

5.3 Technical aspects of ACT implementation

Dr Andrea Bosman, WHO/HQ

The great majority of malaria endemic countries with chloroquine-resistant and SP-resistant falciparum malaria have adopted ACT (75/78) and 58 of them are deploying these medicines in the general health services with varying levels of coverage. Experience in several countries has shown that deployment of free ACTs generates up to two-fold increases in care seeking at public health facilities (compared to pre-ACT period). A few countries have maintained optimal ACT supply management in place (e.g. Burundi, Rwanda, South Africa, Tanzania, Thailand, Viet Nam) and some of these had ACT over-stocks following successful reduction of malaria transmission (e.g. Rwanda, South Africa, Tanzania). In the majority of countries, however, ACT supply is still insufficient, and stock-outs are frequent in peripheral health facilities. Very few countries have deployed ACT for home-based management of malaria, and generally on a low scale. Recent TDR studies in multiple countries have demonstrated the feasibility and acceptability of ACT deployment in home-based management of malaria in Ghana, Nigeria and Uganda. Preliminary results from one large-scale community trial in Ethiopia indicate that deployment of ACTs by CHWs during a malaria epidemic decreased by half the malaria-specific mortality rate compared to deployment at health facility only, and use of RDTs by community health workers (CHWs) generated significant cost saving compared to clinical diagnosis of malaria.

Over the past 3–4 years the public sector of ACTs has progressively decreased, due to increased competition among manufacturers and partly to the price reduction of artemisinin raw material and active pharmaceutical due to over-production in 2006. The recent reduction of the price of artemisinin raw material below production has produced withdrawal of agricultural suppliers and artemisinin extractors from the market, with consequent risk of relative shortage in 2009–2010, when demand for ACTs will continue to increase.

The private sector market in most endemic countries is still dominated by artemisinin monotherapies, showing heterogeneous quality and limited evidence on efficacy. The majority of malaria endemic countries still allow the marketing of these products, posing significant risks to the development of resistance to these medicines. If artemisinin resistance develops there will be no expected replacement medicines before 2015–2016 according to the most optimistic scenarios of the alternative antimalarial medicines currently in the development pipeline.

Several issues need to be considered in relation to the deployment of RDTs to extend parasitological confirmation of diagnosis in areas where microscopy is not available, notably the variability in sensitivity, stability, and user accuracy, as well as the reported limited impact of test results on therapeutic decisions. The variability of RDT performance is being evaluated by the RDT product testing project of FIND–TDR–WHO/WPRO. The results of the ongoing evaluation of approximately 45 tests will become public by November 2008.

5.4 Latest results of drug efficacy studies and development of plan of action for 2008–2009

Based on the recommendations of technical discussions, country representatives developed plan of actions for conducting drug efficacy studies during 2008–2009 (see Annex 3).

6. RECOMMENDATIONS

Member States

1. National malaria control programmes should work closely with national medicine regulatory authorities to withdraw from the market oral artemisinin monotherapy and other antimalarial medicines which do not comply with national treatment guidelines.
2. Malaria endemic countries with low coverage of basic health services should include delivery of artemisinin-based combination therapy together with rapid diagnostic tests in home management of malaria, and should also explore possibilities for integration with other community-based programmes for sustainability.
3. Countries involved in cross-border activities should harmonize and synchronize the implementation of such activities, with special reference to indoor residual spraying, drug efficacy studies and other related malaria control activities.
4. Malaria endemic countries should adopt universal coverage of long-lasting insecticidal nets (one LLIN for 2 persons) in targeted areas and incorporate resistance monitoring as a key component of monitoring and evaluation.
5. Malaria endemic countries should strengthen their routine malaria information systems. In-depth assessment of the current system should be conducted in order to develop a proposal for health management information systems as part of health systems strengthening to be submitted to the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM) in the coming round.
6. Djibouti, southern Sudan and Yemen should immediately plan and prepare for conducting national geo-referenced malaria indicator and parasite prevalence surveys in 2008 and ensure allocation of required funds and identification of survey teams.
7. Countries should identify priority topics for operational research funded by the Small Grants Scheme (July 2008), call for proposals at national level (August 2008), prepare research proposals and share them with the Regional Office for review (November 2008).
8. Countries should continue monitoring drug efficacy by in vivo techniques and other methods in some areas (molecular marker, pharmacokinetics) and should coordinate such

activities through the Horn of Africa Network for Monitoring Antimalarial Treatment (HANMAT).

9. Countries should budget for the cost of monitoring drug efficacy in proposals submitted to the Global Fund, and should consider reprogramming current grants as necessary to ensure the availability of funds for this activity.

WHO and HANMAT

10. The Horn of Africa Network for Monitoring Antimalarial Treatment (HANMAT) should maintain the current Chair, expand its membership to include Saudi Arabia and continue its affiliation with WHO.
11. WHO should continue to provide technical support to HANMAT and should host the HANMAT web site.

Annex 1

PROGRAMME

Sunday, 1 June 2008

- 08:30 – 09:00 Registration
- 09:00 – 10:00 Opening session
 Message from Dr Hussein A. Gezairy, Regional Director, WHO/EMRO *Dr G. Popal, WR/Yemen*
 Message from MOH/Yemen
 Objectives of the meeting and method of work
 Introduction of participants
 Nomination of Officers
- Review of progress made and problems encountered in the implementation of malaria control strategies**
- 10:30 – 10:45 Progress and way forward for malaria control and elimination at global level *Dr A. Bosman*
- 10:45 – 11:00 Regional vision for malaria elimination by 2020 *Dr H. Atta*
- 11:00 – 11:15 Progress of implementation of IVM for scaling up vector control interventions *Dr A. Mnzava*
- 11:15 – 11:30 Progress report of 2007 activities and feedback on annual malaria surveillance *Dr G. Zamani*
- 11:30 – 12:00 Discussion
- Malaria control in high burden countries – Progress, challenges and lessons learnt**
- 12:00 – 13:00 Djibouti
 Eritrea
 Ethiopia
 Saudi Arabia
- 14:00 – 15:00 Sudan (north)
 Sudan (south)
 Somalia
 Yemen
- 15:00 – 15:30 Discussions
- 16:00 – 16:15 Focus on operational research: TDR/SGS *Dr G. Zamani*
- 16:15 – 17:00 Group discussion to identify research priorities and timetable for proposal development
- 17:00 – 17:30 Updates on GFATM: preparation for R8 *Dr H. Atta*

Monday, 2 June 2008

- 09:00 – 09:30 World Malaria Report: country profiles and validation of results *Dr R. Cibulskis*
- 09:30 – 09:45 Discussions
- 09:45 – 10:15 Overview of problems in defining national disease burdens *Prof. B. Snow*
- 10:15 – 10:30 Discussions

11:00 – 11:30	Country Example 1: Somalia	<i>Dr A. Noor</i>
11:30 – 12:00	Country Example 2: Yemen	<i>Dr S. Brooker</i>
12:00 – 13:00	Discussion on how to improve collective national disease burden estimations for <i>P. falciparum</i> and <i>P. vivax</i> malaria in the Region	<i>Prof. B. Snow</i>
14:00 – 15:30	Group work	
16:00 – 17:00	Plenary: presentation of the group work and planning for the next activities in 2008–2009 for risk mapping, burden estimation and surveys	

Tuesday, 3 June 2008**HANMAT MEETING**

09:00 – 09:30	Where are we in HANMAT: Country presentation on results of drug efficacy studies and experience of ACT implementation at various levels	<i>Prof. A. Adeel</i>
09:30 – 10:30	Technical presentation on drug efficacy studies	<i>Dr P. Ringwald</i>
11:00 – 11:30	Discussions	
11:30 – 12:30	Djibouti Eritrea Ethiopia Saudi Arabia	
12:30 – 13:00	Discussions	
14:00 – 15:00	Somalia Sudan (north) Sudan (south) Yemen	
15:00 – 15:30	Discussions	
16:00 – 16:30	Technical presentation on different aspects of ACT implementation	<i>Dr A. Bosman</i>
16:30 – 17:00	Discussions	

Wednesday, 4 June 2008

09:00 – 10:00	Group work on planning for HANMAT activities
10:00 – 10:30	Plenary
10:30 – 12:00	Group work to draft recommendations
13:00 – 13:30	Conclusions, recommendations and closing session

Annex 2

LIST OF PARTICIPANTS

DJIBOUTI

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Annex 3

CURRENT/PLANNED DRUG EFFICACY MONITORING 2008–2009

Country	Sentinel sites	Antimalarial medicines needed	Starting date	Funding available/ source	Molecular laboratory to be used	Other needs	Comments
DJIBOUTI	Hôpital Peltier; CSC Arhiba, CSC Balbala 1, CMH Arta, CMH Ali sabieh, CMH DIKHIL, CMH TADJOURAH, CMH OBOCK	ASU+SP	NOV 08	NA, Reprogramming of GFATM R6, WHO?	PHARO MARSEILLE	French speaking consultant for training and supervision Medicine	Planning and training will start one month earlier (Sep. 08)
	Hôpital Peltier; CSC Arhiba, CSC Balbala 1, CMH Arta, CMH Ali sabieh, CMH DIKHIL, CMH TADJOURAH, CMH OBOCK	ASU+SP	NOV 09	GFATM R8	PHARO MARSEILLE	French speaking consultant for training and supervision Filter paper Medicine	Planning and training will start one month earlier (Sep. 08)
SAUDI ARABIA	Jizan	ASU+SP	NOV 08	WHO 30,000 \$	NAMRU 3	WHO consultant	Target all local cases in Jazan Add MM dhfr and dhps
	Aseer	ASU+SP	NOV 08	WHO 20,000 \$	NAMRU 3	WHO consultant	Target all local cases in Aseer Add MM dhfr and dhps
	Jizan	ART+LUM	NOV 09	WHO, 30,000 \$	NAMRU 3	WHO consultant	Target all local cases in Jazan Add MM dhfr and dhps
	Aseer	ART+LUM	NOV 09	WHO 20,000 \$	NAMRU 3	WHO consultant	Target all local cases in Aseer Add MM dhfr and dhps

SOMALIA	Jammame	ASU+SP	Oct– Dec 08	GFR6	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planning and training will start one month earlier (Sep. 08)
	Janale	ASU+SP	Oct– Dec 08	GFR6	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planning and training will start one month earlier (Sep. 08)
	Jowhar	ASU+SP	Oct– Dec 08	GFR6	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planning and training will start one month earlier (Sep. 08)
	NWZ and NEZ	SP	?	GFR6	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planning and training will start one month earlier (Sep. 08)
	Jammame	ART+LUM?	Sep– Nov 09	GFR6?	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planing and training will start one month earlier (Aug. 09)
	Janale	ART+LUM?	Sep– Nov 09	GFR6?	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planing and training will start one month earlier (Aug. 09)
	Jowhar	ART+LUM?	Sep– Nov 09	GFR6?	NAMRU3	Technical assistance Slide recheck (ext. slide ex)	Planing and training will start one month earlier (Aug. 09)
SUDAN (NORTH)	Kassala	ASU+SP	Sep 08	Not available 8500	National lab.	NAMRU-3 for QC PK/MM?	Fund secured from partners
	Gazira	ASU+SP	Sep 08	Available 8500	National lab.	NAMRU-3 for QC PK/MM?	Fund secured from partners
	Gazira	ART+LUM	Sep 08	Not available 8500	National lab.	NAMRU-3 for QC PK/MM?	Fund secured from partners
	Blue Nile	ASU+SP	Sep 09	Not available 8500 GFR7?	National lab.	NAMRU-3 for QC PK/MM?	
	White Nile	ASU+SP	Sep 09	Not available 8500 GFR7?	National lab.	NAMRU-3 for QC PK/MM?	

	White Nile	ART+LUM	Sep 09	Not available 8500 GFR??	National lab.	NAMRU-3 for QC PK/MM?	
SUDAN (SOUTH)	Juba Teaching Hospital	AS+AQ ART+LUM	Oct 08	GFATM round 2 ? 11350	KEMRI	Training, laboratory supplies and equipment, communication, internal and external quality control	NAMRU 3, as alternative option for PCR drugs in test and filter papers for PCR as well as external QC has to be sent by WHO for all sentinel sites. Consultant for basic training to the study teams in all sentinel sites
	Malakal Teaching Hospital	AS+AQ ART+LUM	Nov 08	GFATM round 2 ? 11350	KEMRI	Training, laboratory supplies and equipment, communication, internal and external quality control	
	Wau Teaching Hospital	AS+AQ ART+LUM	Jul y and October 2009	GFATM round 7 \$15 000	KEMRI	Training, laboratory supplies and equipment, communication, internal and external quality control	NAMRU 3, as alternative option for PCR drugs in test and filter papers for PCR as well as external QC has to be sent by WHO for all sentinel sites. Consultant for basic training to the study teams in all sentinel sites
	Lankien Health Centre	AS+AQ ART+LUM	July- October 2009	GFATM round 7 \$15 000	KEMRI	Training, laboratory supplies and equipment, communication, internal and external quality control	
YEMEN	Al-Malahedh (Hajjah gov)	ART+LUM	Oct 08	No	NAMRU 3	Medicines, slides, reagents, transportation costs, stationery, photocopying.	
	Bajil (Hodidah gov)	ART+LUM	Oct 08	No	NAMRU 3	Medicines, slides, reagents, transportation costs,	

					stationery, photocopying.	
Al-Mesemeer (Lahj gov)	ASU+SP	Oct 08	No	NAMRU 3	Medicines, slides, reagents, transportation costs, stationery, photocopying.	
Jabel Al-Sharq (Dhamar gov)	ASU+SP	Mar 09	No	NAMRU 3	Medicines, slides, reagents, transportation costs, stationery, photocopying.	
Al-Odein (Ibb Gov)	ASU+SP	Mar 09	No	NAMRU 3	Medicines, slides, reagents, transportation costs, stationery, photocopying.	