



Federal Ministry of Health
National Malaria Control Programme

Malaria Programme Review

2001- 2012

December 2013

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List of Acronyms

1.	ACT	Artemisinin-based Combination Therapy	21.	MDGs	Millennium Development Goals
2.	BCC	Behavioural Change Communication	22.	M & E	Monitoring and Evaluation
3.	BHU	Basic Health Unit	23.	MESS	Monitoring and Evaluation System Strengthening
4.	BNNICDs	Blue Nile National Institute for Communicable Diseases	24.	MIS	Malaria Indicators Survey
5.	CCM	Country Coordinating Mechanism	25.	MOH	Ministry of Health
6.	CMS	Central Medical Stores	26.	MPR	Malaria Control Programme Performance Review
7.	FMOH	Federal Ministry of Health	27.	NHSCC	National Health Sector Coordinating Council
8.	GAVI	Global Alliance for Vaccines and Immunizations	28.	NHSSP	National Health Sector Strategic Plan
9.	GFATM	Global Fund for fighting AIDS, Tuberculosis and Malaria	29.	NMCP	National Malaria Control Programme
10.	HANMAT	Horn of Africa Network for Monitoring Antimalarial Treatment	30.	NMPB	National Medicines and Poisons Board
11.	HMIS	Health Management Information System	31.	NPDTM	National Protocol for Diagnosis and Treatment of Malaria
12.	HMM	Home-based Management of Malaria	32.	OMQCS	Outpatient Malaria Quality of Care Survey
13.	IEC	Information, Education & Communication	33.	PHI	Public Health Institute
14.	IMCI	Integrated Management of Childhood Illness	34.	QA	Quality Assurance
15.	IPT _p	Intermittent Presumptive Treatment during Pregnancy	35.	RDF	Revolving Drug Fund
16.	IRS	Indoor-household Residual Spraying	36.	RDTs	Rapid Diagnostic Tests
17.	ITNs	Insecticide – Treated Nets	37.	SHHS	Sudan Household Survey
18.	IVM	Integrated Vector Management	38.	SMCP	State Malaria Control Programme
19.	KMFI	Khartoum Malaria Free Initiative	39.	WHO	World Health Organization
20.	LLINs	Long Lasting Insecticidal Nets	40.	WMR	World Malaria Report

SUMMARY

Background

Malaria Program-performance review (MPR) is a program development process subdivided into two steps: assessment of performance of country malaria control programs; and refining or redefining the strategic direction and focus. The current Sudan malaria control strategic plan (2011-2015) is envisaged as a malaria control plan towards achieving universal coverage with appropriate and affordable services. Taking into consideration the strategy is midway in its implementation; the MPR was considered a useful midterm evaluation tool. In addition to this there has been a perceived reduction in malaria burden between 2001 and 2012 and very low parasite prevalence in some states, Khartoum, River Nile, Red Sea and Northern states necessitated a programme reorientation from control to the consolidation of gains including pre-elimination as part of the malaria control-elimination continuum, hence the need for an MPR to facilitate a targeted epidemiological approach to malaria.

Commissioned by the Federal Ministry of Health (FMoH) in consultation with key stakeholders; the review was coordinated and managed by the Public Health Institute (PHI) in conjunction with the National Malaria Control Programme(NMCP). The MPR objectives were to: review malaria epidemiology in the country (endemicity, seasonality, parasite prevalence, vector distribution); review the policy and programming framework within the context of the health system and the national development agenda (programme organization, structure and management); review the current programme service delivery systems, their performance and challenges; including opportunities for integration of services for FMoH ; assess progress towards achievement of targets and document achievements such as the Khartoum Malaria Free Initiative(MFI) as well as others; define the next steps for improving programme performance and/or redefine the strategic direction and focus; including revision of the strategic plan and operational plans.

The MPR consisted of four phases: phase I: partnership and planning; phase II: internal thematic desk review; phase III: joint programme field validation; phase IV: final report, follow-up of recommendations; updating policies, strategic plans and re-designing the programme.

This aide memoire summarizes the major findings and critical actions emerging from the Sudan MPR.

Key Findings

The MPR documented findings along eight thematic areas: epidemiology; diagnosis and case management; vector control; surveillance, monitoring and evaluation (M&E) and research; epidemics and emergency preparedness and response; programme management; advocacy, information, education, communication and community mobilization and procurement and supply management.

1. Malaria Epidemiology in Sudan

The objective of the National Malaria Control Strategy (NMCS) 2011-2015 is to reduce the morbidity and mortality of malaria by 50% by 2015 all over Sudan (compared to reported cases in 2009). There is a general consensus among stakeholders that the malaria burden is decreasing and malaria programme is on track to reach the main objective of the national strategy; however it is difficult to conclude the exact magnitude of the reduction particularly at subnational level from the available data, mainly from Health Management Information System (HMIS), due to its incompleteness and inaccuracy. In 2011, in comparison with 2009, incidence of reported confirmed cases has decreased by 36%, and reported number of deaths by 46%. Reported total (probable and confirmed) malaria incidence has decreased by 71% in 2011 in comparison to 2000. The incidence of inpatient cases decreased by 25% in 2011 in comparison with 2000 and the proportion of inpatient malaria cases to all cause cases decreased from 26% to 9%. Parasite prevalence at national level was 1.8% in 2009 and 3.3% in 2012. Gedarif and south and west Darfur states were the main contributors to the rise in the parasite prevalence. The objective of the national strategy in areas targeting for malaria free status is to have reported malaria incidence, with 100% laboratory confirmation and reduction of confirmed incidence by at least 80% as compared to 2009 and will reach the level of 10 cases per 1000 in Northern, Red Sea, River Nile, Gezira and White Nile states. The confirmation rate and incidence rate in these states cannot be verified with available data.

Plasmodium falciparum is responsible for more than 95% of malaria cases in Sudan. However, an increase in *P. vivax* cases has been noticed in the last years. The primary vector is *Anopheles arabiensis* and is widely distributed in Sudan although *An. funestus* has been reported in southern parts of Sudan (White Nile state).

2. Diagnosis and case management

Based on the target of NMCS 95% of malaria patients in Sudan will receive prompt and effective treatment as per the national treatment policy by 2015. The use of AS+SP has increased from 44% in 2009 to 47.7% in 2012. A functioning national technical advisory committee for malaria case management exists. Diagnosis and treatment are based on updated national treatment guidelines developed in 2004 including diagnosis, case management of severe malaria and malaria in pregnancy. It was distributed widely all over the country to cover public, NGOs treatment centers and health facilities and some private health facilities. In addition, there are training manuals and job aids for different care providers (medical doctors, medical assistants, and nurses) in English and Arabic languages. The compliance of physicians with treatment guidelines is poor and use of injectable artemether unnecessarily for uncomplicated malaria is wide spread in public and private sectors. Technical advisory committee recommended restricting procurement and distribution of injectable artemether. The coverage of health facilities with malaria diagnosis in 2012 was more than 80% for RDTs among basic health units. Microscopy diagnosis with varying quality is available in health centers and hospitals but there is no recent data to estimate the proportion of functional facilities. In 2012, 78% of health facilities were providing ACTs according to national treatment policy. The NMCP had stock out of ACT in the last quarter of 2012 and the first quarter of 2013. The Home Management of Malaria (HMM) has expanded to reach 1,131 communities with

coverage of 48% of the total targeted communities. This achievement is on track with 65% target of national strategy. However, weak supervision and high drop out of volunteers are the main challenges of the HMM services. As for other diseases, there is a weak referral system and hence poor compliance to protocols. National policy is still not clearly indicating that malaria diagnosis and treatment must be free for communicable diseases to stop public transmission. ACT and RDT are free in public health facilities but not microscopy.

3. Malaria vector control

There is a strong national network of entomological surveillance, which comprises of 64 sentinel sites in 17 States this is supported by two entomological reference research and training centres at Sennar and Blue Nile National Institute for Communicable Diseases. A national inter-sectoral committee (ISC) has guided the process of integrated vector management (IVM) at the national level, consequently an IVM department exists as a component of the environmental health department, which is under the Directorate General of Primary Health Care. Steady progress, with 54% operational coverage in ten states in 2013 in comparison with 17.6% in 2012, has been made in up-scaling Long-lasting Insecticide-treated Nets (LLINs), with maximum coverage achieved in a few selected States (Blue Nile and West Darfur) whereas similar progress in other states has not been made. Based on the results of household surveys, household ownership of ITNs increased from about 41% in 2009 to 51% in 2012 and proportion of households with at least one LLIN per 2 persons in household was 16.5% in 2012. Proportion of household members who slept under LLIN did not change (10.8 % in 2009 and 10.5% in 2012) which is far from the 90% target of national strategic plan. The proportion of household members who had LLINs and slept was 25% in 2009. In one study conducted by the programme in 2012 in three states, 85% of household members who had LLINs slept under the net. Annual Indoor Residual Spraying (IRS) operational coverage has remained above 90% in 2 States (Gezira and Sennar), which exceeds the targeted coverage (85%) by 2015. However operational challenges due, to insufficient insecticide stocks, inadequate logistical support and operational cost have delayed the expansion of IRS operations to other targeted localities. Insecticide susceptibility surveys conducted between 2007 and 2013 in 10 states revealed resistance to 3 insecticide classes (organochlorine, organophosphate and pyrethroid), further investigations are underway to identify the resistance mechanisms involved, geographical scope and incrimination of the vector. Larval source management has been an important component of the Malaria Free Initiative (MFI) launched in Khartoum in 2002 and contributed to a significant decline in malaria prevalence from 29.2% in 2002 to 0.35% in 2008. Coverage of LSM, aside from Khartoum, is 33.7%. The target of national strategy is 85% by 2015.

4. Surveillance, M&E and research

Target of the NMCS for implementation of national malaria database at the states level is not implemented yet. States have M&E units and M&E plan. Planned MIS was conducted in 2012 and draft report is available. Malaria surveillance in Sudan consists of multiple and fragmented systems. Malaria weekly reporting system consisted from 154 sentinel sites, that are reporting total number of cases, number of tested, confirmed cases, deaths, inpatients and all causes of outpatient and inpatient cases, all by age

group. The system potentially provides needed information for detection of epidemics and an overall picture of trends of diseases at national and subnational level in the absence of reliable monthly data from HMIS. However this system is facing challenges such as: shortage of enough trained staff mainly due to high turnover, low coverage of sentinel sites in some states, low quality of microscopy and its quality control in some sentinel sites, weak data management, analysis, usage and feedback particularly at the sentinel site and locality level and in some cases even at the states level. Department of epidemiology and surveillance has its more than 1500 sentinel sites in the whole country and malaria is one of the diseases covered by this system. The report in this system is weekly and includes number of cases treated as malaria; however, confirmed cases are not reported. There is a plan for strengthening Integrated Disease Surveillance (IDS) system by department of epidemiology and surveillance. The epidemiology department informs malaria programme if they detect increase in the number of cases but data are not shared with malaria programme in all states. Routine health information system collecting monthly data on total reported cases, confirmed cases and all causes by age group but there is no data on the number of tested. Reports shows that almost all public hospitals are reporting health services utilization data, while only around 30-40% of PHC facilities are reporting. Ministry of health is planning for implementation of health information system reform strategy for strengthening routine information including malaria in an integrated approach.

Sudan has a strong history and capacity for basic and operational research in different aspects of malaria at the national and subnational malaria programmes, universities and research institutions. Malaria control programme has established some collaboration with research institutions however this link is not dynamic and does not include all institutions involved in malaria research. Programme has a research focal point and is involved in operational research. There is no comprehensive database of the conducted researches in the country that potentially are sources for valuable evidences for strategy development and updates.

5. Epidemic and emergency preparedness and response

Target of NMCS is to detect and properly respond to 80 % of malaria epidemics within 2 weeks of onset. This is on track with more than 80% being detected. Sudan has a history of frequent and devastating malaria epidemics in the low and unstable seasonal transmission areas in the Northern, River Nile, Khartoum, White Nile, Geziera, Kassala, Gedarif, Red Sea and North Kordofan, especially in urban areas. The major risk factor for epidemics has been increased rainfall, spread of irrigated agriculture within city limits, construction of new urban colonies without proper facilities for drainage, influx of refugees and IDPs. There has been an overall reduction of major epidemics reported in the last decade. The last epidemic reported has been in 2009 in Shabasha area, El duweim locality in White Nile State. There is collaboration with the Metrological services but this needs to be more structured to be able to provide short and medium term malaria forecast for early warning in relation to annual seasonal rainfall forecast and in relation to expected cyclical post drought forecasts. For early detection and response to outbreaks there is 154 malaria specific sentinel sites and more than 1500 sentinel sites in epidemiological weekly surveillance system with the use of malaria thresholds in some states such as Khartoum, Gezira, Sennar. There is a need to establish standard a malaria threshold in all states. The epidemic response is through state malaria control

programs which prepare annual preparedness plans with estimated emergency stocks of commodities. There are also general epidemic response teams under the epidemiology section at state level.

Since 2003 there has been a gradual increase in emergency situation in some states has become a major barrier to universal access and coverage with service delivery. However the program has continued to access remote and hard to reach areas through its state and locality malaria teams supplemented by use of HMM volunteers at village level. The program has also been able to directly deliver vector control services to all IDP and refugee camps and has built a unique partnership with national (Roufeda, Sudan Red Crescent) and international NGOs (MSF, Plan , World Vision etc.) and UN agencies (UNICEF, WHO, UNHCR) to compliment supplies and deliver RDT and ACT through IDP health centers.

6. Malaria Programme Management

The target of NMCS is that all malaria programs at locality level will have at least 4 trained staff on different aspects of malaria control. It is reported that in 2013, 90% of locality malaria programs out of target of 107 have at least 2 trained staff on different aspects of malaria programs. The Sudan NMCP is a division at level three in the FMOH organogram under the Directorate of Communicable and Non- communicable Disease Control and General Directorate of Primary Health Care. Following the FMOH policy of integration in early 2013 the program has now downsized from three well-structured departments to one, consisting of monitoring and evaluation department with a support of administration unit headed by the director of National Malaria Control programme. The state malaria control programme (SMCP) in each of the 17 states are well structured with adequate capacity in four departments; monitoring and evaluation, case management, Integrated vector control and advocacy, IEC and partnership supported by an administration unit. The program has a strong human resource technical capacity built on a core of public health officers. This is supported by a positive strategy for on-going in-service training and postgraduate training in entomology and public health but continues to struggle to fill gaps and retain well trained staff especially at the locality level and deploy adequate field workers at administrative and village levels. NMCP has been experiencing changes in offices that resulted in disorientation of staff, efficiency decrease and sometimes loss of vital documents.

The Sudan RBM initiative launched in 1998, the first strategic plan was from 2001 to 2010. The current malaria strategic plan is from 2011 to 2015 and is not aligned to the national health planning cycle 2012 to 2016. The states strategic plans and annual plans are aligned to the federal strategic and annual malaria operational work plans. The program has overtime developed a strong network of national and international partners and stakeholders but there is no updated annual mapping of stakeholders and their contributions with scheduled quarterly and bi-annual consultative meetings. There is lack of support by a functioning and broad based malaria technical committees and thematic area sub-groups from other health departments, universities and research institutions except malaria case management and vector control. Malaria policies in prevention (LLIN, IRS and IVM) and diagnosis and treatment (Microscopy, RDT and ACT) are aligned with WHO recommendations. There has been increasing malaria financing since 2000 from the government at federal, state and locality level and by

many local partners. Malaria control programme is being supported by the Government of Egypt, Islamic Development Bank and the Global Fund, WHO and UNICEF. Gap analysis has not been updated annually. The program conducts joint review and planning meeting three times a year supported by production of quarterly and annual reports at state level. However, NMCP is not being producing quarterly and annual reports.

7. Advocacy, information, education, communication and community mobilization

In 2012, only 30% of the surveyed household had knowledge of the essential package for malaria. Proportion of individual with fever who took medical advice within 24 hours increased from 16% in 2009 to 35% in 2012. The advocacy campaigns for malaria in Sudan have resulted in a very good understanding among politicians and decision makers. Malaria is a priority in national health sector planning and national development planning. This is reflected in strong presidential political commitment and national ownership reflected through increase domestic financing, removal of taxes and tariffs on malaria commodities and incentives for malaria workers. Annual World Malaria Day events continue to sustain advocacy and social investment. The IEC strengths include the availability of health promotion staff, introduction of Communication for Behavioral Impact (COMBI) strategy and the Government commitment to support the malaria prevention. Advocacy, IEC and partnership health promotion officers are present in all states and in some localities and administrative units in some states. However to reach universal coverage there are not enough health promotion officers and there is need to extend this community sensitization and mobilization capacity at field and household level through training of community leaders and youth groups, HMM volunteers, Mosquito control field workers, Red Crescent volunteers, school sensitization and by revitalizing of the national community health worker program.

Malaria IEC materials are widely available but there is need to conduct more focussed research and update the key malaria messages to target populations and produce relevant materials in adequate quantities to use in house visits. The use of malaria metallic bill boards along the roads and other strategic travel points could help to address the issue of malaria associated with movement of people between high and low or malaria free areas.

Malaria indicator survey and other house hold health surveys continue to provide an opportunity to review progress of KABP on malaria at household level. Focus of IEC and even the whole malaria program is centred on mosquitoes and not on parasites.

8. Procurement and Supply Management

The Central Medical Supplies with its revolving fund for subsidized medical supplies has been integrated with GF-Malaria free RDT and ACT supply system since 2012. The storage and logistics support (107 sites) for delivery of Malaria RDT and ACT has been strengthened from locality to state and central level. However some localities have not been covered. There is a monthly reporting system on RDT and ACT and malaria cases treated from all health units to CMS at state level. The locality and state malaria programs do not jointly track monthly stock levels with CMS. This central and state system does not include procurement and supply of LLIN, IRS and LSM chemical and

equipment. The storage for LLINs, vector control equipment and chemicals at locality level appears inadequate and has not received specific attention. The quantification and forecasting of IRS and LSM chemicals, pumps, LLINs, RDTs and ACTs is in place in joint collaboration by CMS and NMCP but remains a challenge due to variation in use and demand by health facilities and malaria workers. There have been reports in the late 2012 and early 2013 of RDT and ACT stock outs and delay in scaling up of IRS campaign due to delay in financing and procurement. There is local production of ACT but all other malaria commodities are imported.

CONCLUSION

Through a highly consultative process involving a number of partners and policy makers, the Malaria Programme Performance Review has highlighted achievements, articulated challenges, and proposed strategic orientation and action points for malaria programming and pre-elimination in Sudan.

The program has shown high level performance and success over the past decade and needs to renew and strengthen political commitment, policy and strategic direction and management capacity to move to rapidly intensify control towards universal access and coverage and in targeted states and localities to consolidate control and move to pre-elimination in others to reach MDG goals and targets by 2015.

Recommended priorities from the review for the next five years towards consolidation of gains and pre-elimination are as follows:

- Develop a comprehensive Strategic Plan for malaria in Sudan including sustained control as well as and pre elimination in selected states and localities, wherever feasible, based on global guidance, new epidemiological realities and local micro-stratification by lowest administrative level possible and integrated approaches.
- Advocate for government to sustain political commitment and increase domestic financial resources to malaria control.
- Active participation and coordination with HMIS for implementation of health information system reform strategy and Integrated disease surveillance
- Provide NMCP with a functional malaria database and strengthen capacity of programme staff for analysis of existing epidemiological data for programme planning and management
- Improve the framework for partner coordination, inter-sectoral collaboration and strong involvement of private sector and community at all levels

1. INTRODUCTION

In 2011 the former Sudan witnessed a process of referendum which resulted in separation of the country into two nations, with the birth of a new government of Southern Sudan. This process has changed the geographical boundaries, size, political landscape and disease epidemiological profile of the country.

Now Sudan has a land area of 1.8 million square kilometers, traversed by the Nile and its tributaries, shares its borders with Southern Sudan, Central African Republic, Chad, Libya, Egypt, Eritrea and Ethiopia. It has access to the Red Sea with 853 kilometers long coastline. Its terrain is generally flat, mountainous in northeast and west, while desert dominates the north. The country now has 18 states instead of the former 15 states, where two new states were created from the former three Darfur states in 2012 and a new state from former North and South Kordofan States (Figure 1).

According to the 2008 Sudan Population Census, total population is estimated at over 33 million people; 88% are settled, including 32.7% in urban areas, while 8% are nomads. Almost 6.9% of the population is internally displaced; partly as a result of the increasing urbanization, natural disasters, civil conflicts and poor conditions in rural areas. Life expectancy at birth is 59 years (58 years for males and 61 years for females – 2008 Census). Meanwhile, 83 out of every 1000 children do not live to see their fifth birthday (*Sudan Household Survey, 2010*).

Figure (1): Map of Sudan after 2011 Referendum



Sudan is rich in natural resources, including oil, mineral, agriculture and animal resources. Its economy, with the export of crude oil in 1999, boomed due to increases in oil production, high oil prices, and significant inflows of foreign direct investment. The economic growth has however promoted mainly the urban and main cities, leading to the increasing disparities between rural and urban areas as well as between states. Poverty remains widespread in Sudan with 46.5% of the population living below the poverty line according to the national definition of poverty (3.8 SDG per person per day). Those who are mostly affected by poverty are the rural dwellers, particularly women and internally displaced people. Indeed the Human Development Index of Sudan is low (a score of 0.408), and ranked Sudan in 2011 at 169 out of 179 countries (*Human Development Report, UNDP 2011*).

Sudan reached an oil production level of about 520,000 barrels per day (83,000 m³/day) in 2011. However, after the 2011 referendum, 75% of the oil production was taken by the new nation. This has significant impact on the government revenues as oil was contributing to about 30% of the national budget. Further, this will impact the near future economic forecast and the fiscal space and the resources available for social services including health. The best scenario shows that the annual economic growth will decrease from 5-6% annual growth rate before 2011 to about 2% in 2012. The table

below shows the projected economic scenario in the short term future (2012-2016) according to Ministry of Finance and Central Bureaus of Statistics forecasts (Macroeconomic Framework, 2011 as referred to in the NHSSP).

Table (1): Economic projections for Sudan, 2011-2016

Economic Indicators	2011	2012	2013	2014	2015	2016
Population	33.2	34.10	35.00	35.90	36.80	37.70
Population Growth Rate	2.65	2.64	2.57	2.51	2.45	2.40
GDP current prices Billion (SDG)		228.6	270.8	318.25	367.6	420.8
GDP growth rate %		2.00	3.00	4.00	5.00	6.00
Inflation Rate %		17	15	13	10	8
Average Exchange rate (USD/ SDG)		3.00	3.10	3.20	3.30	3.40
GDP (Billion USD)		76.20	87.40	99.50	111.40	123.80
Per capita GDP (Nominal) USD		2,233.50	2,497.30	2,772.60	3,029.30	3,282.90

The main anticipated threats to public health in Sudan are natural disasters, conflicts, epidemics and economic hardship. Natural disasters like floods have adverse effects on many States. About 18% of the population is highly affected every year during the rainy season (June-September). Also, drought comprises a real hazard in certain States like West & South Darfur and which affects about 10% of population. The armed conflict in Darfur region, started in 2003, has severely affected the health and development of local communities. Recently conflicts have also taken place in Blue Nile and South Kordofan states.

The epidemiological profile of Sudan, typical of other Sub-Saharan African Countries, is dominated by communicable diseases and malnutrition, frequently aggravated by natural disasters (floods, heavy rains and droughts) as well as sustained internal conflicts. Main causes of morbidity and mortality are infectious and parasitic diseases, particularly malaria, tuberculosis, schistosomiasis, diarrheal diseases, acute respiratory infections and protein-energy malnutrition (*FMOH annual statistical reports*).

With changes in socio-economic and lifestyle conditions, non- communicable diseases (NCDs) are also now emerging as a major public health problem in Sudan leading the country into a double burden of disease era. Priorities to be addressed include

hypertension, diabetes, heart disease, cancer, asthma, cataract and mental diseases (*FMOH annual statistical reports*).

Despite decreasing burden of malaria in Sudan, as will be seen elsewhere in this report, the disease continues to be a challenging public health problem in the country. It is estimated that 75% of the population (24 millions) are at risk of malaria, while 25% are at risk of malaria epidemics (*WHO, 2004*).

Sudan has a long history of malaria control activities, dating as far back as the beginning of the 20th century, when very successful interventions based on simple vector control strategies led to the eradication of malaria from Khartoum in 1906 and the near elimination of the disease from many parts of northern Sudan (*Baflour A, 1904*). Malaria control efforts continued with the attempt to disease eradication in the 1950 – 1960s and were pioneered by the Blue Nile Health Project in Gezira State (1979-89) (*activities reported by El Gaddal 1985*).

In 1998, Sudan endorsed the international Roll Back Malaria initiative (RBM) as the organizing principle for its own activities, placing more attention on early diagnosis and prompt treatment and multiple prevention measures with incorporation of the Abuja Declaration Targets. Being one of the Millennium Development Goals (MDGs), the country continues to prioritize efforts for malaria control as reflected in the key goals of the National Health Sector Strategic Plan (NHSSP). The country vision in that respect is to have halted by 2015, and begun to reverse, the incidence of malaria and other major diseases and the spread of HIV/AIDS (MDG6).

Based on these initiatives three strategic plans were set into action during the last thirteen years, these were strategic plans (2002 – 2006), (2007 – 2011) and (2011 – 2015). A huge number of interventions and activities took place all over the country during this time period with huge government and donor support (RBM, WHO, UNICEF, World Bank and Global Fund for fighting AIDS, Tuberculosis and Malaria (GFATM)). This necessitated conducting a Malaria Programme Review. While looking forwards to the next few years in the National Health Sector Strategic Plan 2012 – 2016, it is necessary to review efforts in the previous decade as a strategic tool for planning, programme management, and to consolidate collective efforts for malaria control in the country. The review covers the period from 2000 to 2012. This report only covers the tracking of information regarding the northern States of the former Sudan (currently the

Republic of Sudan), and most of the secondary data available for this report refer to the former 15 states.

This MPR report falls into eight chapters seven of them covering themes of malaria control:

- MPR objectives and processes
- Epidemiology of malaria in Sudan after referendum
- Malaria control programme management
- Prevention of malaria and vector control
- Malaria case management
- Information, Education, and Communication for malaria control
- Malaria surveillance and monitoring and evaluation system
- Malaria epidemic preparedness and response system

2. REVIEW OBJECTIVES AND PROCESSES

2.1. About the Review

The Malaria Control Programme Performance Review (MPR) is a periodic joint collaborative high level programme management process for evaluation of progress and performance of the country programme within the national health and development agenda. Aim of the review is to improve the operational performance and the strategic direction for scaling up delivery of mix of anti-malaria interventions in order to reduce malaria morbidity and mortality and overall transmission.

The review covers all technical and management areas of malaria control policies and programming and helps to build effective and efficient malaria control programme by identifying major achievements regarding outcome and impact, best practices, lessons learnt, critical issues, priority problems. It also investigates the causes of problems and recommends solutions to move forwards regarding equity, coverage, quality and impact of services and malaria control interventions.

2.2. Review Objectives

Objectives of the MPR are:

- To review malaria epidemiology in the country in terms of endemicity, seasonality, parasite prevalence, morbidity and mortality.
- To review policies and programme framework for malaria control within the context of the health system and the national development agenda (programme organization, structure and management)
- To review current programme service delivery systems, their performance and challenges; including opportunities for integration of services with other MOH health services.
- To assess progress towards achievement of targets and document programme achievements and success stories.
- To define the next steps to improve programme performance and/or redefine the strategic direction and focus; including revision of the Strategic Plan and operational plans.

2.3 Review Processes

2.3.1. Review Management and Coordination:

The NMCP obtained approval to conduct the review from the Federal Ministry of Health and stakeholders; including the current donor funding structures like GFATM.

The Public Health Institute Sudan was approached to conduct the review, and thereafter worked in close collaboration with the NMCP to set up review objectives, methodology, teams, and terms of reference and different roles and responsibilities of stakeholders. The review was conducted mainly as a desk review with participation of the NMCP, the MOH, national stakeholders, and internal and external consultants (Annex 1).

2.3.2. Review Phases

The MPR is supposed to be conducted in four phases, three of which were actually finished and the fourth phase is to come after finalizing and publishing review report (Annex 2).

2.3.2.1. Phase One: Planning and Preparation (Inception)

Phase one of the review consisted of internal consultation within the NMCP and MOH with a policy decision to why a review is required. It is the planning phase

of the review where the review project protocol and plan were formulated with support of experts in the field. In this phase malaria programme thematic areas to be reviewed were approved. Phase one went through the following milestones:

Step.1. Defining the need for the review and developing terms of reference;

Step.2. Assign review coordinator; establish internal secretariat and management team;

Step.3. Identification of multi-skilled internal and external review teams;

Step.4. Develop review check list of activities and time table;

Step.6. Develop review plan and proposal with budgeting;

2.3.2.2.Phase Two: Thematic Desk Review

Phase two consisted of conduction of thematic and systematic reviews by MPR teams supported by local experts in defined areas, based on malaria programme data, reports, documents, and published literature collected by Public Health Institute (PHI) and NMCP teams. Teams met with other departments of the MOH and local stakeholders and RBM partners to prepare a situation analysis to triangulate the issues for consideration in the review.

Data were extracted into tables and excel spread sheets for each thematic area and managed through these tables and spreadsheets (both for qualitative and secondary data). Narrative methods were used to collate and interpret the findings.

Teams compiled the national and state profiles for use in the review. Through phase two report MPR teams communicated their findings to various stakeholders and international reviewers prior to their arrival in the county.

Phase two went through the following milestones:

Step.1. Assembling of documents and conducting literature review;

Step.2. Updating of malaria data base and malaria country profile;

Step.3. Updating of malaria epidemiology, trends and assessing programme impact;

Step.4. Updating data from malaria research studies and sentinel sites;

Step.5. Summarizing data and trends from malaria community and facility surveys;

Step.6. Updating of malaria burden estimates.

Step.7. Updating information about major programme activities, achievements, best practices and lessons learnt;

Step.8. Updating information about status of programme indicators (coverage, outcome, equity, quality, impact);

Step.9. Updating information about changes in major malaria risk factors;

Step.10. Updating information about major problems, bottlenecks or barriers to implementation and scaling-up;

Step.11. Internal systematic/document review and preparation of technical and programmatic areas overviews (Phase Two Report);

2.3.2.3.Phase Three: Field Reviews

Phase three consisted of a more interactive data collection. The internal review team has undertaken in-depth interviews and focus group discussions with key informants from SMCPs and NMCP and stakeholders.

The external review team visit gave reviewers an opportunity to interact with those responsible at the level of service provision and at national, state, and locality levels of malaria programme management and tracking. Each team leader was responsible for completing the review report and participate in the aide memoire.

This phase culminated in a meeting with all stakeholders to solidify the recommendations to the NMCP. Phase three went through the following milestones:

Step.1. Briefing and team building between internal and external review teams;

Step.2. Formation of sub-teams of technical working groups;

Step.3 Review and adapt data collection tools for field visits;

Step.4. Briefing and consensus on central, state and locality field visits;

Step 5. Central visits to national institutions and organizations;

Step.6. State and locality field visits;

Step.7. Sharing of reports/presentations from central, state and locality visits; and consensus;

Step.8. Preparation of draft report and aide-memoire;

Step.9. Preparation of power point presentation of key findings and recommendations;

2.3.2.4.Phase Four: Communication of Findings and Follow up of Recommendations

Phase four will be led by the NMCP, FMOH; and supported by Stakeholder Forum. The final review report will be presented and findings approved by the FMOH and stakeholders. A high level meeting would be organized with the Ministry of Health which would discuss and endorse the Aide Memoire.

Phase four is expected to go through the following milestones:

Step.1. Preparation of the final review report;

Step.2. Finalization and publishing of the report;

Step.3. Presentation of review findings and recommendations and signing of the Aide Memoire;

Step.4. Dissemination of review report;

Step.5. Incorporate recommendations into strategic and annual plans of the NMCP;

Step.6. Monitoring implementation of recommendations;

2.3.3. Review Tools

Based on standard WHO MPR guidelines, tools (Annexes 3 - 12) have been customised based on country specific requirements, for data collection in the thematic desk and field review phases. Checklists, interview guides and questionnaires have been prepared and adapted to fit country requirements. Field review tools have been designed and customised to focus on key Strengths, Weaknesses, Opportunities and Threats (SWOT) elements.

2.3.4. Challenges that faced the Review

The original MPR project schedule was planned for an eight months review. However, due to a number of challenges this was too tight a schedule and the actual time needed for the review was 18 months.

Time planned for phases one and two was 4 months for each phase while the time actually taken was 7 months for each. Phase three needed four months including one month with the external reviewers, while the time planned was 2 months.

The main challenge that faced the review was the high turnover of review staff and experts. Of similar importance was the big volume of data that need to be reviewed from secondary sources in the thematic desk review and consolidated by triangulation and verification from different document sources.

In recognition of the lengthened time for the MPR, the Steering Committee recommended addition of the year 2012 into the review to enhance its relevance to phase recommendations and the forward looking malaria control strategy.

As Phase Two was extended, this had a ripple effect on Phase 3 which was started in parallel to Phase 2 finalisation. This limited the opportunities to customize Phase 3 tools based on Phase 2 findings, and so phase 3 tools were customized to extract the generic SWOT features for the MPR.

There was a great opportunity through the external review team mission to finalise Phase 3 by consolidating all the findings from Phase 2 and 3, leading to a focused assessment on the remaining gaps. The assistance of the external reviewers in this respect is invaluable.

3. EPIDEMIOLOGY OF MALARIA IN SUDAN

3.1. Malaria Morbidity

There has been considerable reduction in malaria morbidity in recent years, following acceleration of malaria control activities in Sudan post RBM initiative. According to the National Protocol for Diagnosis and Treatment of Malaria (NPDTM) “A malaria case is confirmed by demonstration of asexual forms

(trophozoite stage) of the parasite in a thick or thin peripheral blood film or by rapid diagnostic test in the presence of fever". Malaria case definition remained unchanged throughout review period

According to the FMOH annual statistical reports, all age malaria cases reported to public health facilities declined from an estimated 7.5 million cases in 1990 to 4.3 million in 2001 and then to 1.2 million by the end of 2011, with 72% decline in reported malaria case load by the end of 2011 compared to the baseline in 2000 (Figure 2). Malaria cases reported here include both laboratory confirmed and clinically diagnosed cases.

This review period coincides with the first National Strategic plan for Roll Back Malaria 2001 – 2010. By the end of the plan, achievement in reduction of malaria morbidity was 66.2% while plan was targeting 50% reduction.

Though trend of reported malaria cases was decreasing in the period 2000 – 2006 following acceleration of malaria control activities post RBM, reported cases peaked in 2007 and 2008 (Figure 2). This is due to the fact that data of malaria cases attending public health facilities was taken from reports of patients receiving free anti-malaria drugs treatment following scale up and expansion of free anti-malaria drugs distribution to governmental health facilities and not from FMOH annual statistical reports. Thus health facilities reporting to the National Malaria Control Programme (NMCP) were far more than those reporting to the FMOH information system. Following discussions in the FMOH, malaria control programme had to go back to FMOH annual statistical reports for malaria morbidity data.

Percentage of reported malaria cases out of all outpatients' clinic visits almost halved by the end of 2011, where it declined from 17% in 2000 to 9% in 2011 (Figure 3), and incidence of malaria cases declined from 139 cases / 1000 of population in 2000 to 36 /1000 in 2011 (Figure 4).

Prevalence of malaria at national level declined from 3.7% in 2005 to 1.8% in 2009 and then increased to 3.3% in 2012 (based on RDTs). Moreover, it was observed that malaria parasite infection was three times higher in rural compared to urban areas (*MIS 2005 – 2012*). Although in 2012 prevalence increased in 10 out of the 15 states of the country compared to 2009, yet in most of the states

increase was marginal with the exception of two states; Gedarif and South Darfur where increase was substantial. In Gedarif, South and West Darfur States prevalence of malaria was high enough to influence increase of the national figure compared to 2009. As compared to reported malaria cases and according to NMCP, overall malaria case load in 2012 totalled to 964698 cases i.e. trend of malaria case load is decreasing keeping in line with the trend till the end of 2011. Prevalence figures in MIS 2012 were shown for the new Eastern and Central Darfur States which did not exist in 2009. To make possible comparison of prevalence for South and West Darfur States in 2009 with that for 2012, an exercise was done to calculate prevalence for old South and West Darfur States for 2012. Prevalence figures for current South Darfur and Eastern Darfur States were summed up to make the figure for old South Darfur State while figures of current West Darfur and Central Darfur States were summed up to make the figure of old West Darfur State. Results showed that prevalence for old West Darfur State in 2012 is 6.2% compared to 7.1% in 2009 while prevalence in old South Darfur State is 1.2% compared to 4.7% in 2009 i.e. prevalence is increasing in both old West Darfur and South Darfur States.

At state level, in five of the states surveyed in 2005, 2009 and 2012 (Gedarif, Kassala, Sinnar, South Kordofan, South Darfur) prevalence of malaria increased following decline in 2009 (Table 2 & Figure 5). Of special interest was the marked decline in prevalence of malaria in Blue Nile State in 2012 compared to 2009 in spite of the conflict which was expected to have compromised delivery of vector control interventions and ACTs. A number of factors could have resulted in the 2012 increase in prevalence of the disease, but more in-depth investigation is needed. Economical crisis in the country was tighter in 2012 compared to previous years. This might have negatively impacted capabilities of state and locality governments to implement vector control and other major malaria control interventions as effectively as in previous years, especially containment of drawbacks of autumn season in 2012. There is increased population movement between Gedarif and Kassala States and some neighbouring countries due to construction of between countries roads. System of free anti-malaria drugs supply was unstable in 2012, where responsibility for the supply chain was

transferred from the National Directorate of Pharmacy to the Central Medical Stores (CMS) in June 2012. Conflict in Darfur States is unlikely to be behind sharp increase of prevalence of malaria in South Darfur and in West Darfur States in 2012, as in North Darfur State increase of prevalence in 2012 compared to 2009 was only marginal. To add to this is the fact that both Blue Nile and South Kordofan States are conflict areas, yet there was a marked decrease of prevalence in Blue Nile in 2012 compared to 2009 and in South Kordofan increase of prevalence in 2012 compared to 2009 was marginal.

In two states (North Kordofan and White Nile) trend of prevalence was continuously increasing since 2005 up to 2012. It seems that in these states there are chronic unresolved problems of malaria control activities in addition to above mentioned factors, and comprehensive investigation is needed to explore factors behind this increasing trend.

In four states (Northern, Red Sea, River Nile, Khartoum) prevalence of malaria was less than 1% since 2009. These states are now approaching the malaria-free zone according to adopted NMCP classification of zones of malaria transmission (Table 5) and are eligible for reorientation towards pre-elimination phase of malaria control in the coming years. Northern State specifically is considered malaria-free since 2009. This is the result of sustained implementation of major malaria control interventions to date supported by partnership of the long standing cross boarder collaboration project between governments of Sudan and Egypt “the Gambia Control Project”. The project provides an annual budget of around 1.5 million US dollars in form of vehicles, insecticides, running cost of IRS campaigns and conduction of malaria entomological and parasite prevalence surveys. Project activities also target some parts of River Nile and Kassala States.

Although the percentage of admitted malaria cases out of all disease admissions in hospitals declined from 26% in 2000 to 9% in 2011 (Figure 6), yet the absolute number of admitted malaria cases did not decline compared to the baseline (Figure 7), and indeed there was an increase in the number of admitted malaria cases for most of the period between 2000 – 2011 with the exception of the year 2011. Increase of reported malaria admissions could reflect limitations in

coverage of population by primary health care facilities, namely health centres and dispensaries, but could also reflect late presentation of cases to these facilities, or limitations in implementation of malaria case management protocol in these facilities or chloroquine resistance.

According to MIS 2012 results, prevalence of malaria infection was marginally higher among male compared to female members of the household, as in MIS 2009. Prevalence is higher in rural (4.3%) compared to urban (1.7%) areas, similar to result in 2009. When stratified by age, prevalence was highest in the age group 5-19 years followed by age group 0-4 years and lowest in the age group 44 years and above. Prevalence of infection among individuals in the lowest wealth quintile was almost 9 times higher than those in the wealthiest quintile also similar to result of 2009.

According to annual statistical reports of the FMOH for the period 2004 - 2011, all age malaria case loads in females is slightly higher than males; cases in females represent 50% - 51% of total case load while cases in males represent 48% - 49% of the total malaria case load (Figure 8).

Despite considerable reduction in malaria case load through review period, yet according to FMOH annual statistical reports the disease is still ranking at the top of the list of the first ten causes of morbidity in Sudan till the end of 2011. In the list of the first ten causes of hospital admission, the disease was ranking 1st till 2009 where it shifted to rank 2nd and then the 3rd for 2010 and 2011. These figures entail that malaria is still a leading cause of morbidity in Sudan.

Figure (2): Reported Malaria Outpatient Cases 2000- 2011 (All ages)

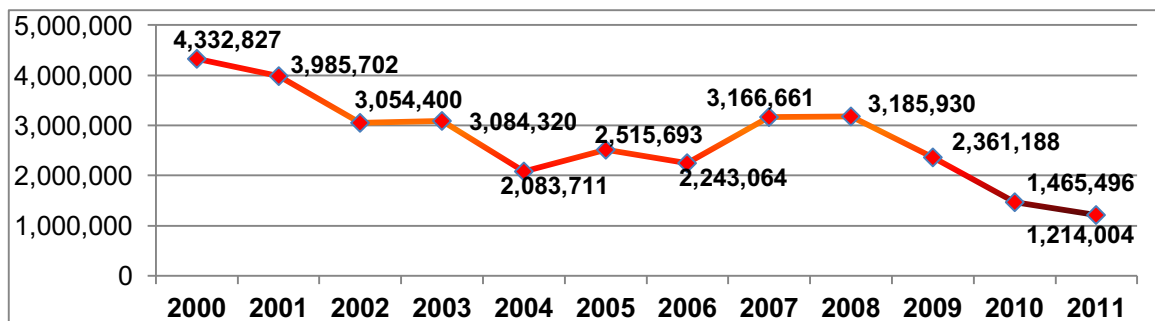


Figure (3): Percentage of reported malaria cases out of all outpatient clinic visits 2000 – 2011 (All ages)

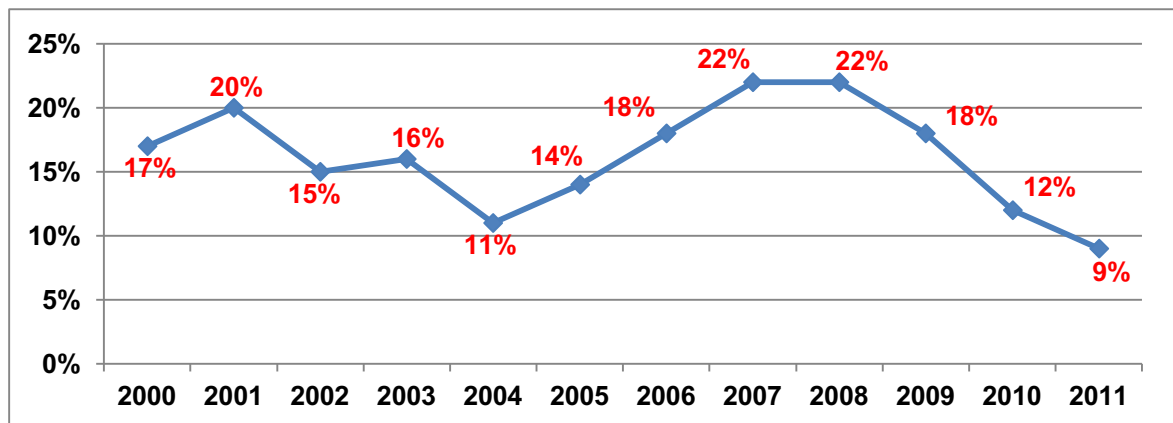


Figure (4): Incidence of malaria cases per 1000 of population 2000 – 2011

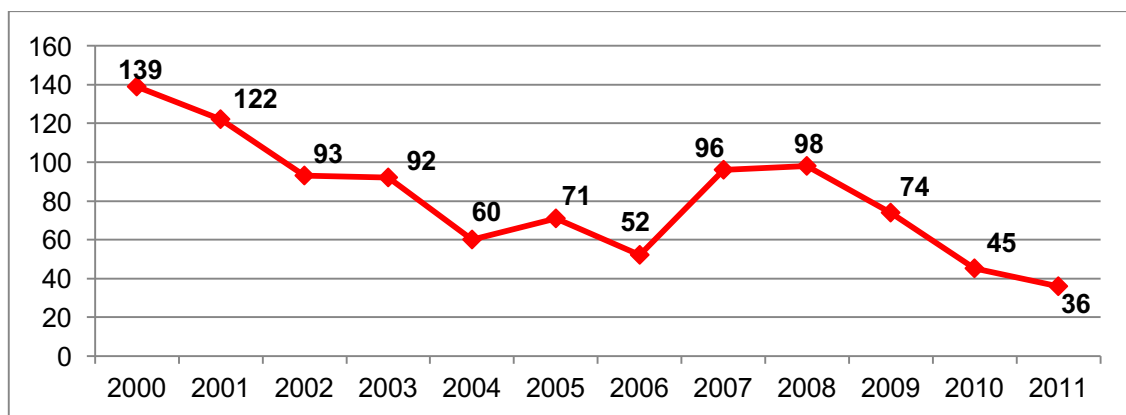


Table (2): Comparison of prevalence of malaria infection in MISs 2005/2009/2012 by states

States	Prevalence		
	MIS 2005	MIS 2009	MIS 2012
Gedarif	2.9%	1.6%	10.9%
Kassala	1.5%	1.1%	2.6%
North Kordofan	1.8%	2.6%	3.5%
Sinnar	3.2%	1.1%	2.1%
South Kordofan	11.2%	2.1%	3.7%
"Former" South Darfur	2.5%	1.2%	4.7%
"Current" South Darfur			8.8%
"Former" West Darfur	4.8%	7.1%	6.2%
"Current" West Darfur			8.0
White Nile	1.3%	1.8%	3.2%
Blue Nile	-	12.5%	3.7%
Gezira	-	1.2%	1.2%
Khartoum	-	0.1%	0.5%
North Darfur	-	1.1%	2.8%
Northern	-	0.0%	0.0%
Red Sea	-	0.0%	0.1%
River Nile	-	0.5%	0.4%

Figure (5): Prevalence of malaria infection in MIS 2009 and 2012

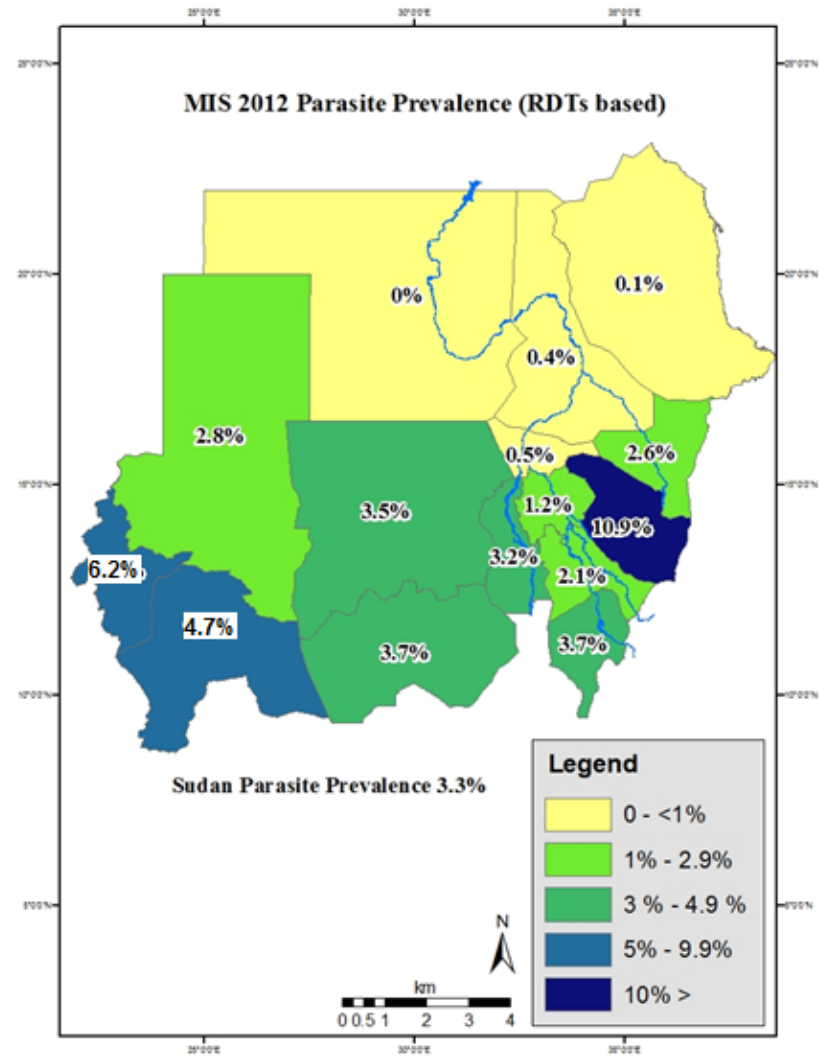
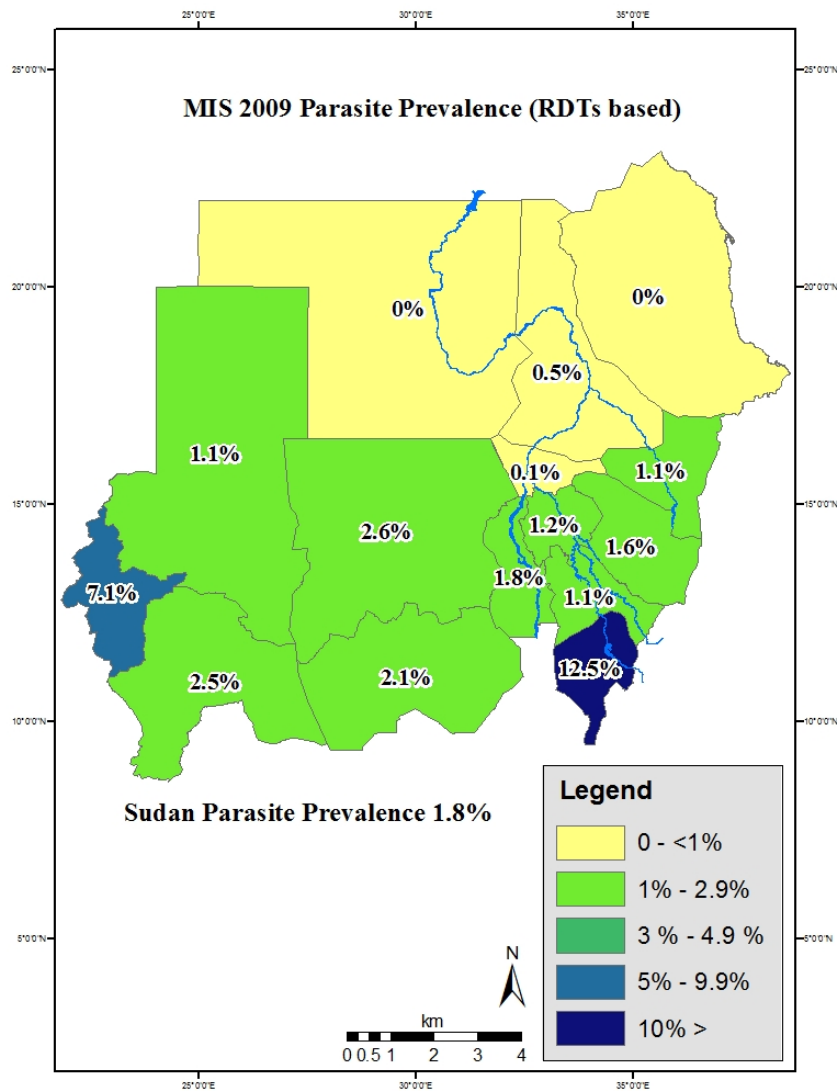


Figure (6): Percentage of admitted malaria cases out of all disease admissions 2000 – 2011 (All ages)

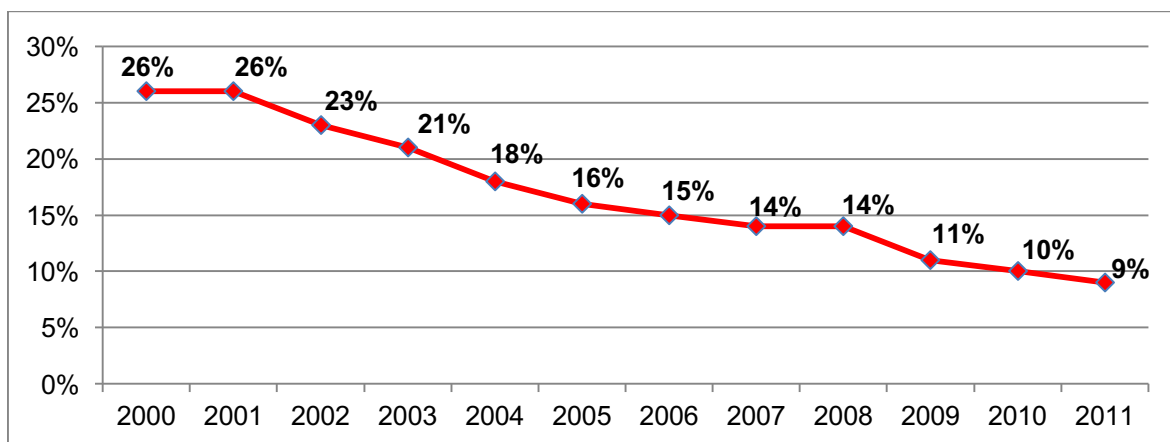


Figure (7): Number of reported malaria admissions 2000 – 2011 (All ages)

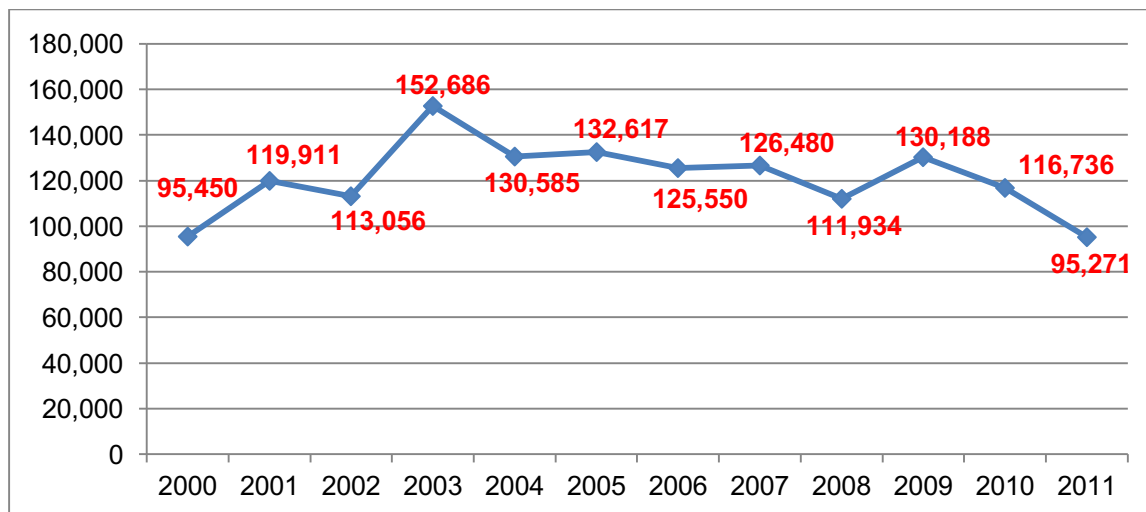
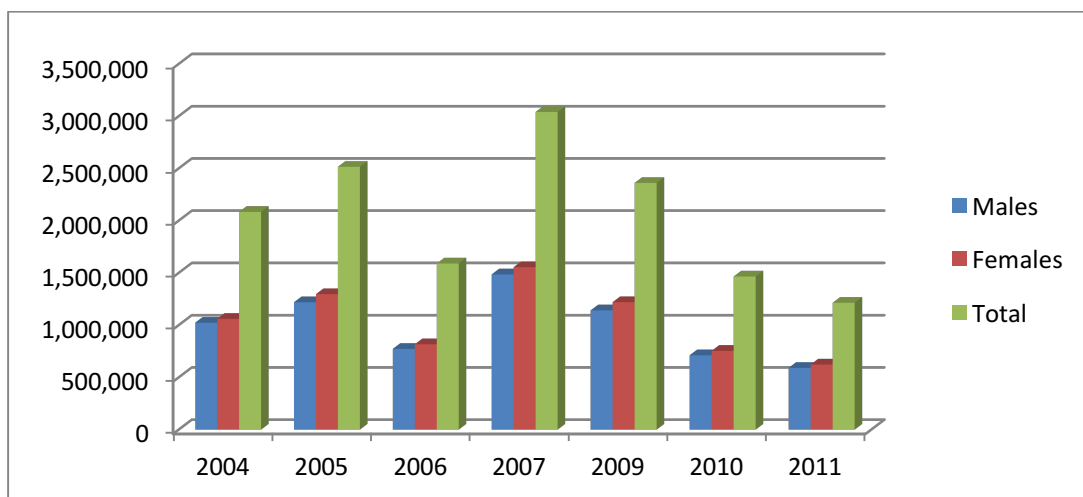


Figure (8): Number of reported all age malaria cases by sex for the period 2004 - 2011



3.2. Malaria Mortality

Notwithstanding the under-reporting of malaria deaths, the best source of data remains the routine health information system.

Although malaria mortality was not representing a big toll of disease burden at the start of the acceleration process of malaria control activities in Sudan, yet malaria mortality statistics also witnessed considerable reduction.

According to the FMOH annual statistical reports the absolute number of reported malaria deaths from hospitals declined from 2162 deaths in 2000 to 612 deaths by the end of 2011, which represents a reduction in malaria deaths by 72% (Figure 9). In the list of the first ten causes of mortality malaria was ranking 1st for most of the period 2000 – 2008 and shifted to rank the 3rd in 2009, 5th in 2010, and by the end of 2011 the disease was not in the list.

Concerning achievement in the First National Strategic Plan for Roll Back Malaria 2001 – 2010, malaria mortality decreased by 61.2% while plan was targeting 50% reduction. This could be explained by the fact that starting from the year 2005 the NMCP was giving more focus on training of doctors, sisters, and nurses on management of severe malaria coupled with starting supervisory visits to hospitals to monitor compliance to the protocol of management. Introduction of ACTs for treatment of uncomplicated malaria in 2004 following widespread chloroquine resistance in Sudan could also have played a role in mortality reduction. Other factors include introduction of prereferral treatment of severe cases of malaria in 2005 and home management of malaria at community level in 2007 and availing ACTs and prereferral treatment for severe cases of malaria for community volunteers though link with nearest health facilities.

With respect to overall malaria case fatality rate, there was no change in the rate which was 0.05% in 2000 and remained so by the end of 2011 (Figure 10), while inpatient malaria case fatality rate declined from 2.27% in 2000 to 0.64% by the end of 2011 (Figure 11).

Figure (9): Number of reported malaria deaths 2000 – 2011 (All ages)

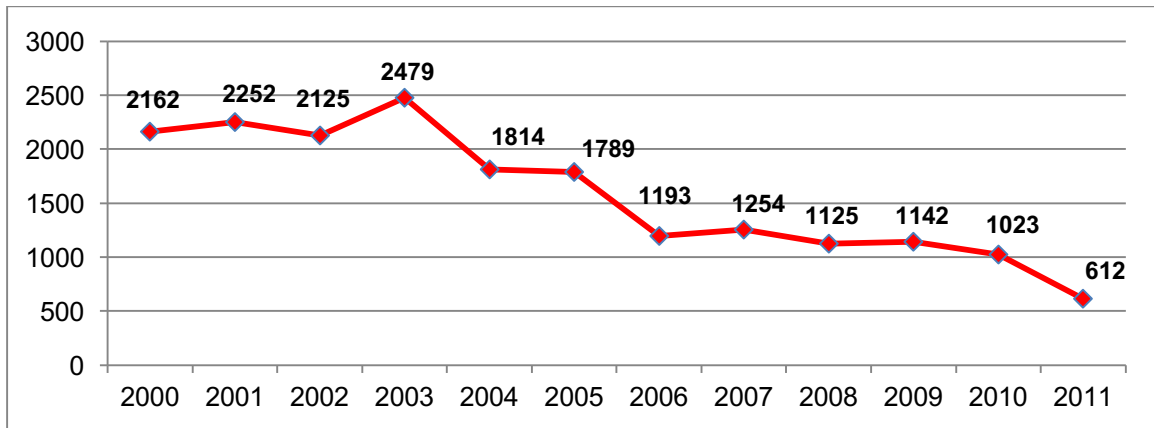


Figure (10): Overall malaria case fatality rate 2000 – 2011 (All ages)

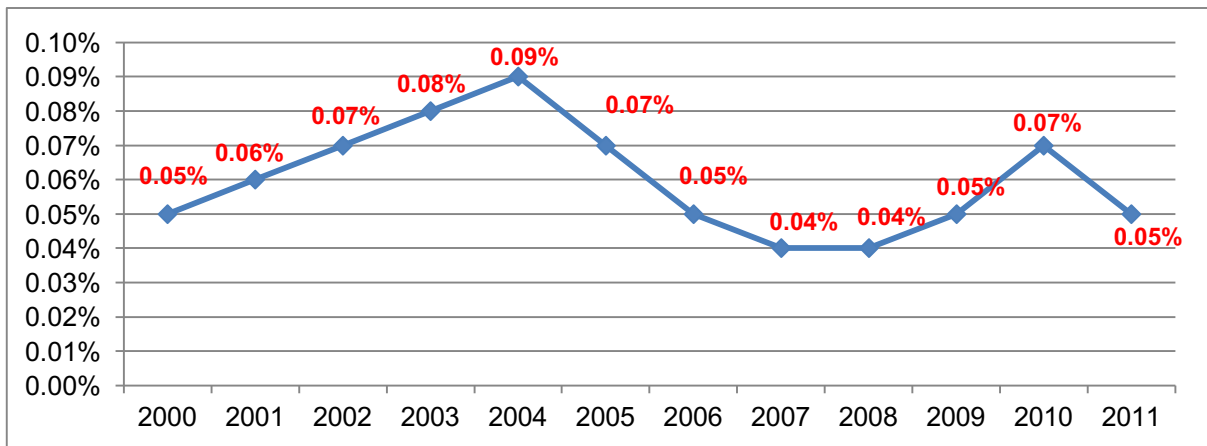
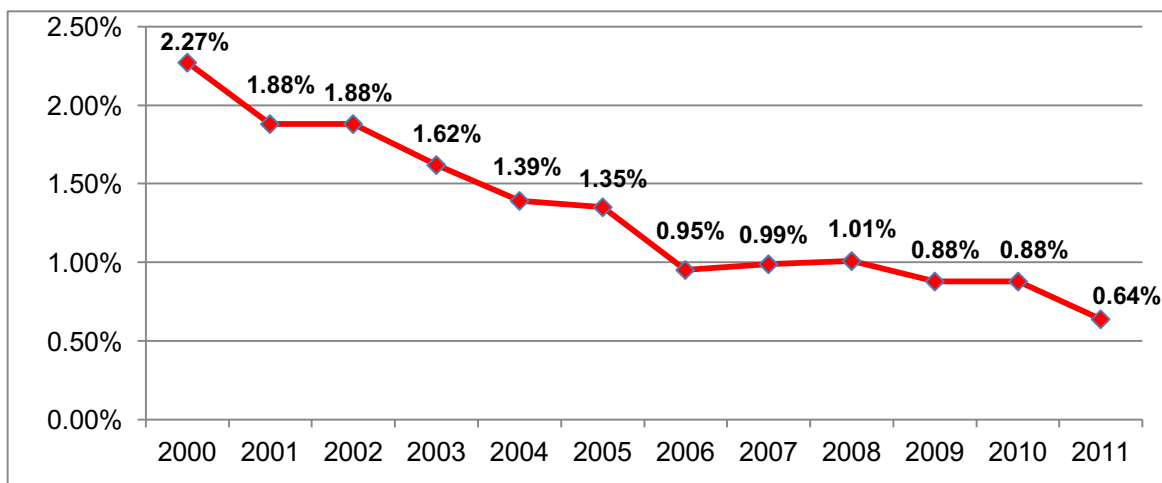


Figure (11): Inpatient malaria case fatality rate 2000 – 2011 (All ages)



3.3. Malaria High Risk Groups

Available data clearly show that malaria poses a considerable risk for morbidity in children under five years of age, and the disease remains a significant cause of morbidity and mortality in childhood. Annual statistical reports of the FMOH show that malaria cases among children under five years of age account for one quarter to one third of the total malaria case load (Figure 12).

Malaria cases in children under five years of age account for 30% of all hospital admissions due to malaria (*NHSSP 2012 – 2016*), 8.7% - 20% of all disease hospital admissions of these children (Figure 13), while 12% - 28% of all outpatients' clinic visits of this age group were due to malaria (Figure 14).

According to the FMOH annual statistical reports, there was a 69% reduction in malaria case load in children under five years of age in the period from 2001– 2010.

Throughout the years 2009 – 2011 malaria ranked the 2nd in the list of the first ten causes of morbidity in children under five years of age presenting to outpatient clinics, and the best situation in causing morbidity was to rank the 3rd in 2004. With respect to causes of hospital admissions, malaria ranked the 2nd in the list of the first ten causes of hospital admissions in children under five years of age for the years 2004 – 2009 and the 3rd for 2010 – 2011.

Acceleration efforts of malaria control have also a positive reflection on reduction of malaria case load in children of this age group by the end of 2011 compared to the baseline (Figure 15). The percentage of children under five years of age admitted to hospitals due to malaria out of the total disease hospital admissions declined from 20% in 2004 to 8.7% by the end of 2013 (Figure 13).

In Sudan, 83 per 1000 children born alive do not live to reach their fifth birthday. While there has been a significant reduction by a third, this is still far from achieving the Millennium Development Goal which is to reduce mortality by two thirds by 2015. The National Health Sector Strategic plan has set a target to reduce mortality to 53 per 1000 live births by 2016 (*NHSSP 2012-16*). As malaria is still an important cause of mortality in children, reductions in malaria mortality will have a positive impact on overall childhood mortality.

FMOH annual statistical reports show that deaths due to malaria in children under five years of age declined from 11% of all hospital disease deaths in 2004 to less

than 3% by the end of 2011 (Figure 16). Deaths due to malaria in this age group remained less than 5% of all reported deaths due to malaria in all age groups through the period from 2004 – 2010 (Figure 17). By the end of 2011, malaria was not in the list of the first ten causes of mortality in children under five years of age for the first time, while it ranked 3rd to 10th for the years 2004 – 2010. Inpatient malaria case fatality rate in children under five years of age declined from 1.95% in 2004 to 0.73% by the end of 2010 (Figure 18). The low percentage of deaths due to malaria in children under five years of age out of deaths due to malaria in all age groups could be explained by the known fact about quality of care in paediatric hospitals which is believed to be better than in general hospitals.

No data was found from routine health information system to show trends of morbidity and mortality due to malaria among pregnant women during review period. Literature search was done for burden of malaria in pregnancy in Sudan. Search revealed 12 studies in the period 2003 – 2010. Of these 11 studies were hospital-based and one community-based. All studies were conducted in areas of unstable malaria transmission in Eastern (Gedarif & New Halfa Hospitals) and Central (Medani & Omdurman Maternity Hospitals) Sudan. In 11 studies, prevalence of malaria infection among pregnant women ranged between 11.5% - 64.1% (Table 3). One of the studies (Bader E et al, 2010) was investigating association between malaria and stillbirth. Among 4760 singleton deliveries, rate of stillbirth was 22/1000. Maternal sociodemographic characteristics were not associated with stillbirth and history of malaria in the index pregnancy was the main risk factor for stillbirth.

The only available data about maternal mortality due to malaria were from an ecological study associated with the Sudan Maternal Mortality Survey in 2010 which showed that nearly 23% of reported maternal deaths were reported to have had malaria.

Figure (12): Percentage of malaria cases in children under five years of age out of all age malaria case load 2001 – 2011

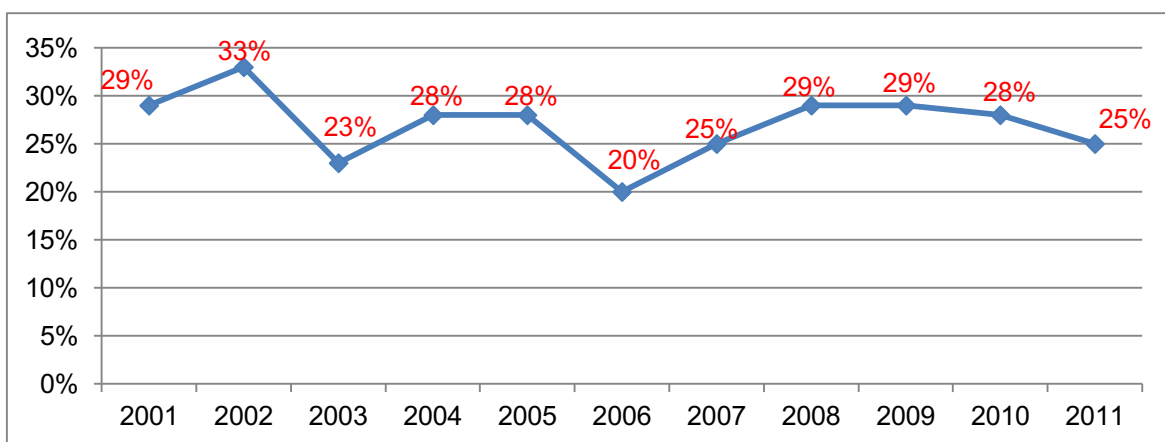


Figure (13): Percentage of hospital admissions due to malaria in children under five years of age out of the total under five disease hospital admissions 2001 – 2011

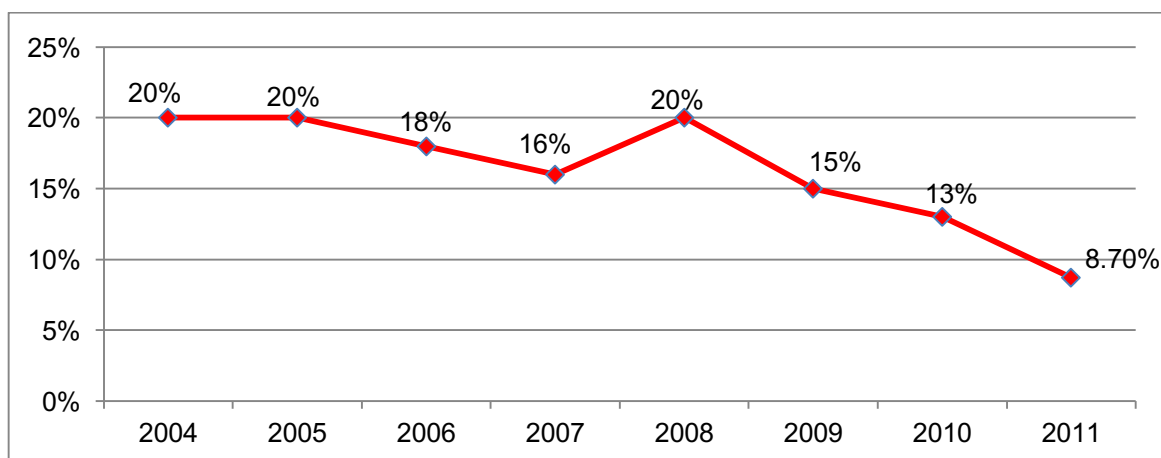


Figure (14): Percentage of malaria cases out of all children under five years of age outpatients' clinic visits 2004 - 2011

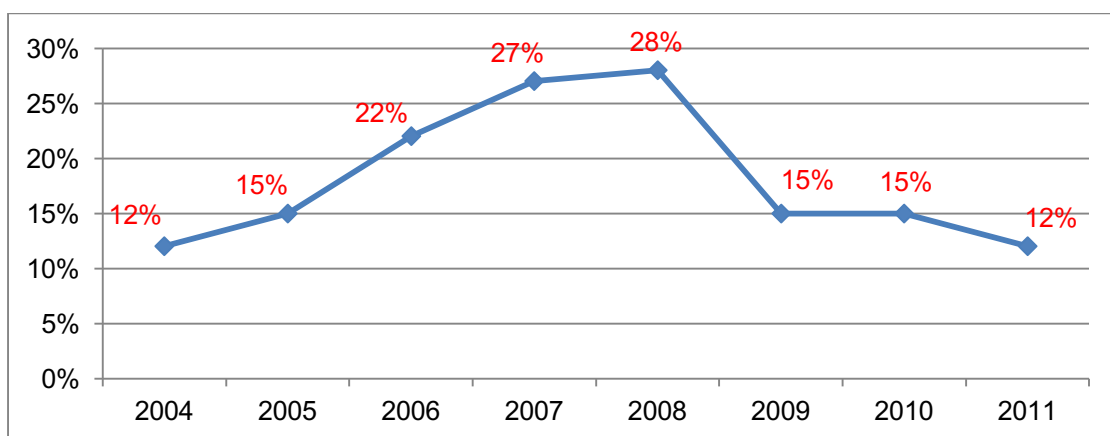


Figure (15): Malaria case load in children under five years of age 2001 – 2010

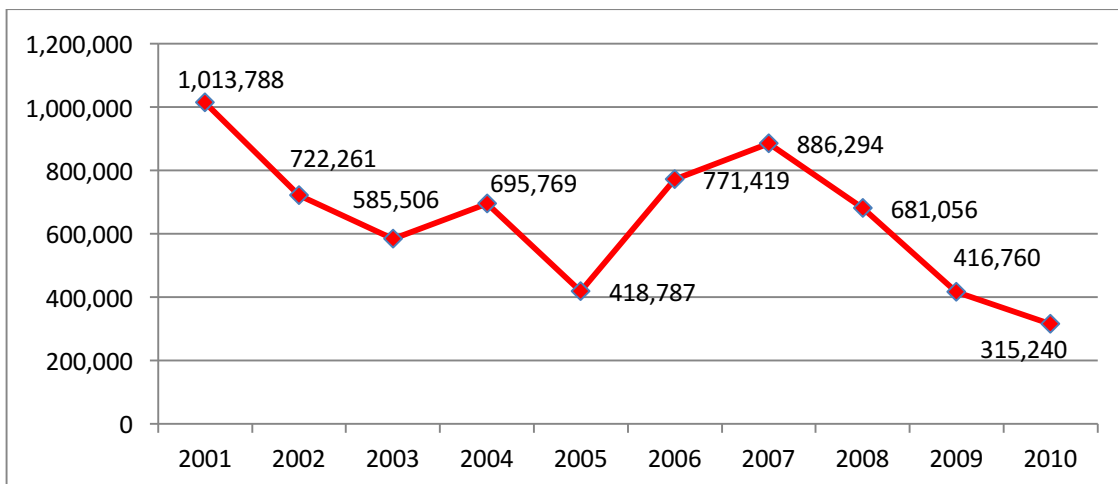


Figure (16): Percentage of deaths due to malaria in children under five years of age out of all disease hospital deaths 2004 – 2011

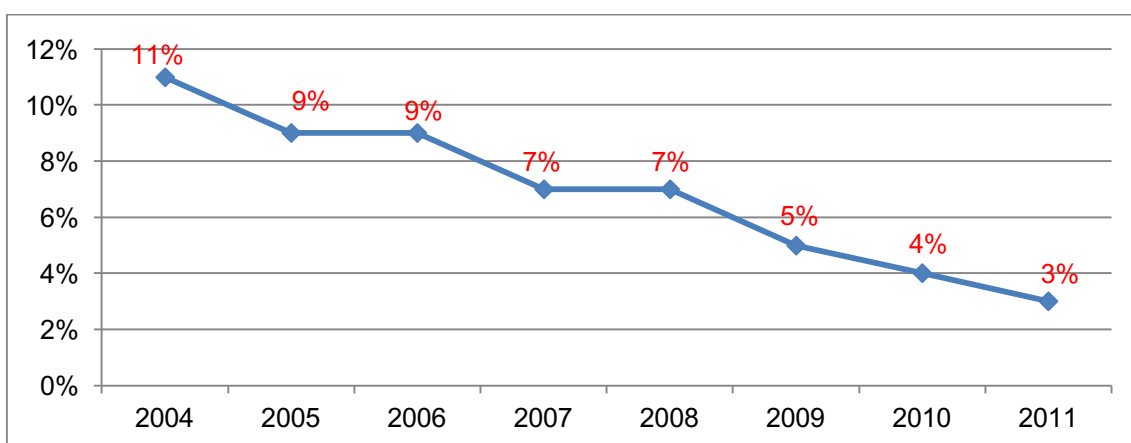


Figure (17): Percentage of reported deaths due to malaria in children under five years of age out of deaths due to malaria in all age groups 2004 - 2010

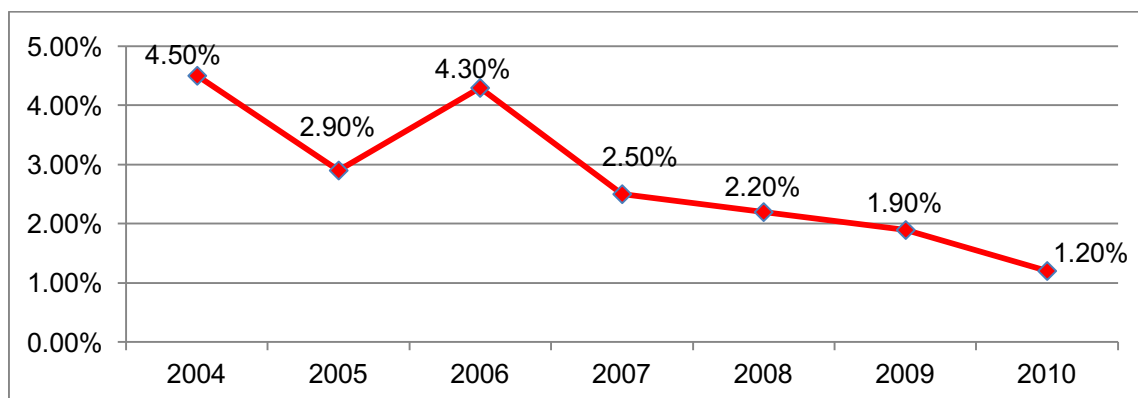


Figure (18): Inpatient malaria case fatality rate in children under five years of age 2004 – 2010

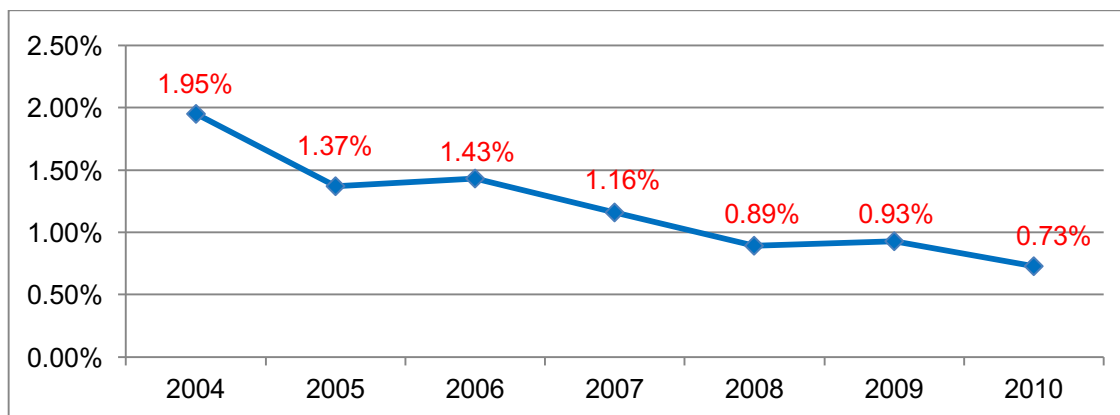


Table (3): Prevalence of malaria in pregnant women 2003 – 2010

Setting	Sample	Prevalence of malaria infection	Author
Village – Eastern Sudan	86	17.4%	Elghazali G et al, 2003
New Halfa Hospital	142	40.1%	Adam I et al, 2005
New Halfa Hospital	744	13.7%	Adam I et al, 2005
New Halfa Hospital	293	32%	Adam I et al, 2007
Gedarif Hospital	236	19.5%	Adam I et al, 2009
New Halfa & Gedarif Hospitals	-	32% & 19.5%	Adam I et al, 2011
Gedarif Hospital	93	24.8%	Salih MM et al, 2011
Medani Hospital	128	64.1%	Hassan Sel-D et al, 2011
Medani Hospital	107	31.8%	Elbashir HM et al, 2011
Omdurman Maternity Hospital	836	56.9%	Omer S et al, 2011
Gedarif Hospital	156	11.5%	Kashif AH et al, 2013

3.4. Malaria Parasites

Because malaria species differentiation is not a routine practice in laboratories of health facilities, data about prevalent malaria parasites' species cannot be obtained through the routine health information system, and available studies remain the only source to have such data.

Predominant parasite species in Sudan is *P. falciparum* with prevalence ranging between 94% (*MIS 2009*) to 96.5% (*MIS 2012*). According to *MIS 2012*, prevalence of *P. vivax* infection was 2.6% (either *P.v.* [1.6%] alone or mixed with *P.f.* [1.0%]) and prevalence of *P. malariae* infection was 1.0% (either alone [0.6%] or mixed with

P.f. [0.4%]). A study by Mahgoub et al, 2012 showed that the most common parasite is *P. falciparum*, while *P. vivax* is a recognized entity in Eastern Sudan. A study in Haj Yousif in Khartoum State showed that 83% of patients have *P. falciparum*, 10% have mixed infection (*P. falciparum* and *P. vivax*), 5% have *P. vivax* only and 2% of cases have *P. ovale* (Ali et al 2009). Elsayed et al (2000) also reported presence of *P. vivax* (8.2%) and *P. ovale* (6.2%) in Khartoum State. In Gedarif, patients with severe malaria were more likely to have strains of *P. falciparum* that produces a high gametocyte rate (Giha 2006). A study among 1565 blood donors showed that prevalence of infection with malaria parasites is 6.5% (Ali et al., 2004). The vast majority of infections (98.1%) were with *P. falciparum* and 1.9% with *P. vivax*.

3.5. Malaria Vectors

In sub-Saharan Africa, where 90% of the world's malaria cases occur, *Anopheles gambiae* Giles, *Anopheles arabiensis* Patton of the *Anopheles gambiae* complex and *Anopheles funestus* Giles from the *Anopheles funestus* group are the most efficient malaria vectors (Gillies and DeMeillon, 1968). Predominant malaria vector all over Sudan is *Anopheles arabiensis*, covering all arid and semi-arid areas of the country (Haridi, 1972; Nugud et al., 1997; Petrarca et al., 2000). It is considered as the most widespread member of the *Anopheles gambiae* complex, endemic through most of the Afro-tropical region extending northwards along the River Nile to ~20° N in Sudan (Dukeen and Omer, 1986).

Other efficient vectors include *Anopheles gambiae* and *Anopheles funestus* which are restricted to humid areas in the country (Five years Strategic Plan for the Sudan National Malaria Control Programme, 2011 – 2015). According to NMCP, recent surveys observed re-emergence of competent malaria vector *Anopheles funestus* at the extreme borders with South Sudan. Other vectors of little or no importance in malaria transmission are *Anopheles nili* Theobald (Lewis, 1956) and *Anopheles pharoensis* which is widespread (EL Gaddal et al., 1985).

3.6. Accuracy of Reported Malaria

Data of malaria morbidity and mortality obtained mainly through the routine health information system exhibit two main limitations; underestimation and limitations of accuracy of diagnosis of cases. According to FMOH annual statistical reports, average completion of reporting from all public health facilities for the period 2007 – 2012 ranged between 16% - 29%; for hospitals the range was 74% - 83%, health centres 16% - 32%, and basic health units 4% - 22%.

Federal information system obtains data of malaria morbidity and mortality only from public health facilities and no such data are obtained from the private sector and health facilities belonging to the Armed Forces, Police and National Security Department, while an expected considerable number of malaria cases are managed in these health facilities.

Many other cases of malaria are not reported to the routine health information system due to self- treatment. In 2002, the burden of malaria was estimated to be 9 million episodes and 44,000 deaths (*Abdalla 2007*), yet the routine health information system could only pick up 3 million episodes and just over 2,000 deaths from malaria. A comparison of the results of the study on “Stratification of Khartoum urban area by the risk of malaria transmission” conducted in 2003 had concluded that malaria accounted for 20–40% of the total outpatient attendance and around 30–40% of hospital admissions at that time (*Malik et al.2003*). More recently, the problem of over-diagnosis of malaria became apparent. Out of 655 febrile patients, 35.9% were recorded as having malaria based on hospital laboratory results. However, re-examination of slides at the National Malaria Control Programme Reference Laboratory confirmed malaria in only 32.8% of those diagnosed with malaria at hospital level (*Malik et al 2005*).

Reported malaria cases still include a considerable number of clinically diagnosed cases that are not parasitologically confirmed (probable malaria cases). Annual statistical reports of the Department of Epidemiology in the Ministry of Health - Khartoum State for the last 11 years show that between 24% - 58% of reported malaria cases from sentinel sites in the state are probable malaria cases (Figure 19). Limitations in compliance of doctors in health facilities to the National Protocol for Diagnosis and Treatment of Malaria are expected to be behind the high percentage of clinically diagnosed (probable) malaria cases. A study conducted by

the Department of Research in the Ministry of Health – Khartoum State in a number of public health facilities in 2000 about clinically diagnosed (probable) malaria cases showed that 93% of these cases were actually not true malaria cases.

Systems of reporting malaria cases, whether through the routine health information system or sentinel surveillance system, do not allow for having real estimates of malaria burden as they are lacking epidemiological classification of malaria cases into indigenous, recrudescence or imported cases. Currently it is not possible to differentiate new incident cases from recrudescence cases. Imported cases are of particular importance when it comes to malaria burden estimates at state level; where in some states reported malaria cases include cases from other states. People from peripheral states visit central states seeking treatment, for economical purposes or other life matters.

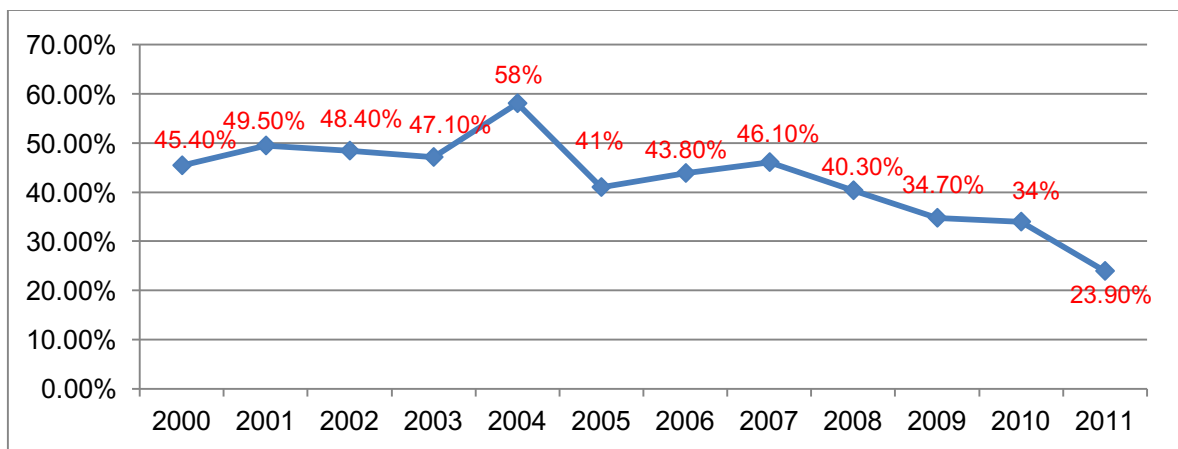
Accuracy of malaria microscopy is expected to be affected due to lack of sustainability of training of laboratory technologists on standard malaria microscopy in the light of the high turnover of these cadres in health facilities. Adding to this is the lack of sustainability of the quality assurance programme of malaria microscopy. Reporting of malaria hospital admissions is not an exception from lack of accuracy. Admission for malaria is expected to be for the severe cases only. Some cases are admitted for a main cause other than malaria but associated with uncomplicated malaria, yet some hospitals report malaria as a cause for such hospital admissions. Deaths due to malaria are expected to be underestimated due to underreporting of home deaths. Reported deaths due to malaria from hospitals do have the same problem of lack of accuracy as in hospital admissions due to reasons above.

A number of these concerns were already addressed in a WHO expert final review report (*Kondrachine, 2006*), who was in a mission to Khartoum State in 2006 to review KMFI. Report identified a number of setbacks in relation to diagnosis and surveillance of malaria cases. A major setback was massive over diagnosis of malaria cases due to the high percentage of clinically diagnosed cases (45%) in health facilities. Report emphasized importance of confirmation of malaria cases and recommended availing microscopes in lacking health facilities and continuous basic and refreshment training for laboratory technologists in standard malaria microscopy in addition to providing malaria rapid diagnostic tests (RDTs) in health

facilities lacking malaria microscopy. This recommendation formed the basis for NMCP policy of introduction of RDTs use in public health facilities lacking malaria microscopy in 2008, where according to NMCP data for 2012 80% of target health facilities in Sudan were covered by RDTs.

Another major setback was the lack of epidemiological classification of malaria cases into indigenous, recrudescence and imported cases and report recommended gradual introduction of such classification. This latter is to remain a challenge for the NMCP at all levels.

Figure (19): Percentage of clinically diagnosed cases of malaria out of all reported malaria cases in Khartoum State 2000 – 2011



3.6. Socioeconomic Impact of Malaria

Available data show that 2,877,000 DALYs were lost in Sudan in 2002 due to malaria mortality, episodes, anaemia and neurological sequelae. Children under five years of age had the highest burden. Males had the highest incidence and mortality, but females lost more DALYs (*Abdalla et al., 2007*). There have not been more recent estimates of disease burden from malaria in the last ten years.

3.7. Geographical Stratification of Malaria

Operational stratification of malaria in Sudan was based on climatic conditions (mainly rainfall), Hydrologic conditions related to River Nile, population displacement, movement and activity. Based on these parameters and according to the Gap Analysis Report of the National Malaria Control Programme of 2007, six

strata were identified. Endemicity, population, states and the suitable interventions for each of the 6 main strata are shown in the table and map below (Table 4 & Figure 21). Meteorological factors are considered as the environmental factors for increased risk of malaria because of their impact on the mosquito vector activities and Plasmodium incubation rate (*Rasha A. Aal, Ayman A. Elshayeb, 2011*).

Most of the country below north latitude 15 is an endemic zone. In such areas, peak of transmission is seasonal and depends on rainfall (June/July – October/November) except in urban cities and irrigated schemes which may have another peak of transmission during winter (December- February) due to broken water pipes; and /or poor water storage mechanisms (Figure 20). Sudan's rainy season lasts for about three months (July to September) in the north, and up to six months (June to November) in the south. Hence, the duration of transmission varies from 3-6 months with an average of 4 months, while a longer season is noticed in the southern areas. Transmission season may last from July/August to November/December, with an earlier beginning in June in the southern areas (e.g., Kadugli, El Damazin) and a later start in August in central areas (Wad Medani, Kosti, Kassala, El Obeid).

According to the WHO criteria for risk of malaria transmission there are three distinct zones of risk; low transmission (low endemic or hypo-endemic), moderate transmission (moderately endemic or meso-endemic), and high transmission (highly endemic or hyper-endemic) zones (Table 5). After separation of the former Sudan southern states, which were known to be hyper-endemic for malaria, now and according to results of MIS 2012 all of the country states are hypo-endemic except Gedarif State which is considered as meso-endemic.

This entails that these states are more liable to malaria outbreaks and epidemics. With more reduction in malaria morbidity, risk of malaria outbreaks and epidemics increases and more cases of severe malaria are expected due to the drop in population immunity towards malaria due in turn to decreased exposure to the disease. This ultimately entails rebound of malaria morbidity and mortality. A good example for this scenario is what happened in Khartoum State in the last 5 years. Following the launch of Khartoum Malaria Free Initiative (KMFI) in mid 2002, malaria morbidity was reduced in 2008 to more than 70% of morbidity in 2001. In

this year a small outbreak was observed in some rural parts of Bahri Locality north of Khartoum around Seleit Irrigated Scheme. Areas affected were known areas of recurrent malaria outbreaks, with more cases of the severe form of the disease and more mortalities. In 2010, more severe cases of malaria were observed in areas around irrigated schemes in five of the seven state localities during winter season with more malaria mortalities. These events led the Department of Epidemiology in Khartoum State to inject a system for surveillance of severe malaria into malaria surveillance already integrated into the communicable disease surveillance system in late 2011. This is to enable the state malaria control programme to timely investigate sustainability of implementation of vector control operations and prioritize targeting different state areas with revitalization of vector control methods.

Figure (20): Percentage of malaria cases out of all outpatient attendants in Khartoum State by months of the years 2009 – 2012

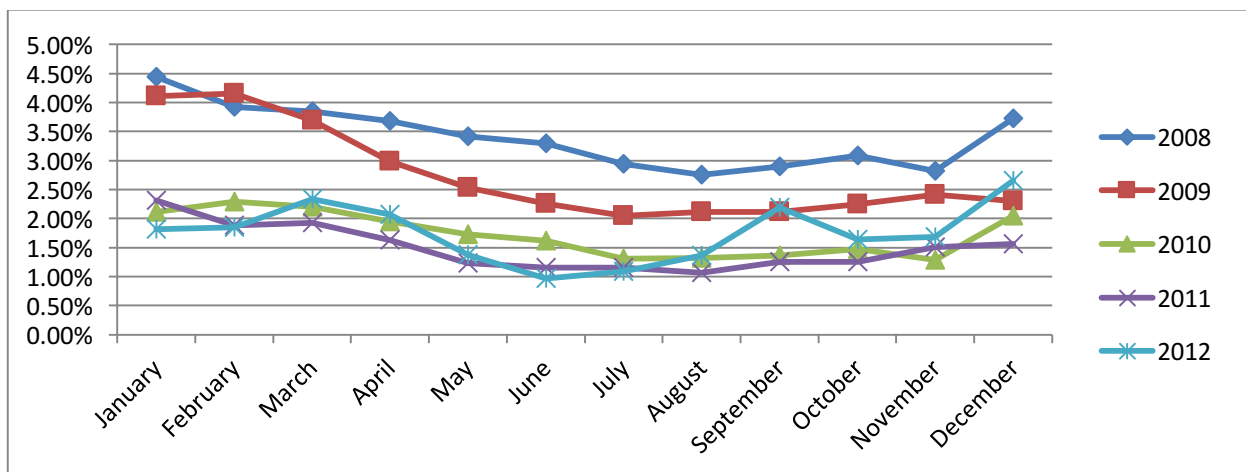
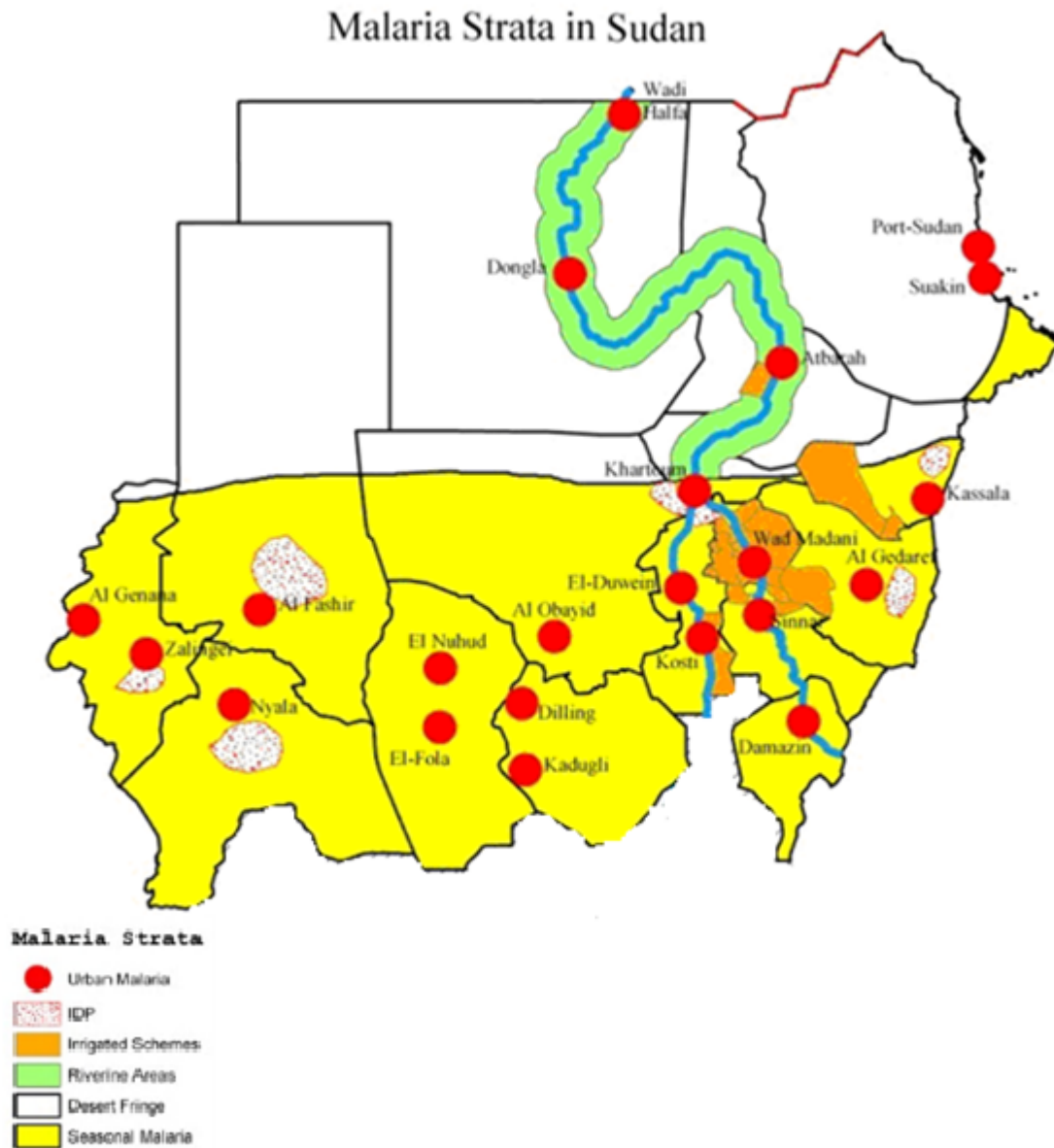


Table (4): Geographical stratification of malaria in Sudan

Strata	Transmission Risk	Population	Areas	Recommended Control Interventions
Desert fringe	No transmission, malaria free	654,923	Desert fringe areas in the north above Latitude 150 except cities, riverine areas, irrigated schemes in River Nile State and delta Tokar in Red Sea State	Case management, entomological/ parasitological surveillance
Riverine areas north of Khartoum	Epidemic prone seasonal unstable transmission related to floods, dams	1,576,860	Area about 20 Km on both sides of River Nile above Latitude 150	Epidemics' early warning, early detection and rapid response, case management, entomological monitoring, and Larviciding as appropriate
Seasonal malaria	Seasonal, low to moderate risk	14,590,161	Rural areas other than irrigated schemes in Greater Darfur, Kordofan, Blue Nile, White Nile, Sennar, Gezira, Gedarif, Kassala and Khartoum States	Case management, LLINs, epidemic early warning, early detection and rapid response
Urban malaria	Seasonal transmission with low risk	9,461,161	Khartoum and all large cities e.g. Port Sudan, Wad Medani, others	Case management, environmental management, larviciding, epidemic early warning, early detection and rapid response.
Irrigated Schemes	Seasonal transmission for 6-9 months with low to moderate risk	3,679,340	All large- scale irrigated schemes (Gezira, Elrahad, Kinana, Asalaia, West Sennar, New Halfa and Elzidab, Suki, Khashm Elgerba)	Case management, indoor residual spraying, LLINs, epidemic early warning, early detection and rapid response
Emergency and complex situation	Epidemic prone or seasonal transmission	3,153,720	IDPs and refugees camps (the number is as per 2007 and is subject to change)	Case management, LLINs, epidemic early warning, early detection and rapid response

Figure (21): Map of Malaria Strata in Sudan



WHO expert review report of KMFI (*Kondrachine, 2006*) identified a major setback in relation to early warning system of malaria epidemics. Report concluded that current surveillance system is using indicators inadequately sensitive to early warning of malaria epidemics as it is not using other more sensitive indicators especially metrological indicators and recommended establishment of a malaria early warning system in collaboration with other related departments and sectors. These facts entail that NMCP needs to make much more investment in malaria case management strategy in terms of more resource allocation and more time for supportive supervision in a number of areas of priority focus. More emphasis should

be given to confirmation of malaria cases as discussed above. Malaria parasite differentiation and identification of parasite density should be practiced routinely as part of malaria microscopy to assist standard treatment of severe cases of the disease. More focus needs to be given for management and surveillance of severe cases of malaria in terms of training for doctors, nurses, laboratory technologists, and surveillance personnel. Malaria Epidemic Preparedness and Response (EPR) system should be revised, strengthened and revitalized, especially at state and locality levels and work in establishing malaria early warning system should continue reaching to a functioning system.

Table (5): Zones of risk of malaria transmission

Zones	According to Reported Malaria Cases through HMIS	According to Results of Malaria MIS
Malaria Free	0 cases / 1000 of population for 3 years	-
Low Transmission (Hypo-endemic)	1 case or less / 1000 of population	0% - 10%
Moderate Transmission (Meso- endemic)	>1 – 10 cases / 1000 of population	10% - 50%
High Transmission (Hyper-endemic)	>10 cases / 1000 of population	>50%

3.8. Conclusions

Considerable reduction in malaria morbidity and mortality was achieved in Sudan in the last 12 years post acceleration of malaria control activities in the country based on RBM initiative. Malaria morbidity and mortality were both decreased by 72% compared 2011 figures to the baseline of 2000. Achievements in first ten years national strategic plan (2001-2010) for RBM were 66.2% reduction of morbidity and 61.2% reduction of mortality while plan was targeting 50% reduction for both. Despite this reduction the disease is still a leading cause of morbidity in Sudan, ranking first in the list of the first ten causes of morbidity and 3rd in the list of first ten causes of hospital admission for 2010 and 2011.

Children under five years of age are the main risk group for the disease, shouldering a quarter to a 3rd of all age malaria case load. By the end of 2011

malaria is no longer in the list of the first ten causes of mortality in the country. Predominant malaria parasite in Sudan is plasmodium falciparum known to be virulent and causing epidemics.

Reported malaria cases is an underestimate of the true disease burden due to under-reporting. A number of limitations negatively impact accuracy of reported malaria cases. A significant percentage of reported malaria cases were actually probable cases and parasitologically confirmed. Malaria parasite species differentiation is not a routine practice in health facilities.

After separation of the former Sudan southern states, most of the country states are now falling in the hypo and meso-endemic malaria strata known to be liable for malaria epidemics. With decreasing disease morbidity, risk of malaria epidemics and severe form of the disease will further increase in the coming years. NMCP needs to make much more investment in malaria case management and epidemic preparedness and response strategies in terms of more resource allocation and time for supportive supervision.

3.9. Recommendations

- Conduct risk mapping and burden estimation of malaria for stratification at the lowest possible administrative level using all available data including 2005, 2009 and 2012 Malaria Indicator Surveys (MIS) and routine data for strategy development
- Determine the distribution of malaria parasite by species by introduction of RDTs that detect other species than *P.falciparum* particularly in areas that there is enough evidence of transmission of *P. vivax* and include differentiation of species in reporting formats
- Conduct a thorough investigation for the causes of increased prevalence of malaria infection in most states as per results of MIS 2012 compared to MIS 2009 with special focus on Gedarif and South Darfur States and for the continuous increase of prevalence since 2005 in North Kordofan and White Nile States.

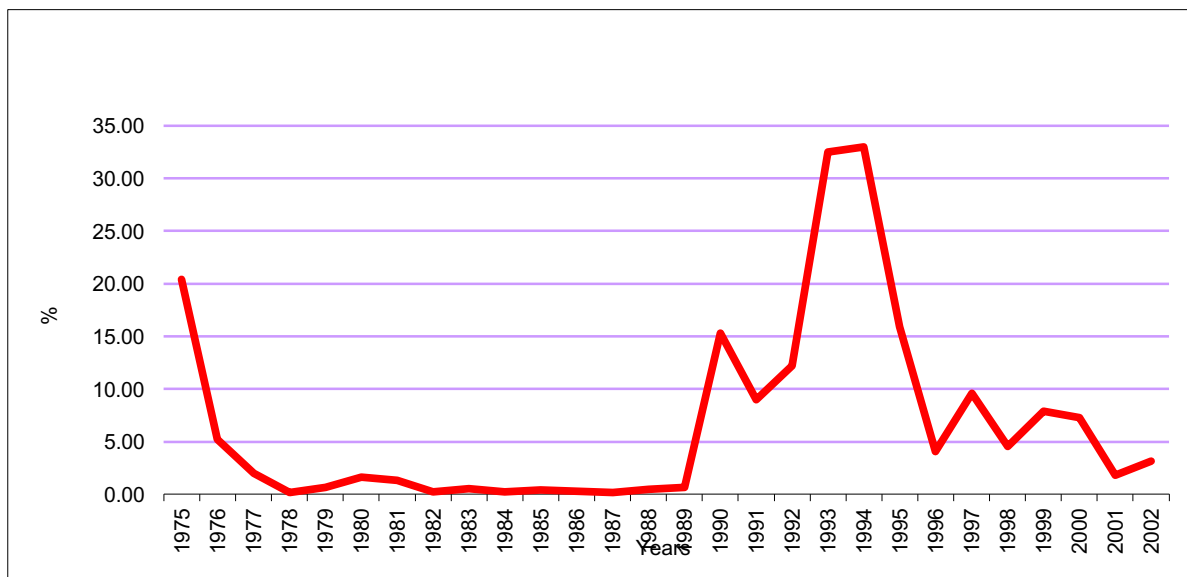
- Develop and implement a plan in collaboration with Department of Health Information System to improve completeness of reporting public health facilities and involve private sector in health information system.
- More emphasis in terms of plans of action should be given to availing an environment in health facilities conducive for laboratory confirmation of malaria.
- More emphasis should be given to practicing malaria parasite differentiation as a routine part of malaria diagnosis.
- Developing and implementing a system for surveillance of severe malaria as part of malaria or communicable disease surveillance systems.
- Giving more focus on training of doctors, nurses, and laboratory technologists in management of severe malaria.
- Malaria EPR system should be revised, strengthened and revitalized especially at state and locality levels.

4. MALARIA PROGRAMME MANAGEMENT

4.1. Background

Malaria control programme in Sudan is the oldest in the tropics. History of the programme goes back to last century when Andria Bafloor (1904) initiated a campaign and succeeded to eradicate malaria from Khartoum, and control efforts continued in many parts of Sudan. Control activities continued in the form of Sinnar pilot project during the eradication era which ended in the 1960s. Late in the 1970s the Blue Nile Health Project was established as a partnership between the government of Sudan, World Health Organization (WHO), World Bank, Kuwait, Japan, USA and others. The project succeeded to decrease malaria prevalence in target areas from over 20% to less than 1% for more than 10 years of the project life span (Figure 22) (*Malik et al, 2006*).

Figure (22): Prevalence of malaria in Gezira State 1975 – 2001



Till late in the 1990s there was a Malaria Administration in Federal Ministry of Health. The recent history of the NMCP dates back to 1998 following release of the international RBM initiative. Since establishment, the programme underwent a number of changes for its organogram to cope in each time with current challenges and needs. Central Government plays a key role in running the NMCP in partnership and active participation of the states and Local Governments, health related sectors, UN Agencies, donors, other countries, NGOs and the community.

4.2. Place of Malaria in the National Development Agenda

Government of Sudan was one of the first governments which signed the Abuja Declaration and committed itself to achieve the Millennium Development goal concerning reduction of malaria morbidity and mortality based on RBM initiative. A National Health Sector Coordinating Council (NHSCC) was established in late 2010, headed by President of the Republic and the MOH as secretariat. The council is represented, in addition to the Ministry of Finance and National Economy, by different departments allied to the health sector. The Council is meant to be a vehicle for inclusion of health in all sectoral policies emphasizing the governing role of the MOH. Four national committees constituted for specific functions have been formulated and are active. According to International Health Department in the FMOH, the council should meet half annually. Three meetings were so far held out of a target of four meetings. Issues discussed in these meetings and decisions made about included coverage with primary health care services and medicines' procurement and supply system, including anti-malaria drugs. Decisions made will have positive implications on malaria control. Some changes in the mechanism of action of the council are now being made which will be in favour of more facilitation for the health system, including malaria control activities.

4.3. Place of Malaria in the National Health System

Following endorsement of Sudan for the international RBM initiative as the guiding principle for malaria control, the FMOH had to give more attention to malaria control upgrading the NMCP to meet requirements of malaria control targets and mobilize more resources for the programme. In 1998, the former Malaria Administration in the ministry was upgraded and staffed and supported by necessary logistics to become a comprehensive programme capable of conducting activities covering all strategies of malaria control at national, state, and local governing levels.

In 2001 the FMOH guided and supported the state ministries of health to establish malaria control programmes (SMCPs) technically and with logistics and continued supporting the NMCP and state programmes by logistics and capacity building according to strategic and annual plans of action. In the period 2001 – 2005 considerable support was given to SMCPs. A total of 189 cars were provided to

states, in addition to support with furniture and information technology equipment. Prior to the rainy season every year, support is provided to SMCPs in line with special national plans to minimize draw backs of the rainy season on malaria morbidity and mortality. Support includes insecticides, hand pumps, fogging machines, malaria microscopy equipment and consumables. No available data to show support provided to states before the rainy season during the last 12 years, and an example for this support is that provided to states before the rainy season of 2013 which according to a document from NMCP included 8.5 tons of insecticides, 700 hand pumps, 70 fogging machines, and 50,000 LLINs.

After 2005, there was more investment in establishing malaria control departments at locality level. This response from the NMCP was in line with 2003 local governing law and later 2007 local governing law, where both of which centred implementation of malaria vector control activities in the locality government and not the state government.

4.4. Programme Governance, Policy, Strategies, Plans, and Guidelines

The NMCP is the technical governing body in the FMOH mainstreaming malaria control all over Sudan. According to the 1994 federal governing law, the programme is the technical advisor for States' Malaria Control Programmes and not an implementing body.

Malaria control strategies adopted by the programme are in line with RBM principles and guidelines; early diagnosis and prompt treatment of malaria cases, multiple preventive measures (Integrated Vector Management = IVM), and information, education, and communication to encourage personal and institutional behaviours supportive for malaria control. Based on adopted strategies, a comprehensive package of guidelines and policies were developed and implemented. In the strategy of early diagnosis and prompt treatment policies and guidelines covered the areas of standard method of diagnosis of malaria, options for diagnosis when standard methods are lacking, treatment of uncomplicated and severe malaria cases, management of malaria in pregnancy, anti-malaria drugs, advice for the public for care seeking behaviour, coverage of population with malaria case management services, organization of malaria case management services, and

training of health personnel to provide malaria case management services. In the strategy of multiple preventive measures they included; malaria strata in Sudan, recommended methods of malaria vector control, suitable vector control methods for the different malaria strata in the country, in addition to a set of policies and guidelines detailing each malaria vector control method.

Early following establishment of the NMCP, the programme with support of the FMOH set into action the National Strategic Plan for Roll Back Malaria (2001-2010) with a number of priority strategic directions. Two 5 years strategic plans were then developed based on the 10 years plan; the NMCP five years strategic plans 2002 – 2006 and 2007 – 2011. According to NMCP, no comprehensive evaluation was done for achievements in all malaria control strategic plans. Visiting the first strategic plan showed that the main objective of the plan was “Control of malaria so that it is no longer a public health problem by the end of 2010”. Specific objectives of the plan included; 1) decreasing percentage of mortality due to malaria out of all disease hospital mortalities by 80% compared to percentage in 2000; 2) decreasing number of reported malaria cases by 70% compared to the number in 2000; 3) decreasing absenteeism due to malaria; and 4) expansion of malaria free areas initiative in Northern, River Nile, Red Sea, Kassala, Gedarif, Khartoum, Gezira, North Kordofan, and North Darfur States.

Though it was a healthy sign to use strategic planning approach early in the life span of the NMCP, yet a number of gaps do exist in the first strategic plan. Main objective of the plan is not measurable, as it was not clearly defined when to consider malaria as no longer a public health problem. Closing year of the plan was written in the main objective as 2010 while duration of the plan is five years. The 3rd specific objective is actually not specific as it has no target, and so it is not measurable. Available data from epidemiology chapter above in addition to feedback from NMCP will be used to evaluate achievements in the first strategic plan retrospectively. Although there was considerable reduction in malaria morbidity and mortality during the review period, yet there is no answer by the end of 2006 or 2010 as to whether malaria is no longer a public health problem or still so. Percentage of reported malaria mortality out of all reported disease mortalities was reduced from 2.27% in 2000 to 0.95% by the end of 2006, with 58.1% achievement.

Number of reported malaria cases decreased from 4,332,827 cases in 2000 to 2,243,064 cases by the end of 2006, with 48.2% achievement. Third specific objective is not measurable and no available data to show whether absenteeism from work absolutely decreased or not. Malaria free areas initiative was implemented only in one state (Khartoum) out of the nine states, with 11.1% achievement. Main objective of the 2nd strategic plan (2007 – 2012) was “to reduce the morbidity and mortality of malaria by 50% by 2012 all over the northern Sudan (compared to reported cases in 2005)”. No specific objectives were used in this plan as in the first one and instead outcome targets were used under each malaria control strategy.

Available data will be used for evaluation of achievements in the second strategic plan. No data available for the year 2012 and instead data for the year 2011 will be used. Number of reported malaria cases decreased from 2,243,064 cases in 2006 to 1,214,004 cases by the end of 2011, with 45.9% achievement. Percentage of reported malaria mortality out of all reported disease mortalities was reduced from 0.95% in 2006 to 0.64% by the end of 2011, with 32.6% achievement. Achievements in outcome targets will be shown in table (6) below. Going back to the national malaria control strategic plan 2001 – 2010, the main objective was “To reduce morbidity and mortality of malaria by 50 % by 2010”. Available data shows that number of malaria cases decreased from 4,332,827 cases in 2000 to 1,465,496 cases by the end of 2010, with 66.2% achievement. Percentage of reported malaria mortality out of all reported disease mortalities was reduced from 2.27% in 2000 to 0.88% by the end of 2010, with 61.2% achievement. Specific objectives for each of the plan strategic directions will be shown and achievements evaluated in table (7) below, using available data.

It is evident from above evaluation that after the first five years strategic plan lessons might have been learnt and reflected in improvement of the second five years plan. In the first plan only impact targets were shown without selecting outcome targets in the different malaria control strategies, achievements in which will feed impact targets. In the second five years plan, there is one impact target which is the main objective of the plan and the rest of targets are outcome targets shown by strategy of malaria control or strategic directions. The same comment on

the second five years plan applies to the 10 years strategic plan 2001 – 2010. Yet there are number of limitations. Some main and specific objectives do not contain targets, so they are not measurable. For all objectives and outcome targets, no preset measurement indicators were shown to tell how to evaluate achievements, and sources of data going to be used for evaluation of achievements in plan objectives and outcome targets are also not already shown. No clear arrangements for means of timely collection of data going to be used for evaluation of achievements. Both five years strategic plans did not contain obvious health promotion targets as complementary for other malaria control strategies.

Table (6): Achievements in outcome targets of the second National Five Years Plan 2007 – 2012

Strategy	Outcome / Output Targets	Achievement
Early diagnosis and prompt treatment of malaria cases	By 2012, 80% of malaria patients will receive prompt and effective treatment	Only available data are from the OMQCS of 2009. Only 34.3% of malaria patients received prompt and effective treatment.
Early diagnosis and prompt treatment of malaria cases	By 2012, 85% of patients with uncomplicated malaria will be correctly managed at health facilities	No apparent difference from the 1 st target in terms of wording, as wording of the 1 st target entails prompt and effective treatment for uncomplicated malaria, severe malaria, and pregnant women with malaria, while there is a separate outcome target for severe cases of malaria and no available data to show management of malaria cases among pregnant women specifically. So, same achievement as in the 1 st outcome target above.
	60% of women received IPT for malaria during their last pregnancy in targeted areas	No available data for evaluation of achievement.
	By 2012, 90% patients hospitalized with a diagnosis of severe malaria will be managed according to the national guidelines	No available data for evaluation of achievement.
Multiple preventive measures (IVM)	To provide appropriate prevention measure for at least 80% of targeted population in at risk areas by 2012	1) By the end of 2012, LLINs were distributed to 17.6% of target populations, and MIS 2012 showed that states' figures for households having at least one LLIN ranged between 8.0% and 75.9% and an overall of 46.7% for target states.
		2) IRS was implemented in 2012 in two states out of 7 targeted states; Gezira and Sinnar. In Gezira state two rounds were implemented in 7 localities; locality household coverage ranged between 96.6% - 99.1%. In Sinnar state only one round was implemented in 7 localities; locality household coverage ranged between 94.6% - 100%.
		3) No available data to show coverage of populations with other vector control methods.

Detection and control of malaria epidemics	By 2012, 75% malaria epidemics will be detected and properly responded to within 2 weeks of onset	1) No malaria alert or epidemic thresholds established yet to decide whether an epidemic is eminent or already occurred. 2) Available data show that only one malaria epidemic was reported in the period 2007 – 2012, from Shabasha – White Nile State and was contained within two weeks of notification as shown in the chapter of epidemic preparedness and response below.
Strengthening of the malaria control programme	By 2012, 70% of the annually allocated budget for malaria control received by NMCP and SMCPs	65% - 70% of the annually allocated budgets for malaria control were received by NMCP and SMCPs.
	By 2012, 80% of State Malaria Control Programmes will have at least 3 trained personnel	1) 100% of State Malaria Control Programmes (17 states) have at least 4 trained personnel. 2) All SMCPs were capacitated and more than 80% of locality malaria control programmes were capacitated well to the level that could maintain administrative and communication network running.

Strategy	Outcome / Output Targets	Achievement
	By 2012, all malaria control programmes at locality level will have at least 3 trained staff on different aspects of malaria control (planning, management, M&E, diagnosis and treatment and vector control)	72% of malaria programmes at locality level (111 localities) have at least 2 trained staff on different aspects of malaria control.
Strengthening of the malaria control programme	By 2012, 90% of public health facilities will have at least one personnel trained on malaria case management and prevention measures	Although a number of training courses in malaria case management were conducted, but no documents to show exact coverage of public health facilities by trained doctors.
	By 2012, all localities will have adequate warehouses with appropriate storage conditions for malaria commodities	96% of localities (103 out of 107 target ware houses) have adequate warehouses with appropriate storage conditions for malaria commodities.
Malaria surveillance and M&E and Operational research	By 2012, 80% of localities will provide monthly quality reports and feedback using standardized system	About 50% of localities provide monthly quality reports and feedback using telephone calls and e-mailing.
	By 2012, national malaria database will be implemented in all states and localities	All SMCPs' personnel were trained on malaria database and are using planned indicators for reporting but not according to the planned software.
	By 2012, all states will have a functional M&E unit with regularly updated M&E plans	All states have functional M&E units with clear M&E conceptual framework but no written regularly updated M&E plans.
	By 2009 and 2012 information on malaria burden and coverage of interventions will be updated using a national malaria parasite prevalence survey and coverage indicator survey	100%; information on malaria burden and coverage of interventions was updated through conduction of MISs in 2009 and 2012.
	By 2009 and 2012, a joint review mission will be conducted	No review missions were conducted in the two target years.
	By 2008, national malaria control programme will have a national strategy	Although there is coordination with the FMOH research department in identifying research priorities and research conduction, but this is not

	for conduction of operational research on identified priorities	according to a strategy.
	By 2012, 80% of the approved research proposals by the malaria programme will be funded by domestic resources	Available data show that most of conducted researches were funded from external sources.

Table (7): Achievements in specific objectives of the National Malaria Control Strategic plan 2001 - 2010

Strategy	Specific Objectives	Achievement
Epidemic Management	To improve the disease surveillance system for timely prediction of epidemics in all epidemic prone states.	Though surveillance system was improved considerably as will be shown in surveillance chapter, yet there is no system based on alert or epidemic thresholds for timely prediction of malaria epidemics in epidemic prone states.
Epidemic Management	To establish adequate buffer stock in all epidemic prone States	100%, there is an established adequate buffer stock in all epidemic prone states with support of the NMCP.
Epidemic Management	To enable all epidemic prone States to establish an effective and efficient system to respond and contain epidemics.	100%, in all states there is a SMCP extending down to locality level, with a component for responding to and containing malaria epidemics.
Case Management	To reduce morbidity and mortality of malaria by 25%, from the existing situation by the year 2005.	1) This objective is similar to the main objective of the plan as shown above, and should not be a specific objective for case management strategy only, and is rather an objective for the collective strategies of malaria control. 2) As shown in evaluation of achievement in the main objective above, malaria morbidity was reduced by 66.2% and mortality by 61.2%.
Multiple Preventive Measures	To ensure selective use of vector control measures based on epidemiological stratification and according to policy, in at least 16 States, by the end of the second year of the plan.	100%, in all states there is a SMCP with a department for integrated vector management extending down to locality level, implementing vector control methods in different parts of the state according to national guidelines with support from state and locality governments and NMCP.
Multiple Preventive Measures	To increase the use of ITNs by the community, by 40% of households within the first two years of the plan through activating public – private social marketing in supply and demand of the ITMs, targeting subsidy.	According to MIS 2012, percentage of household members sleeping under LLIN ranged between 1.9% - 27% in target states.

Focused Research	To avail evidence based solutions to problems in malaria control activities through capacity building on operational research.	100%, there is capacity for operational research in the NMCP supported first by the research department in the FMOH and in 2012 by the Public Health Institute in the FMOH.
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Strategy	Specific Objectives	Achievement
Community Involvement	To strengthen community role and involvement in malaria control programme.	Objective is not measurable as it does not contain a target, and no available data to perform any type of evaluation for achievement.
Partnership Building	To strengthen effective partnership between stakeholders, at both federal and State levels within the first year of the plan	100%, Effective partnerships were established at both national and state levels with different stakeholders as shown in partnership section below.
Health System Development	To contribute and support the development / review of policies and systems to optimize efforts towards strengthening health system functions: financing, resource generation, Stewardship and provision of care, according to the National Health Strategy.	No available data to evaluate achievements.

Due to successes and lessons learnt from the Roll Back Malaria, and the success story of the KMFIs launched in mid 2002, The National Malaria Control Strategy for 2012-2016 is aiming at replicating this initiative in some selected states. The Northern, Red Sea, River Nile, Gezira, and White Nile states were selected based on overall commitment; financing and health system potential indicating higher potential for significant reduction of local malaria transmission with the ultimate goal of malaria elimination. Priority focus of the strategy is on case management, free of charge treatments, distribution of ITNs for target risk groups, and Indoor Residual Spraying.

4.5. Programme Functions, Structure, and Coordinating Mechanisms

Functions of the NMCP include: 1) setting national strategies, policies and plans for malaria control; 2) setting standards, technical guidelines, and quality assurance protocols and systems; 3) assessment of human resource needs and capacity building at all levels; 4) resource mobilization, partnership building, and liaising

between different partners through intersectoral and intrasectoral collaboration; 5) advocate for malaria control at different levels; 6) Support state ministries of health in establishing and maintaining efficient states' malaria control programmes (SMCPs); 7) support control of epidemics of national threat; 8) guide and implement applied research activities; and 9) supervise, monitor and evaluate malaria control activities throughout the country.

SMCPs are the implementing bodies of malaria control activities according to the Federal Governing Law and have the same functions at state level with exception of the fact that they are not responsible for setting strategic directions, policies, standards and guidelines for malaria control, which is the concern of the NMCP, and they are only responsible for implementing them.

The organogram of the NMCP was meant to capacitate the programme to perform its functions efficiently.

The programme is under the General Directorate of Primary Health Care in the FMOH and consists of five departments in line with adopted malaria control strategies (Figure 23): Integrated Vector Management (IVM); Case Management; Information, Education, and Communication (IEC); Surveillance, Monitoring and Evaluation, and Research; and States' Affairs departments. At state level, the programme consists of three departments: IVM; Case Management; and IEC departments. At locality level, due to between states variation regarding recruitment of health personnel, some states have a malaria administration at locality level with an IVM and IEC sections, some have a focal person, and in some states vector control activities at locality level are still implemented by the environmental health department.

The NMCP uses a number of coordinating mechanisms at national and state levels to perform its functions. At the national level there are the Country Coordinating Mechanism (CCM) for Global Fund activities and health sector coordinating committee for Global Alliance for Vaccines and Immunizations (GAVI), where the programme is a member in both forums. The FMOH developed a donor's forum to ensure continuous dialogue and coordination with partners, but it is not yet functioning. In January 2005 the FMOH initiated establishment of a national intersectoral committee for vector control headed by the undersecretary, with terms

of reference to coordinate between different stakeholders, guide the process of integrated vector management, and develop implementation plans. Members of the committee represent the FMOH, Ministry of Environment and Tourism, Ministry of Agriculture, Water Resources, state ministries of health, academy representatives, community-based organizations, resource person(s), Ministry of Science & Technology, UN organizations (UNDP, WHO & UNICEF), Non-governmental organizations, and private sector representatives. Committee is not well-utilized to serve IVM activities.

There are guidelines for reporting, feedback, and communication channels between NMCP and SMCPs as shown in monitoring and evaluation chapter below. The Malaria Control Programme Coordinator in each state is a facilitator for the NMCP that is contacted to obtain information that is not obtained from states on a regular basis, or coordinate for conduction of certain activities in the state.

4.6.Programme Partnerships

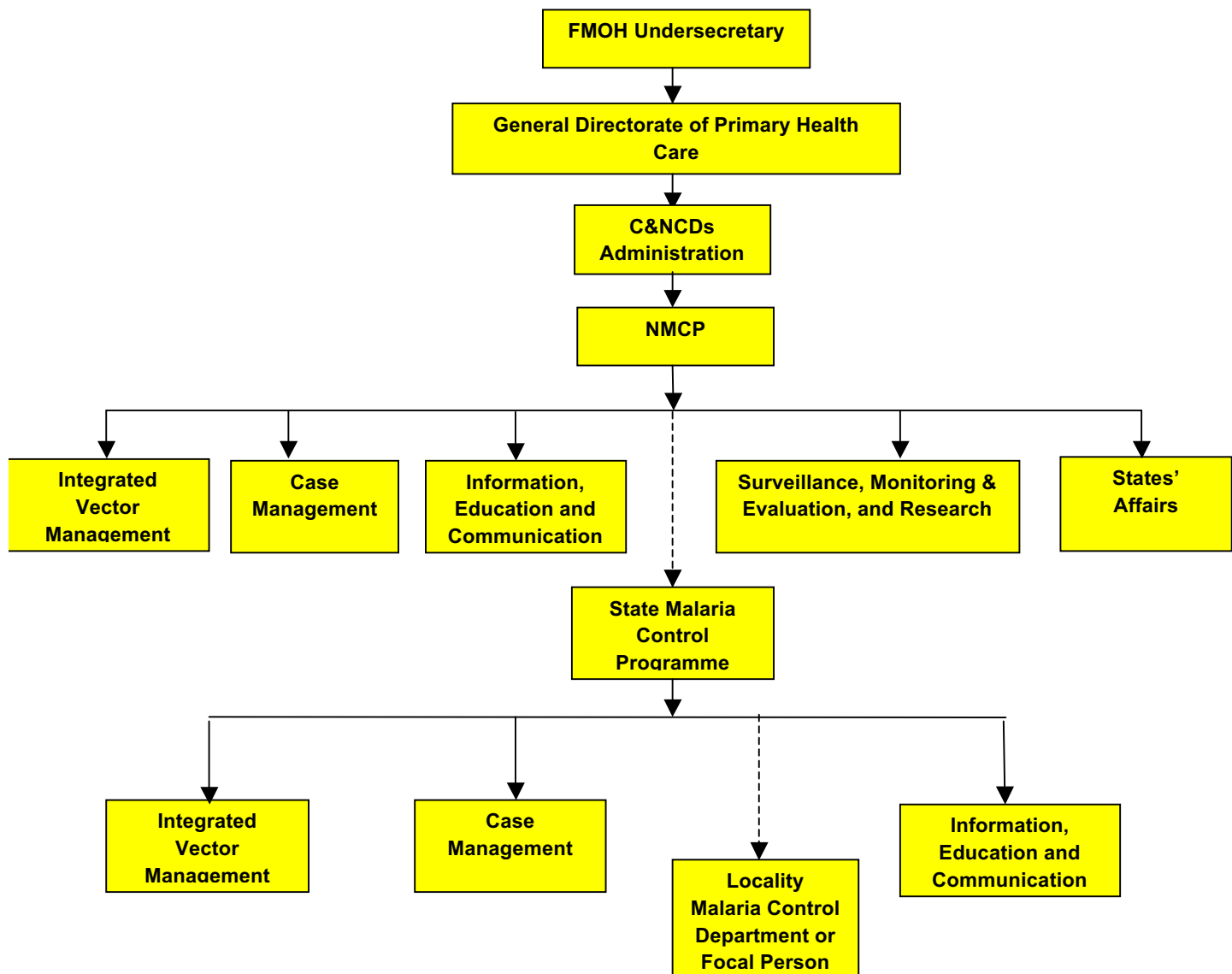
Since adoption of the RBM initiative, the NMCP has given much attention to partnership. With the growing scale of RBM activities, RBM partners have been differentiated into distinct partner communities led and coordinated through a top level board or task force coordinated by NMCP. The list of RBM partners includes:

- UN agencies: WHO, UNICEF, UNDP
- Non-governmental Organizations (NGOs): over 40 NGOs were part of a forum (Malaria NGOs forum) to coordinate and communicate malaria control issues. Plan Sudan, Goal, and Development Action Now, are good examples (Annex 13).
- Private sector: Saving and Development Bank initiated investment in ITNs early. The idea was carried over by the Financial and Investment Bank. Recently Canar Telecommunication Company, contributed considerably in malaria control based on a two years action plan. Other private sectors include: DETASI, Coca Cola, Kenana Sugar Co., Gezira Scheme Board.
- Academic and research institutes: Blue Nile National Institute for Communicable Diseases (FMOH and Gezira University), Tropical Medicine Institute (Ministry of Science and Technology), Endemic Disease Institute

(University of Khartoum), Public Health Institute (FMOH), Continuous Professional Development centre, and other medical schools.

- Bilateral and cross-border collaboration: The government of Egypt as part of Gambia Control Project that involves both south of Egypt and north of Sudan is a good example.

Figure (23): Organogram of the NMCP



4.7.Human Resources

Considerable investment was made in recruitment of required health personnel for malaria control programme at all levels. Average available staff during the review period out of the total required is shown in table (8) below for the NMCP and four states; Blue Nile, Sinnar, South Kordofan, and White Nile. Number of required staff was changing at all levels especially locality level, mostly due to update of organogram or increase in number of localities in states. Average staffing of the NMCP was 95%, states ranged between 58.3% - 91.7%, and localities between 32.4% - 92.5%. Maintaining an adequate number of health personnel at all levels of the malaria control programme was a continuous challenge for the NMCP and SMCPs throughout the review period. States affected by conflicts suffer considerable staff shortage due to insecurity conditions.

Table (8): Average staffing of NMCP and states and locality malaria control programmes for the period 2000 – 2011

Level		Average Number Required	Average Number Available	%
National	NMCP	60	57	95%
Blue Nile State	State	7	5	71.4%
	Localities	71	23	32.4%
Sinnar State	State	9	8	88.9%
	Localities	40	37	92.5%
South Kordofan State	State	12	7	58.3%
	Localities	90	38	42.2%
White Nile State	State	12	11	91.7%
	Localities	161	65	40.4%

4.8. Capacity Building

Training of malaria control programme staff at all levels in different fields of malaria control through short courses and postgraduate studies (masters and diplomas) was an important requirement for moving forwards in rolling back malaria in Sudan. The NMCP has inputs in designing all types of training courses to suit malaria control programme needs, in collaboration with training institutes specialized in training for malaria control, namely the Blue Nile National Institute for Communicable Diseases

(BNNICDs) in Wad Medani city and Professor Elgadal National Institute in Sinnar city. The programme in collaboration with WHO, Global Fund, Islamic Development Bank of Jeddah and other partners made huge investment in upgrading these two institutes. The BNNICDs was established in 1993 as a result of partnership between FMOH, WHO, Gezira State MOH and University of Gezira as the Blue Nile Research & Training Institute. By support of mainly the Global Fund the institute was upgraded in 2007 to become the current BNNICDs. A complete new extension was built so that uptake increased from 12 candidates up to 40 candidates. The institute is equipped with an electronic library and periodic international journals, laboratories (Entomology, Parasitology, Microbiology, and Molecular Biology), insectary, computer laboratory and a well-furnished accommodation for candidates and international visiting experts. Financial support was also received by BNNICDs from ministry of finance through a loan from the Islamic Development Bank that has resulted in further extension in the institute in terms of building the molecular and entomological laboratories. Training programmes provided by the institute include different short courses, master and PhD degrees for malaria programme personnel at different managerial levels. The institute (BNNICDs) also provides special courses for other disease control programmes based on MOH needs and plans. In Professor Elgadal National Institute buildings were rehabilitated and an insectary was built by ministry of finance through a loan from the Islamic Development Bank of Jeddah and equipped by Westergaard Company. The institute mainly provides short courses in entomology and vector control, and on malaria diagnosis.

The second strategic plan contained a number of output targets under programme management strategic direction, devoted to training in different malaria control fields. The plan targeted training at state, locality, and health facility levels. Types of training at locality and health facility levels were clearly shown but not for state level. As the second National Malaria Control Five Years Strategic Plan was the only plan containing training target, achievements in human resources' capacity building will be evaluated using this plan training targets as shown in table (9) below. Training courses carried out during review period were mostly in line with types of training targeted in the plan. No available data to show retention of trained staff in work at all levels.

Figure (24): Distribution of Master holders in Medical Entomology and Vector Control by states

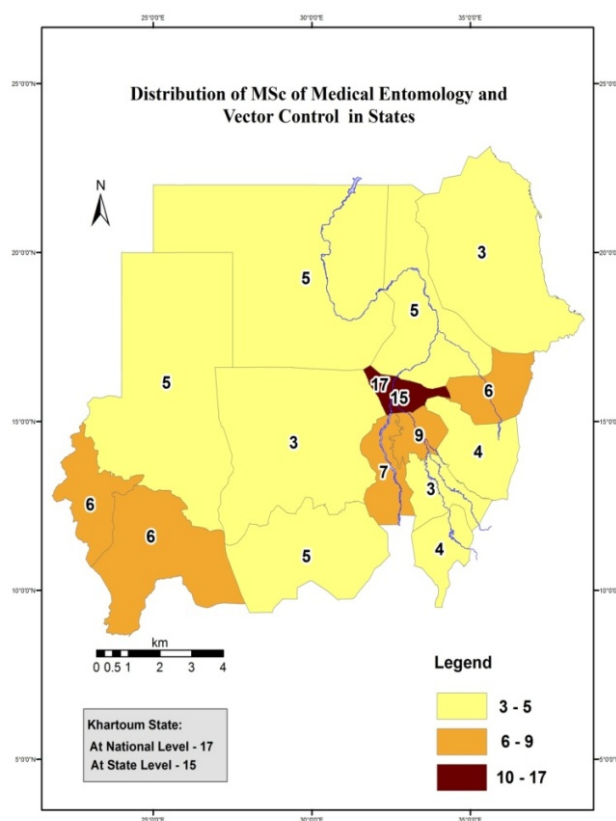


Table (9): Achievements in training of malaria control programme staff at all levels 2001 – 2012

No	Type of Training	Target Number	Number Trained	%	Training Institutions
1.	Shot course in planning for malaria control and management of malaria control programmes	221	188	85.1%	Bandar Abbas – Tehran, BNNICDs, Professor Elgadal National Institute
2.	Short course in monitoring and evaluation of malaria control programmes	221	44	20%	Professor Elgadal National Institute
3.	Short course in vector Control	221	168	76%	Professor Elgadal National Institute and BNNICDs
4.	Short course in malaria case management	221	14	6.3%	BNNICDs and Professor Elgadal National Institute
5.	Master of Medical Entomology and Vector Control or Diploma of Malariology	221	200	90.5%	BNNICDs
6.	Short course in epidemic detection, reporting, and control	375	62	16.5%	BNNICDs
7.	Training of personnel in public health facilities in malaria case management according to national treatment guidelines	5294	-	-	No available data to evaluate achievement

4.9. Procurement, Supply Chain Management and Delivery System

Before 2006, procurement of malaria microscopy equipment and consumables used to be done by WHO and by UNICEF according to NMCP annual plans and no anti-malaria drugs were provided. These supplies were mostly directed to malaria microscopy quality assurance programme. UNICEF used to provide support with laboratory equipment and consumables and anti-malaria drugs to states mostly witnessing emergency situations. During this period government was not providing any support regarding these commodities through the NMCP. Government support in this field was by provision of supplies and consumables for malaria microscopy through health facilities budget or in some instances through state ministry of health. In the period 2006 – 2008 procurement and storing of all medical items related to malaria case management continued to be done by mainly WHO and UNICEF. SMCPs then receive clinics' supplies and drugs from WHO and UNICEF through NMCP and distribute them to health facilities in the state. Provision of laboratory supplies and consumables was mainly meant to support quality assurance programme for malaria diagnosis rather than to fill health facilities needs. Concerning anti malaria drugs, WHO and UNICEF used to procure them for the NMCP which in turn distribute them to SMCPs, which also distribute them to health facilities in the state, where mostly focal persons from health facilities attend to SMCPs to receive their anti malaria drugs and then bring a feedback report about consumption. Distribution of anti malaria drugs to states is based on monthly consumption. SMCPs then send a feedback report to the NMCP about distribution of anti malaria drugs to health facilities, based on which the NMCP send a feedback report to WHO about supplies actually distributed to states and health facilities. In the period 2008 – June 2011, responsibility towards the supply system for anti-malaria drugs was transferred from NMCP to the General Directorate of Pharmacy in the FMOH, where a unit was established to manage procurement and supply system and monitors and supervises rational use of anti-malaria drugs. Estimation of drug needs for the country used to be done by the unit in collaboration with the NMCP. After procurement, drugs used to be stored in NMCP stores and distribution to states is based on approval from the NMCP. From each state, a focal pharmacist from the Revolving Drug Fund (RDF) or Pharmacy Department in the state ministry of health

or any other focal person attends to the unit in the FMOH to receive drug supply to the state. Costs of drug transportation to states are provided alternatively by NMCP and state ministries of health.

At state level, supply to health facilities is coordinated between the RDF or pharmacy department and SMCP. Representatives of health facilities attend to these departments to receive their drugs supply. In some states, the SMCP avails drugs for health facilities at the locality headquarters, from where health facilities' representatives can receive their drugs supply. Health facilities send back consumption reports to SMCPs which in turn transfer them to RDF or pharmacy departments for compilation into state consumption report and then send them to the free drugs unit in the national pharmacy department. During this period the government supported the procurement and supply system with 9 cars for the federal unit and states to monitor the system. UNDP contracted the national pharmacy department to perform all operations concerning global fund free drugs namely; transportation of drugs to states, printing of report and prescription forms, monitoring and supervision of the system and rational use of drugs, and preparation of feedback reports to UNDP. National pharmacy department was paid in a reimbursement base by UNDP to cover these operations. UNDP was providing technical assistance for the national pharmacy department to improve supply system. Training was provided by UNDP for health personnel from the NMCP, pharmacy department, SMCPs, state RDFs and pharmacy departments, and from health facilities.

During this period, laboratory equipment and consumables used to be procured by both WHO and UNDP, provided to NMCP for distribution to SMCPs and then ultimately to health facilities. SMCPs then report back to NMCP which in turn report to both organizations. Supply of health facilities with new laboratory equipment is based on assessment of old equipment by a team from National Malaria Reference Laboratory which might decide that equipment is repairable or provides new equipment. Starting from late 2008, in coincidence with round 7 of the global fund, procurement of laboratory equipment and consumables was done only by UNDP. From 2005 and thereafter, most of the fund for supplies and equipment including anti malaria drugs, as well as running the PSM system was provided by the GF.

In June 2011, a ministerial decree transferred the responsibility of PSM tasks including from the national pharmacy department to the Central Medical Stores. Accordingly the CMS receives procured drugs from the UNDP, stores them and then distributes them to states' RDFs or pharmacy departments which in turn distribute drugs to health facilities in collaboration with state and locality malaria control departments. Starting from 2010, 107 drug stores at locality level were rehabilitated by the global fund in addition to providing 107 cars to localities' malaria departments for distribution of anti-malaria drugs to health facilities, monitoring rational use of drugs, and collection of consumption reports from health facilities. This is the system functioning up to date concerning free anti-malaria drugs.

Estimation of country needs of RDTs is done by the NMCP, UNDP procures supplies to the CMS which distributes them to states with anti-malaria drugs.

In 2008 the Euro Health Group provided technical assistance for the procurement and supply system and for the last two years assistance is provided by AXIOS Foundation to date.

A number of difficulties hamper performance of supply system of anti-malaria drugs and other medical supplies. A monthly coordinating meeting was supposed to be held between the CMS and NMCP for feedback and improvement of supply system, but according to NMCP it is not regularly held and mostly adhoc. No monthly feedback report is received by the NMCP from the CMS as supposed, and the report is instead received quarterly. This calls the NMCP to go back to SMCPs to collect consumption reports from health facilities to have information about consumption and stocks in health facilities and states. This entails double work and waste of scarce resources. Difficulties arising from poor coordination can possibly be resolved with building up and more stability of the system.

Regarding procurement and supply with vector control needs such as ITNs/LLINS, insecticides and different spray pumps and machines, the system is mainly based on national public tenders and sometimes directs quotations done in collaboration between the NMCP and the Department of Finance and Administrative Affairs in the FMOH. Other ways of procurement include donations from WHO, UNICEF, and other NGOs. The GF also procure these commodities in large quantities through UNDP. Supplies are then distributed to SMCPs which in turn distribute them to

locality malaria control departments. Some quantities of these needs are always kept at NMCP stores as buffer stock.

4.10. Programme Success Stories

As in other states of Sudan malaria was a leading cause of morbidity and mortality in Khartoum State before 2002. In mid 2002 the KMFI was launched in partnership between Khartoum State Government, Ministry of Health (MOH) – Khartoum State, FMOH, WHO, and Khartoum State locality governments. Aim of the initiative was to achieve significant reduction of malaria morbidity and mortality using recommended evidence-based malaria control interventions, providing a current viable model for malaria control in the county that can be replicated in other states.

One of the main factors behind the strong start of the initiative and viability to date is the strong political commitment from Khartoum State Government, locality governments, Ministry of Health – Khartoum State, and Khartoum State Legislative Council. A monthly budget is provided from the state ministry of finance for malaria control activities in the state since 2002 and to date. Locality governments were made responsible for recruitment of mosquito men, provision of transportation facilities, fuel, and provision and maintenance of hand pumps. The state ministry of health took a share in providing additional transportation facilities, fuel, hand pumps and other spray machines (fogging and truck-mounted machines), part of personnel incentives, in addition to responsibility towards procurement of insecticides. Other factors behind success include the significant and continuous technical and sometimes logistical support from the FMOH and WHO.

Following launch of the initiative, responsibility towards malaria vector control was transferred from the Department of Environmental Health in the state MOH to a newly established malaria control programme in the MOH. Strategies adopted by the initiative were; integrated vector management, early diagnosis and prompt management of malaria cases, IEC and partnership building for malaria control. Surveillance of malaria was already integrated into the communicable disease surveillance system centred in the state epidemiology department since 1998, and malaria control programme receives a weekly epidemiological report from the department of epidemiology for monitoring purposes.

Being classified as an urban malaria state, the main vector control method selected was larval source management. The state was divided into 245 sectors and each sector was divided into 6 daily working subsectors (circles), **with technical support from the Omani Sultanate Malaria Control Programme**. Mapping for potential breeding sites in the sectors and subsectors was done, with a system for weekly update of breeding sites. A number of mosquito men and a supervisor are allocated for each sector. This team is responsible for visiting the subsectors weekly for checking potential breeding sites and updating breeding sites. If mosquito larvae are detected, the breeding site has to be sprayed using Temephos EC 50%. Huge numbers of breeding sites became under regular supervision and corrective action. As there are a number of main irrigated schemes in the state, intermittent irrigation was the choice for vector control in urban and rural settings around these schemes. A very strong partnership was established with administrations of these schemes and with the state ministry of agriculture, which resulted in adoption of this policy. Irrigation of schemes has to be interrupted once a week. A joint committee was established between administrations of schemes and SMCP and counterpart locality malaria department to supervise compliance of farmers to the policy and decide punishments for those not complying. Average compliance rate to the policy was mostly above 90%. A similar partnership was established with the Khartoum State Water Corporation for repair of broken pipes especially during winter season, the first malaria peak in the state every year. Broken water pipes in the subsectors are reported from sector supervisors up the system to locality malaria departments on daily basis, and then to locality water corporation to carry out repair operations. Sector supervisors report back to locality malaria departments about performance regarding repair operations. A joint committee was established between the SMCP and state water corporation to plan for repair operations and extract funding from the Ministry of Architectural Planning, and for follow up of repair operations through a weekly meeting. Despite considerable efforts the yield used to be not satisfactory for the SMCP. In best situations repair did not exceed 25% of target broken pipes. Main difficulty is that water pipeline is old enough and incapable to accommodate increasing quantities of water pumped from new water stations. Biological control using *Gambusia affinis* fish was also started in irrigated schemes water canals.

Some quantities of fish were brought from Gezira State and left to breed for some time and then distributed to target sites. Inclusion criteria were developed for sites where the fish can be used. A number of studies conducted by SMCP staff showed effectiveness of the fish in larval control, that chemical methods were no longer used for larval control in sites where the fish is used. Total number of sites covered by *Gambusia affinis* by the end of 2012 was 540 sites, representing all target sites in the state.

Starting from 2004, distribution of ITNs to populations around irrigated scheme was adopted as a policy in the state to bridge gaps in vector control during the rainy season where intermittent irrigation is not possible. Marked distribution campaigns were implemented in 2007 and 2009 through support from Jeddah Islamic Development Bank and global fund.

Especially during winter and rainy seasons knock down methods are used for adult mosquitoes to decrease densities, these include fogging for households in certain high risk areas and space spraying.

Case management strategy witnessed remarkable investment. A task force was established jointly between SMCP, the Department of Laboratories, Directorate Generals of Primary Health Care and Curative Medicine in the MOH – Khartoum State. Aim of the task force was to create an environment conducive for standard management of malaria cases attending public health facilities, according to national treatment guidelines. A number of medical doctors at state and locality levels had TOT training in malaria case management to be resource persons for training in malaria case management. Almost every month during the period 2004 – 2007 a number of 25-30 medical officers or assistants from public health centres and hospitals were trained in malaria case management. During the period 2002 – 2010, a total of 1670 medical doctors and 876 medical assistants were trained in malaria case management representing 67.7% and 92.4% of the target respectively.

A well-organized malaria microscopy quality assurance programme was established in the laboratories department soon after launch of the initiative. Regular supervisory visits to public health facilities are conducted by the QA team for assessment of laboratory setup using the 3x3 model and accordingly decide corrective interventions needed. A standard was set up for microscopes to be used in laboratories of public

health facilities that are supportive for good malaria microscopy. Repair of microscopes or provision of new ones is funded by the concerned department according to feedback from the QA team, with support also from the SMCP. In 2003, the SMCP procured more than 60 new microscopes for public health centres. Every month, a minimum of 2 training courses in standard malaria microscopy for laboratory technologists from both public and private health facilities were conducted by the malaria unit in Laboratories Department, with 25 participants in each course. Training is either basic or refresher. Training needs are identified through laboratory assessment visits or reporting of new laboratory technologists recruited for public health facilities. During the period 2002 – 2010, a total of 2651 laboratory technologists were trained in standard malaria microscopy representing 60.1% of the target.

Doctors (registrars), sisters, and nurses in hospitals were also targeted by training in management of severe malaria. In 2012 more than 5000 copies of guidelines for management of severe malaria were distributed to doctors in public and private hospitals in form of plastic covered A4 papers. A system for surveillance of severe malaria cases was injected into the communicable disease surveillance system in the state epidemiology department in the same year.

Following approval of local governing law by Government of Sudan in 2003, Khartoum State MOH had to update health structure at locality level. Update resulted in establishment of Preventive Medicine Departments at locality level. These departments host the communicable disease surveillance system and are technically responsible for case management services for all communicable disease programmes including malaria. This was a good opportunity for the malaria control programme, where since that time malaria case management services in health facilities were closely monitored with more corrective actions compared to the time when only one body was responsible for these services, the case management section in the SMCP.

An intensive advocacy plan for malaria control was implemented through the IEC department. Mobile theatres were conducted in public places like markets and bus stations and at population residence in all localities. Interactive sessions were implemented with community leaders in public places. Malaria control messages

were distributed to school children. School children were involved in larval source management in potential breeding sites around their schools during rainy season. Intensive mobilization campaigns for widespread larval source management used to be conducted in all localities during the rainy season. In some localities there were home visits for awareness raising concerning environmental management of malaria vector and early treatment seeking behaviour. Annual celebration of the World Malaria Day was a good opportunity for advocacy for malaria control.

Impact of Khartoum Malaria Free Initiative:

- Malaria case load decreased from 879,795 cases in 2001 to 160,507 cases by the end of 2012, with 81.8% reduction in case load (Figure 25).
- Percentage of reported malaria cases out of all disease outpatient attendants to all public health facilities decreased from 23% in 2001 to 2.5% by the end of 2012 (Figure 26).
- Prevalence of malaria dropped from 91 cases / 1000 of population in 2001 to 4 cases / 1000 of population by the end of 2006 and remained so to the end of 2008 (figure 27).
- Malaria was ranking 1st in the list of the first ten causes of morbidity and the 4th in the list of the first ten causes of mortality in the state by the end of 2001, and moved to rank the 5th in the list of morbidity and the 8th in the list of mortality by the end of 2010 (Table 10).

Lessons learnt:

Political commitment and concomitant local funding of sustainable vector control activities is key in leading to success in combating malaria. Continuous advocacy from state ministries of health among politicians and decision makers in the state is crucial in keeping the issue of fighting malaria hot and state malaria free initiatives viable, as decision makers tend to decrease budget allocated for malaria control with decreasing disease burden. Continuous technical support from the FMOH and WHO and other NGOs is also crucial and encouraging for state ministries of health to keep moving forwards in the fight against malaria.

Figure (25): Reported malaria cases from public health facilities in Khartoum State 2001 – 2012

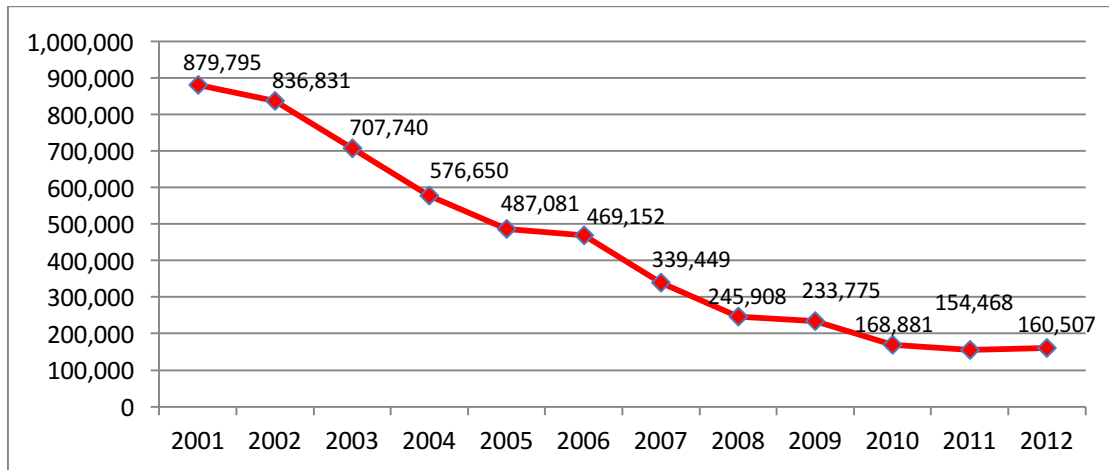


Figure (26): Percentage of reported malaria cases out of all outpatient attendants to public health facilities in Khartoum State 1999 – 2012

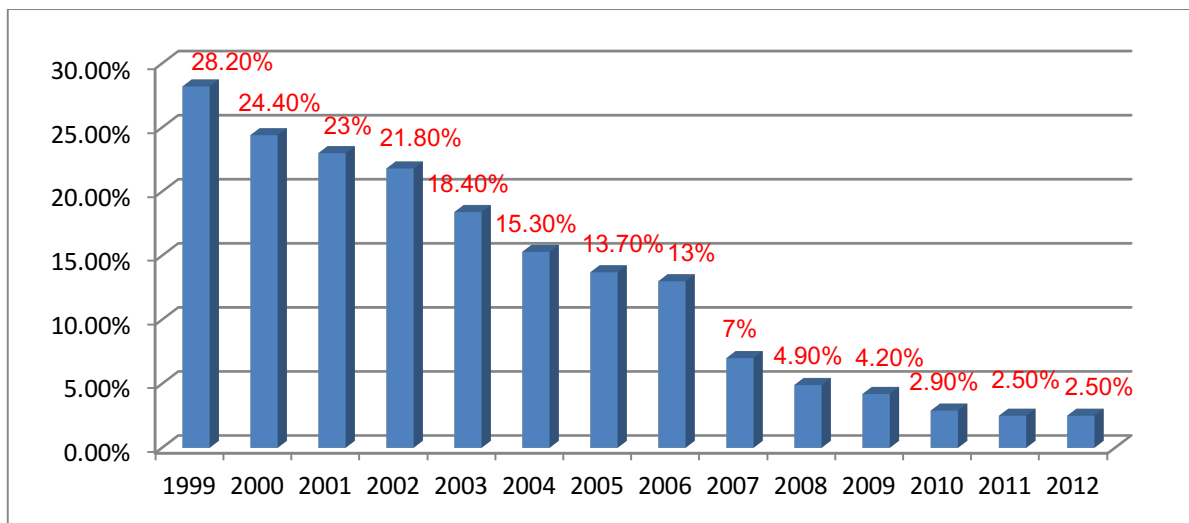


Figure (27): Prevalence of malaria in Khartoum state per 100000 of population 1999 - 2008

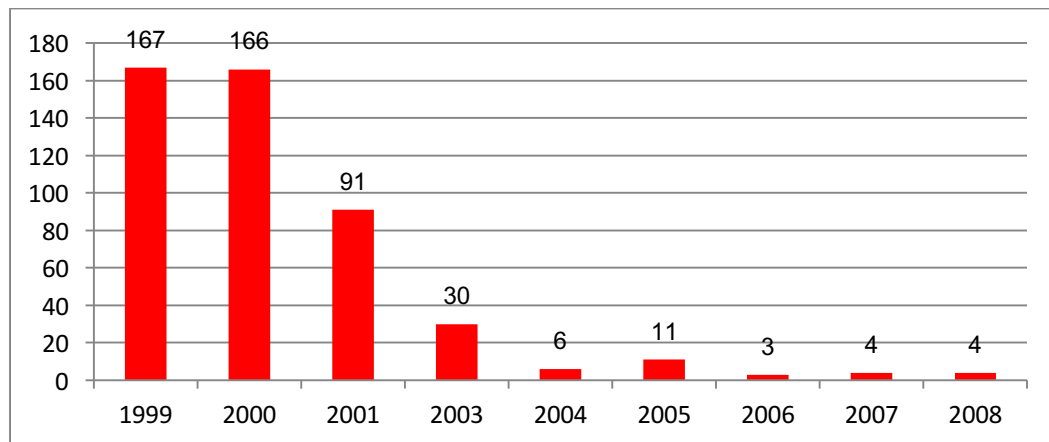


Table (10): Ranking of malaria as a cause of morbidity and mortality in Khartoum State 2000 – 2010

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Morbidity	1 st	1 st	1 st	1 st	2 nd	2 nd	2 nd	2 nd	3 rd	3 rd	5 th
Mortality	1 st	4 th	5 th	4 th	6 th	5 th	6 th	8 th	8 th	8 th	8 th

4.11. Results of Field Visits to SMCPs

Programme management was one of target themes for field visits to malaria control programmes in six states in May 2013. Interview showed that all states have national malaria control policies and SMCPs receive updates on policy changes. All participants mentioned that malaria control programme in their states is not facing legal or legislative obstacles. Majority of SMCP coordinators mentioned that there is clear structure and functions of the programme within state health system. Three of SMCPs hold follow-up meetings weekly, two monthly, and meetings are irregular in one state. In four states conclusions of follow-up meetings are documented in a written form. Four states have a clear coordinating mechanism between specialized committees and working groups. All states have trained personnel in programme management.

Majority of SMCP coordinators mentioned that partners mostly choose the way through which they participate in malaria control and not necessarily according to roles identified for them by the programme, and all of them mentioned that effectiveness of current partnerships is excellent.

All states have a system for estimation of needed materials and equipment which in majority of states based on local rather than national guidelines and not based on work plan. All states have a supply system for materials and equipment mostly dependent on support from NMCP and other partners e. g. Gambia project, yet state ministries of health sometimes provide supplies. All states have a system for transportation of supplies, either through transportation agencies of the state MOH. All states have stores for storage of supplies and a system for storage and distribution of supplies.

4.12. SWOT Analysis of Malaria Programme Management

Strengths

- A well-established malaria control programme at national and state levels with clear structure and functions is in place as the driving force for RBM in Sudan.
- Presence of a strong communication, reporting, and feedback system between NMCP and SMCPs (solidarity), and between SMCPs and locality malaria control departments.
- Extension of malaria control programme structure down to locality level.
- Use of strategic planning approach in planning for malaria control in Sudan, and presence of a number of five years plans set into action soon following establishment of the programme.
- Presence of a number of good achievements in strategic plans' outcome targets and impact objectives for strategic plans so far implemented.
- Development of a well-established monitoring and evaluation system for malaria control activities.
- NMCP reaching a state of well-functioning and governing in main streaming malaria control in Sudan through planning, policy-making, technical guidelines development, and pushing malaria control into national development agenda.
- A viable procurement and supply system for malaria control commodities is in place.
- Scientific approach of the programme in selecting evidence-based malaria control interventions and seek better performance through research.

Weaknesses

- Lack of performing a timely and comprehensive evaluation for achievements in the two five years and ten years strategic plans set into action throughout the life span of NMCP, and each time planning for coming five years was not based on evaluation of achievements in the preceding five years.

- Lack of a system for periodic reviewing of malaria control programme performance for monitoring progress before performing comprehensive evaluation of achievements in strategic plans, as recommended in the ten years National Malaria Control Strategic Plan 2001 – 2010.
- Lack of clearly identified and timely arrangements for regular collection of data necessary for evaluation of achievements in strategic plans' outcome targets and impact objectives.
- Poor documentation of a wide range of malaria control activities implemented throughout programme life span.
- Malaria control departments at locality level are still weak and mostly not yet having the standard structure being short in staffing and facilities.
- Difficulties in availability of running costs of monitoring and supervision for malaria control activities in some states and most localities.
- Frequent transfer of responsibility for procurement and supply system of free anti-malaria drugs from one department to another, delaying reaching a state of stability and maturity.
- The still weak system for monitoring and supervision of availability, storage conditions, and rational use of free anti-malaria drugs.
- Lack of clear vision concerning retention of trained staff at all levels of malaria control programme.

Opportunities

- The strong political commitment of Sudan government for malaria control in the country.
- Availability of support from the global fund.
- Availability of technical support and guidance from WHO and other international expertise mediated through WHO and global fund.
- Presence of current successful stories for combating malaria in some states that can be replicated in other states.
- Presence of strong partnerships for malaria control with a considerable number of institutions and NGOs, built throughout the life span of the programme at national and state levels.

Threats

- Stoppage or interruption of global fund support to malaria control activities.
- High turnover of trained staff at all malaria control programme levels.
- Insecurity conditions in some states which hamper sustainability of malaria control activities.
- Frequent division and emerging of new administrative levels (states and localities) could have a negative impact on capacity building that took place

4.13. Conclusion

Through more than 10 years of experience in malaria control in Sudan, malaria control programme is now a well-established programme at national and state levels, and is the driving force for RBM in the country. Strong communication, reporting, and feedback system do exist between NMCP and SMCPs and between SMCPs and locality malaria control departments. NMCP was capable of timely responding to country governing legislative laws (local governing laws 2003 & 2007) by extending malaria control programme structure and functions down to locality level.

Early in its life span, NMCP chose the strategic planning approach for malaria control with significant achievements in implemented plans and current success stories in combating malaria as models to be replicated in other parts of the country. NMCP now reached a state of governing in mainstreaming malaria control in the country through planning, policy-making, technical guidelines development, and pushing malaria into national development agenda.

Programme has a well-established system for monitoring and evaluation for malaria control activities, a scientific approach in selecting evidence-based malaria control interventions, and a viable procurement and supply system for malaria control commodities.

Yet, some gaps in performance do exist and need to be bridged towards better performance. Comprehensive and timely evaluation of achievements in implemented strategic plans is lacking. Reviewing programme performance

every two years as recommended in the first 10 years strategic plan was not performed. There is poor documentation of malaria control activities and no clear arrangements for timely collection of data needed for evaluation. Malaria control departments at locality level are under capacitated. In some states and most localities unavailability of running costs severely impede effective monitoring and supervision of malaria control activities.

4.14. Recommendations

- Emphasize timely and comprehensive evaluation of implementation of strategic plans.
- Update malaria policies, strategic and M&E plans in line with the national health strategy based on a broad based consultation with the states and all partners and stakeholders.
- Strengthen the institutional and managerial capacity of the NMCP and establish a new coordination focal point in NMCP to ensure malaria program success is sustained and to effectively support primary health care service delivery integration and decentralization with other health departments, partners, private sector and other sectors at all levels of the national health and development system.
- Conduct annual assessment of the malaria human resource gaps at locality and state level and ensure incentives and sustain capacity building for all malaria workers in line with the FMOH guidelines.
- Annual assessment of the malaria financing gaps at locality and state level to increase and sustain domestic funds with monthly, quarterly and annual malaria financial reporting at all levels with capacity building of the malaria administration units
- Establish technical malaria committee and thematic sub-committees and allocate funding for their scheduled meetings and for coordination with existing and potential partners and stakeholders
- Improve timely production of quarterly and annual malaria program reports at state and federal level with appropriate indicators and presentation templates to support effective decision making for timely

action on status of delivery, accountability and performanceDevelop and implement a system for arrangement for timely collection of data needed for evaluation of achievements in strategic plans.

- Develop and implement a plan for reactivation of the National Health Sector Coordinating Council in collaboration with concerned departments in the FMOH, towards more facilitation for malaria control programme.
- Develop and implement a plan for capacity building of locality malaria control departments in collaboration with concerned states governments, states ministries of health and programme partners.
- Strengthen monitoring and supervision capacities of SMCPs and states' RDFs and pharmacy departments to sustain vector control interventions and improve malaria case management services at health facility level including improvement of supply system with free-anti-malaria drugs and encouraging rational use of drugs.
- Push forwards implementation of state malaria free initiative in new states.

5. PREVENTION AND VECTOR CONTROL

5.1. Background

Vector control is a key malaria control intervention which was behind malaria control success stories in Sudan in the past and recently in some states post RBM initiative. Predominant malaria vector is *Anopheles arabiensis* all over Sudan besides *Anopheles gambiae* and *Anopheles funestus* (*Five years Strategic Plan for the Sudan National Malaria Control Programme, 2011 – 2015*). Breeding site requirements for *Anopheles arabiensis* is small pool while *Anopheles gambiae* and *Anopheles funestus* need more humid & forested habitats (VCNA 2006).

Main vector control interventions implemented in the context of integrated vector management include larval source management (environmental, chemical or biological), indoor household residual spraying (IRS), mosquito nets (ITNs), and space spraying. In recent years, some of these interventions have been challenged due to reports of vector resistance to certain insecticides in some parts of the country. In central Sudan, *Anopheles arabiensis* has been reported resistant to several insecticides BHC, DDT, and Malathion (*Haridi, 1972; Hemingway, 1983*). In 2008, resistance of *Anopheles arabiensis* to pyrethroids has been reported in Gezira and Sinnar states (*Abdallah, 2008*). Resistance to pyrethroids has become a challenge for LLINs use in these parts as it is the only class of insecticides used for LLINs treatment. For IRS the challenge is the higher cost of alternative insecticides.

5.2. Policy and Guidance

The Integrated Vector Management Department (IVM) in the NMCP is the actual governing body responsible for setting standards and guidelines for vector control interventions and application of interventions to specific situations, development of policies regarding vector control interventions and in general it is the technical advisor in the NMCP for all matters related to vector control interventions. There was a national strategic plan for IVM for years 2007 – 2012, but no such plan was set for 2012 – 2016 to be in line with the NHSSP 2012 – 2016. There is urgent need to set a strategic plan for IVM to update policies and guidelines and be in line with the NHSSP for coming years.

5.3. Organization of Vector Control Service Delivery

The national IVM department in the NMCP is the department responsible for performing the national programme functions and responsibilities with regard to vector control activities.

At state level, the IVM department in addition to overall supervision of vector control activities in all localities, it is also responsible for setting vector control interventions that should be applied in the different parts of localities and recommended manpower at locality and grass root levels of vector control activities.

At locality level, a malaria administration is supposed to be established in each locality according to local governing laws 2003 and 2007, with the mandate of implementation of vector control and information, education, and communication activities in the locality. According to IVM Department in NMCP such administrations are present in 81.1%% of localities (150 locality). Only in Khartoum and Gezira States the locality administrations are taking the shape of the recommended administration with regard to recommended sections and staff. For the rest of states, the administration is mostly in the form of a single focal person. All of the Darfur states and South Kordofan state suffer shortages in locality malaria focal persons with average coverage 59.4% for Darfur states and 70.8% for South Kordofan. Where there are no locality malaria administrations or focal persons, vector control interventions are integrated into the Environmental Health Department at locality level.

Lower down below the locality level, there is a vector control unit at administrative unit level in only Khartoum and Gezira States. These units are the bodies directly responsible for implementing and supervising vector control activities and directly connected with manpower at the grass root level of vector control activities (Mosquito Men). In the states where there are no such units, the locality administration is the body directly connected with grass root level of vector control activities.

Based on local governing laws 2003 and 2007, localities are responsible for recruitment of mosquito men, provision and repair of pumps, provision of fuel and transportation, protective equipment, and other running costs for implementation of vector control activities.

According to IVM Department in NMCP, there is mostly poor commitment of locality governments towards availing vector control commodities especially recruitment of mosquito men, provision of transportation and fuel for operations, but no available data to show availability of these commodities at locality level.

To keep in line with the FMOH programmatic integration guidelines, the IVM department at all levels of the NMCP is also responsible for control of disease vectors other than the malaria vector at times of outbreaks, especially haemorrhagic fevers.

Implementation of Vector Control Methods

5.3.1. Larval Source Management

According to VCNA 2006, the main larval control method to be used in urban areas of the county is environmental management through intermittent irrigation in irrigated schemes; repairing broken water pipes, clearance of vegetations, draining rain water, drying and flushing water pools in addition to larviciding using Temephos EC 50% and larvivorous fish *Gambusia affinis* as a biological larval source management method in irrigated schemes.

According to IVM Department in NMCP, only 33.7% of areas in Sudan (40 areas) aside from Khartoum state, are covered by larval source management methods. No available data to show compliance of irrigated schemes to intermittent irrigation or performance in repair of broken water pipes or other environmental management operations. Biological control method (*Gambusia affinis* fish) is used in Khartoum, Gezira, Kassala (New Halfa Irrigated Scheme), and River Nile (Zeidab Irrigated Scheme) states but no available data to show average coverage of target sites by the method. Larval source management is a demanding method and the method suffering significantly from lack of resources mentioned above in most states

It is of worth mentioning that implementation of the nationally recommended package of larval source management methods was behind the success story of KMFI, which adopted larval source management as the primary method for malaria vector control.

5.3.2. Indoor Household Residual Spraying (IRS)

History of IRS in Sudan goes back to the 1950s and 60s when DDT was extensively used throughout the country. According to NMCP policy, IRS is implemented in states

with irrigated schemes and malaria epidemic prone localities; these include targeted areas of Gezira, Elrahad, New Halfa, Suki, Zeidab, Kenana and Sugar cane projects. According to IVM Department in NMCP, IRS used to be implemented annually since 2000 in Gezira, New halfa, Atbra River locality and Zeidab Irrigated Scheme in River Nile State, and in the areas covered by the Gambia Project in Northern State. Insecticides used to be provided by Gezira Irrigated Scheme Board and the Gambia project for target areas in River Nile and Northern States. No available data to show coverage of households by spraying since that time.

Currently a total of 32 localities in 7 states are targeted by IRS campaigns; Gezira, Sinnar, White Nile, Gedarif, Kassala, River Nile and Northern states. The national malaria strategic plan (2011 – 2015) targets covering 85% of households in these localities biannually by 2015, covering the 2 malaria seasons: August – October and December- March. Campaigns are funded by global fund round 10. The insecticide used is Bendiocarb, where a total of 33,525 tones of the insecticide is procured annually in round 10 of the global fund for implementation of IRS in most irrigation. IRS in Northern, R. Nile, Kasala are run in regular base through the Gambia project and funded by the government of Sudan for the running cost and by the government of Egypt for insecticides provision.

IRS campaigns funded by global fund round 10 were implemented in 2012 in only Gezira and Sinnar States. In Sinnar State only the second round was implemented due to financial difficulties in availing running cost of operations. A total of 477,439 households in Gezira and 188,979 households in Sinnar were targeted by campaigns. In Sinnar State, campaigns were implemented in 7 localities; percentage of population protected ranged between 96.4% - 100% and households covered between 94.6% - 100% (Table 11). In Gezira State, campaigns were implemented in 7 localities also; percentage of population protected ranged between 92% - 99.5% and households covered between 96.6% - 99.1% (Table 12).

Following implementation of IRS campaigns in Gezira and Sinnar States, number of population protected increased from 2,828,025 persons in 2002 to 4,926,163 persons in 2012 with 74.2% increase in protection rate, while number of households covered increased from 565,605 in 2002 to 895,666 in 2012 with 58.4% increase in coverage.

The main constraints for implementation of IRS in Sudan include the high cost of implementation, the need for very skilful spray men in the light of difficulty in organizing regular training sessions for these men prior to spraying round, and the need for a large number of supervisors for close supervision.

According to IVM Department in NMCP, IRS operations in most irrigation schemes with the exception of Gezira, were not consistent with national standard methods of implementation due to poor planning and resource (human and financial) limitations.

Table (11): Percentage of population protected and households covered in IRS campaigns in Sinnar State in 2012

Locality	% of population protected	% Household covered
Sinnar	96.4%	95.8%
Singa	96.4%	94.6%
Elsuki	97.5%	96%
Abu Hugar	96.8%	95.4%
East Sinnar	96.9%	97.7%
Eldali	98.5%	98.2%
Eldindir	100%	100%

Table (12): Percentage of population protected and households covered in IRS campaigns in Gezira State in 2012

Locality	% of population protected	% Household covered
Medani	97.9%	99.1%
Elhasahisa	96.6%	96.6%
East Gezira	98.9%	97.9%
South Gezira	99.5%%	98.6%
Elmanagil	98.9%	97.7%
Um elgura	92%	98.3%
Elkamlin	98.3%	97.8%

5.3.3. Mosquito Nets

Following successful demonstration by community field trials that Insecticide Treated Nets (ITNs) offer both personal and community-wide protection, Sudan developed a national strategic plan for ITNs distribution in 2004, targeting areas

with varying levels of endemicity such as seasonal malaria, irrigated schemes and complex emergency situations. The first policy for ITNs distribution was targeting only children under five years of age and pregnant women.

Following development of the strategy for ITNs distribution, the NMCP started a project for availing ITNs through partnership with the Sudanese Savings Bank as the funding agency. Conventional nets were prepared and treated with recommended insecticides locally, and were to be retreated after six months. ITNs were availed for population in specific distribution points and purchase was charged. Concomitant with this the programme started advocating for ITNs encouraging target population to own and use ITNs through different Information, Education, Communication, and Behavioural Change Communication (BCC) methods.

Various financing and distribution channels were piloted only to result in low coverage of target population.

Low uptake of ITNs in addition to failure to set up viable retreatment strategies for conventional nets led to shift to the current approach (policy) of ITNs distribution, which is based on the National Malaria Strategic Plan 2011 - 2015, Abuja targets for 2015, and the RBM Partnership targets which recommend 80% utilization of Long Lasting Insecticidal Nets (LLINs) by the target population as the most appropriate objective for universal coverage. The RBM Harmonization Working Group (HWG) has recommended that countries should plan for 1 LLIN for 2 persons (RBM Dakar meeting, 2010). According to these guidelines current policy of ITNs distribution is to use LLINs with a life span of 3-5 years and free distribution of one net for 2 persons of target population aiming at universal coverage by 2015.

WHO and UNICEF have a huge contribution in availing, at the beginning, conventional ITNs, and thereafter shifted to LLINs procurement. Later on, ITNs/LLINs were massively funded by the global fund through round 2 and round 7. In the global fund round 10, a total of 14,244,550 LLINs will be procured and distributed over the five years implementation period. UNICEF Sudan will be responsible for procuring and distributing LLINs down to locality level. UNHCR will lead distribution of LLINs to refugees only, while Ministry of Health, and local governments will participate in distribution campaigns in target states and nomads.

Currently, LLINs are distributed in 12 target states (Blue Nile, South Kordofan, North Kordofan, Kassala, Gedarif, West Darfur, central Darfur, East Darfur, North Darfur, South Darfur, Khartoum, and White Nile) including internally displaced persons (IDPs), refugees, and nomads through house-to-house campaign and mop-up approaches.

Recently a campaign was implemented for free distribution of LLINs in late 2012 and another planned in 2013. Main obstacles greatly hampering LLINs distribution include lack of enough standard warehouses at both national and locality levels, in addition to the high running cost of net distribution.

Household ownership of at least one ITN 51% on a national scale while within the states targeted for LLIN distribution, ownership of at least one ITN was 62% as shown by 2012 MIS. The universal coverage of ITNs (2 persons per ITN) was 24% at the national level, while within the targeted states, the figures were 33%. Better coverage with ITNs and LLINs were generally observed in urban areas, and in the states of Central Darfur and White Nile.

According to MIS 2012, highest LLINs ownership was observed in White Nile (75.9%), Gedarif (64.4%) and Kassala (54.9%) states (Table 14). Comparing results of MISs 2009 and 2012, LLINs ownership improved in only 4 (White Nile, Gedarif, Kassala and old West Darfur) out of the 10 target states. To make possible comparison of results of household ownership and utilization in 2012 for current South, West, Eastern and Central Darfur States with that of 2009 for old South and West Darfur States, figures for current South and Eastern Darfur States were summed up to make the figures for old South Darfur State, while figures for current West and Central Darfur States were summed up to make the figures for old West Darfur State (Table 14).

In both surveys, ownership of LLINs in rural settings is higher than in urban settings (Table 14). Concerning utilization of LLINs, it is to remain a challenge for the NMCP across all target states. In the best situations only slightly higher than a quarter (West Darfur) and a quarter (Gedarif) of target population in the state is sleeping under a LLIN. In all target states, all household members' utilization of LLINs is far behind ownership (Table 14). Net utilization is still low even if assessment of utilization is done using members in households with at least one net as the

denominator (Table 15). As in MIS 2012 net utilization in households with at least one net is shown only for “any net” and “ITN”, comparison of net utilization in 2009 and 2012 in households with at least one net is done using ITNs as a proxy for LLINs. According to MIS 2012, main reasons for not using nets in households with at least one net are absence of mosquitoes (47.6%) and lack of nets (35.3%). Indeed in 2012 survey was conducted in December when mosquitoes’ density is generally low, while in 2009 it was conducted in September when it was just the end of autumn and mosquitoes’ density was still high. Role of other important factors in low net utilization cannot be ruled out. Implemented malaria control strategic plans did not contain explicit targets for promotion of utilization of different malaria control interventions including LLINs utilization as shown in programme management chapter. IEC activities targeting improvement of LLINs utilization are not routinely implemented as will be shown in the IEC theme below.

Table (14): Results of household LLINs ownership and utilization by states in MISs 2009/ 2012

States	Number of households surveyed		% of HH with at least one ITN		of HH members who slept under ITN	
	2009	2012	2009	2012	2009	2012
*Blue Nile	239	177	51.4	50.3	22.7	13.8
*Gedarif	279	160	64.6	73.1	18	25.3
Gezira	640	653	48	34.3	13.7	5
*Kassala	338	331	33.1	70.1	8.1	21.2
Khartoum	1054	774	23.7	21.1	3.1	2.3
*North Darfur	357	420	48.9	52.6	18	10.5
*North Kordofan	578	383	44.3	52.7	5.8	5.9
Northern	218	158	36.1	53.2	0.8	9.1
Red Sea	239	267	27.6	27.7	2.6	17.1
River Nile	239	180	64.6	55.6	6.9	5.1
Sennar	279	172	46.1	65.7	15.2	12.6
*Former South Darfur**	600	800	43.1	49.5	21.3	8.4
*South Darfur		600		60.5		13.3
*Eastern Darfur		200		38.5		3.4
*South Kordofan	279	280	54.2	67.1	17.3	6.4
* Former West Darfur**	280	440	39.4	68.1	16.1	29.4
*West Darfur		240		54.2		18.9
*Central Darfur		200		82		39.8
*White Nile	360	315	54.2	84.1	24.6	18.5
Total	5980	5510	41.4	50.9	11.2	11.4
*States targeted for LLIN distribution	3232	3306	48.1	62.0	16.6	14.6

**** Former South Darfur = results of current South Darfur and Eastern Darfur; Former West Darfur = current West Darfur + Central Darfur. These allows direct comparisons of the 2009 and 2012 results. Eastern and Central Darfur did not exist as states in 2009 hence no results are shown for the MIS 2009.**

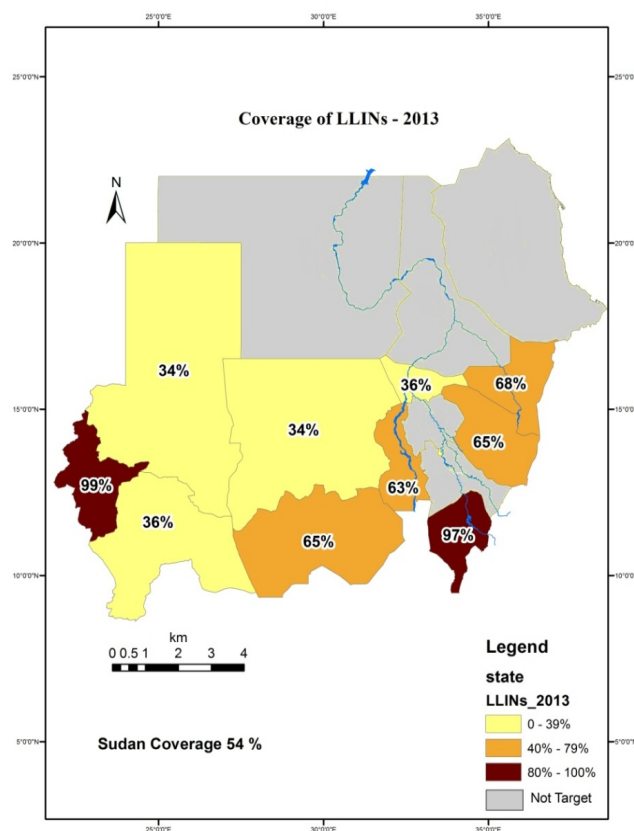
Table (15): Results of household members' utilization of ITNs in households with at least one net in 2009 and 2012 in states targeted by free LLINs distribution

States	MIS 2009	MIS 2012
	% of HH members who slept under ITN	% of HH members who slept under ITN
Blue Nile	42.6%	24.3%
Gedarif	25.9%	31.5%
Kassala	23.7%	31.8%
Khartoum	12.9%	7.8%
North Darfur	36.9%	17.5%
North Kordofan	12.7%	10.2%
South Darfur	43.7%	17.5%
South Kordofan	26.4%	9.0%
West Darfur	36.5%	39.9%
White Nile	39.3%	21.4%

5.3.4. Space spraying

Space spraying is not a priority method for malaria vector control in Sudan. According to NMCP guidelines, this method should only be used for control of malaria outbreaks. However, in some states space spraying is used in autumn or winter seasons at times when adult mosquito density and trend of malaria morbidity are increasing. The method is also sometimes used for control of bruiting nuisance insects in urban areas. In the last 10 years space spraying was used for control of disease outbreaks other than malaria, mostly haemorrhagic fevers (Yellow fever 2005, Rift valley fever 2007 in central Sudan, Creamian Congo fever 2008 in South Kordofan, Dengue fever in Port Sudan 2010, and Yellow fever 2012 in Greater Darfur states) (*FMOH 2012*).

Figure (28): Operational coverage of target states with free LLINs distribution



5.4. Malaria Vector Surveillance

Entomological surveillance in malaria control is used to determine changes in the geographical distribution and densities of the vector, evaluate control programme, obtain relative measurements of the vector population over time and facilitate appropriate and timely decisions regarding vector control interventions. It may also serve to identify areas of high-density infestation or periods of population increase. In 2012, vector surveillance units in the NMCP and SMCPs were strengthened and capacitated by trained personnel who were trained on vectors surveillance and entomological Skills. Each of the 17 states of the country has a team of 4 trained personnel; one entomologist and three technicians equipped with a full set of entomological survey kits. A total of 64 sentinel sites were identified for malaria vector surveillance in all states in 2006 (Figure 29). In some states (Khartoum), malaria vector surveillance is well – organized and sustainable and its results feed decisions

In 1970, *Anopheles arabiensis* resistance to DDT and BHC (Haridi, 1972) was reported, and in 1983 resistance of the vector to Malathion in Gezira irrigated Scheme was reported (Hemingway 1983). Recently, resistance to Malathion, DDT, Dieldrin and Premethrin have been reported from central and eastern parts of the country (Himeidan, et. al. 2004 & 2007; Siedahmed et al 2007; Matambo et. al. 2007; Abd alla et al. 2008).

In February 2007, a national workshop with the support of international experts reviewed malaria vector resistance data, and put a plan of action to manage insecticides resistance in the country. Of the important recommendations; the switch to Bendiocarb for IRS where malaria vector is resistant to pyrethroids, and setting in place a robust routine monitoring system that would inform the control programme. As part of the insecticide resistance action plan; a review meeting was convened on 13 February 2010 with the same objectives of 2007 workshop.

From 2007 -2013, at least 10 states out of 17 have been conducting insecticide resistance bioassay following WHO (1998) guidelines and using WHO standard kits, and reported some resistance levels against various classes of insecticides, but these activities were on irregular base due to lack of financial resources.

Khartoum State has a long history of vector surveillance and insecticide resistance monitoring activities dating back to the 1990s, where there were 8 identified sentinel sites for vector surveillance. However, following the launch of the KMFI in mid 2002 much progress has been done in relation to representation of sentinel sites for the state, and sustainability of activities. Sentinel sites were increased from 8 to 24 sites covering the seven state localities, and activities were continuing since that time to date.

Sentinel sites are visited regularly on a weekly basis, with the objectives of evaluating daily vector control activities (spot check evaluation) as well as monitoring the trend of adult mosquitoes density. Feedback from surveillance activities is given to counterpart malaria departments in localities and administrative units to direct vector control interventions.

Generally, for both adult and larval mosquito densities, there are two peaks one major soon after rains (late August- September), and one minor during winter season (December – January).

Nine of the 24 sentinel sites were selected for monitoring *Anopheles arabiensis* insecticides resistance (Figure 30). A small entomological laboratory was established in 2003 with support of the WHO (EMRO) and NMCP. Since that time and up to-date malaria vector insecticide resistance is monitored annually. However, in 2010 the SMCP started to monitor resistance of adult *Culex* mosquitoes as well as larvae of both *Anopheles* and *Culex* species

5.6. Effective Pesticide/Insecticide Management

Insecticides for vector control operations are mostly procured for all Sudan states by the NMCP with exception of Khartoum. Estimation of quantities needed is based on actual consumption for last year in addition to 10% of actual consumption. Insecticides are distributed to SMCPs based also on state consumption for last year, and then to locality malaria control departments.

NMCP currently does not have enough warehouses at locality level and no standard warehouses for storage of LLINs and insecticides at national level. This problem is now greatly hampering the distribution and storage system of LLINs, insecticides, spraying equipment and other related materials. Moreover, the lack of standard warehouses and insecticide disposal facilities at all levels might be hazardous to those handling the insecticides, store keepers, and general population living close to facilities currently used for warehousing insecticides.

There are technical guidelines distributed to SMCPs for standard doses of insecticides and ways of application. No standard methods for disposal of insecticides are available yet in the country, therefore NMCP has a system for between states mobilization of quantities of insecticides according to needs so that insecticides do not remain unutilized in states till reaching expiry date.

Figure (30): Sentinel sites for monitoring malaria vector insecticides resistance in Khartoum State

Figure (31): Average density of female *Anopheles arabiensis* per room from PSC collection in 24 sentinel sites in Khartoum State 2005 – 2012

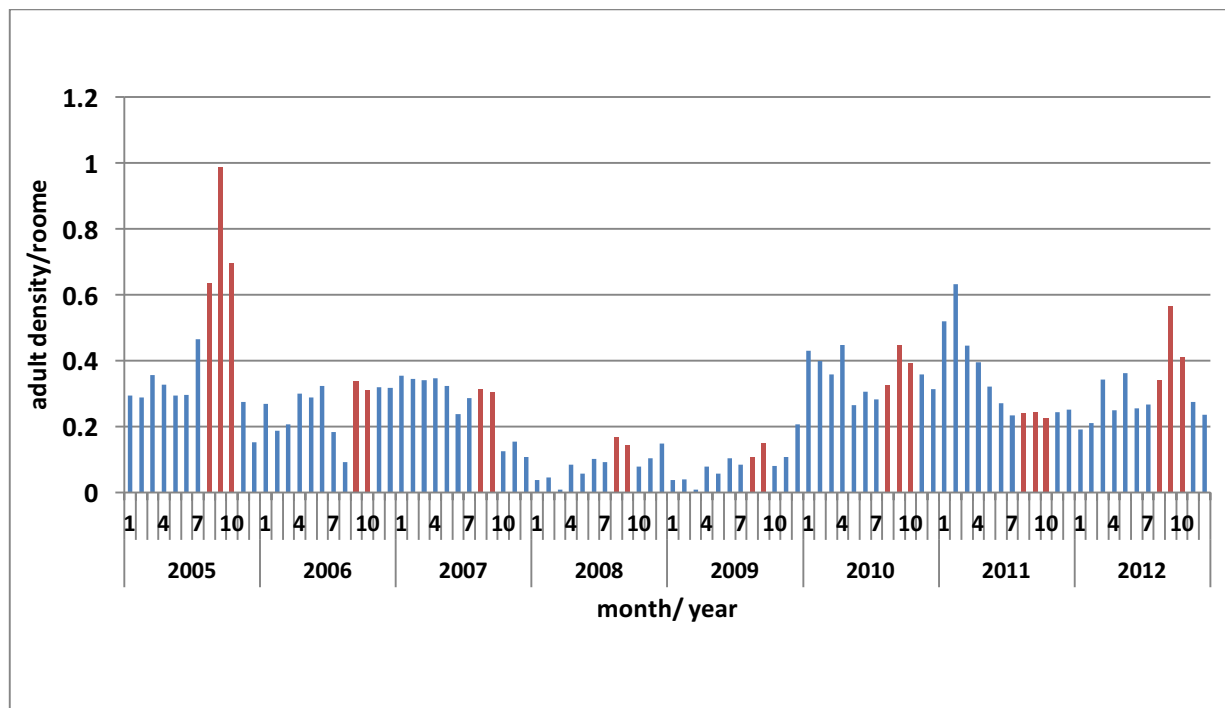


Figure (32): Mean % mortality of female *Anopheles arabiensis* after 24 hours against different insecticides in the Khartoum State 3 greater localities 2004 - 2012

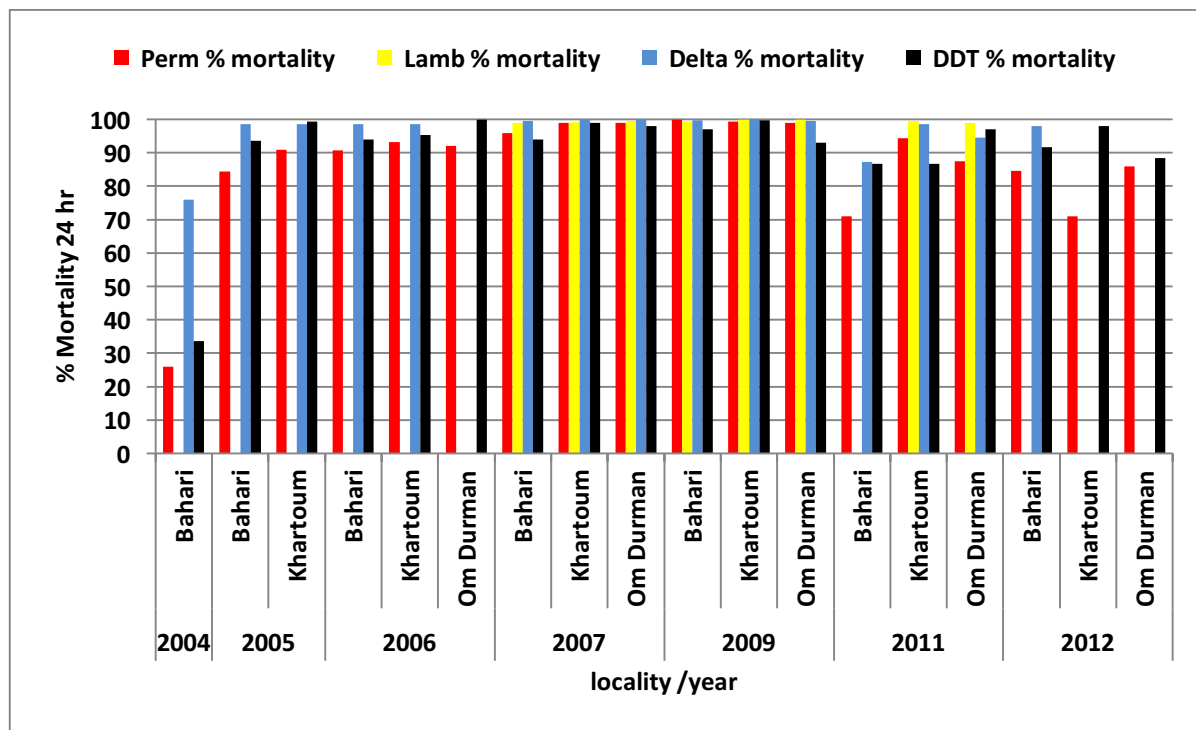
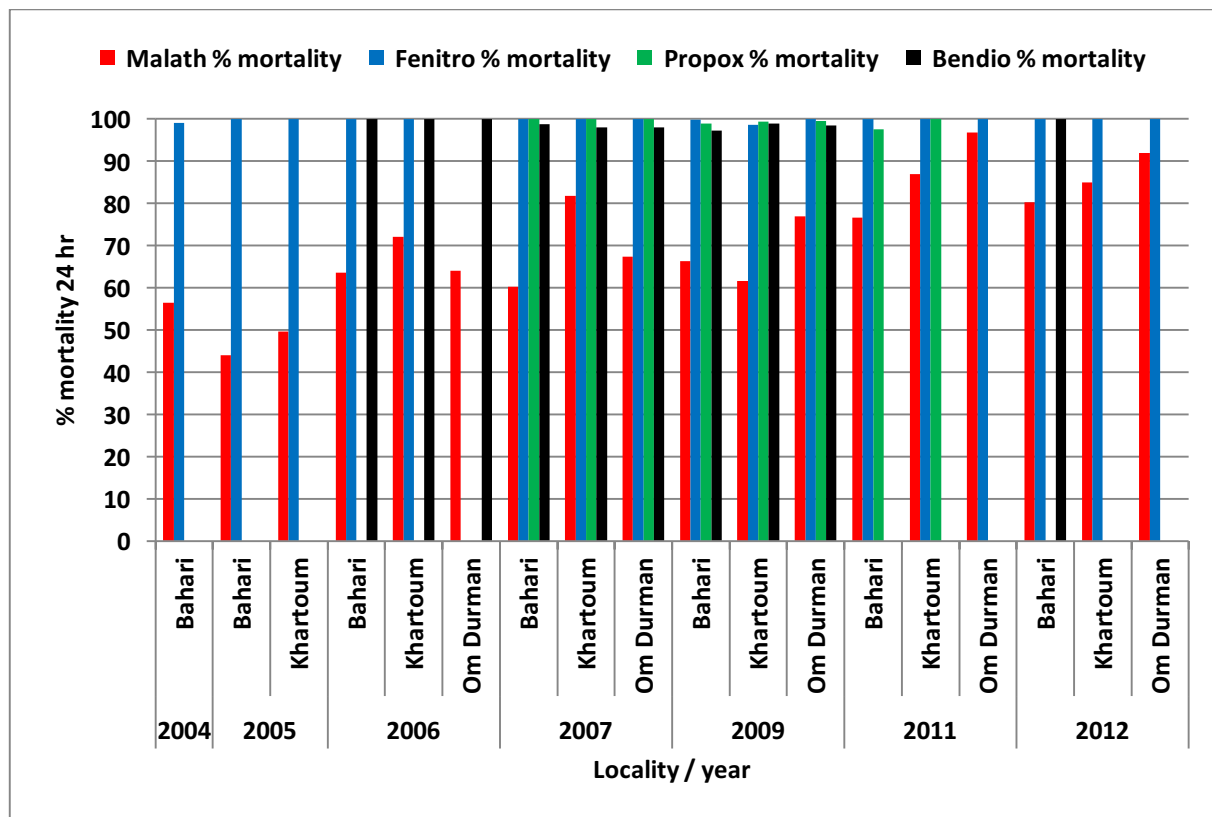


Figure (33): Mean % mortality of female *Anopheles arabiensis* after 24 hours against different insecticides in the Khartoum State 3 greater localities 2004 - 2012



5.8. Results of Field Visits to States' IVM Departments

Findings from field visits to six selected states of the 17 states, representing the six malaria endemicity strata in May 2013, showed findings evidencing conformance of most states to NMCP guidelines for IVM. All states have policies or guidelines for vector control with a section devoted to larval control. Five states conduct internal audits to assess compliance to vector control policies and guidelines, while four states conduct external audits for this purpose. Five of the six states have a department, a sub-committee, or a working group specialized in vector control and responsible for planning for IVM, supervision and evaluation of activities and conduction of malaria vector surveillance and monitoring insecticide resistance activities. All states have sentinel sites for vector surveillance; five states have data about vector distribution and five have data about vector breeding sites. Percentage of larval source coverage in selected states varied between 9% - 70%. All states conducted IRS and LLINs distribution campaigns last year.

5.9. SWOT Analysis for IVM Activities

Strengths

- Political commitment towards rolling back malaria at national and state levels.
- Decentralization of implementation of malaria vector control interventions down to locality level with clear roles for each level.
- Capacitating all states and most localities with trained personnel and reasonable infrastructure, resulting in sustainable implementation of vector control interventions.
- Establishment of well-equipped entomological laboratory at national level and small laboratories in some states (Khartoum and Gezira).
- Well established system for monitoring insecticide resistance, informing decisions about suitable insecticides.
- Good coverage with vector control interventions in some states, and increasing coverage in others.
- Strong partnership with epidemiology departments at state level, making use of weekly epidemiological reports to direct vector control interventions.
- Available evidence for positive impact of vector control interventions on malaria morbidity.
- Ability of the NMCP in partnership with ministries of health in Khartoum and Gezira states to bring in reality success stories of vector control interventions impacting malaria morbidity, providing lessons that can be drawn by other states.
- Good experience of IVM departments in control of other disease vectors (e.g. haemorrhagic fevers).

Weaknesses

- Poor commitment of local governments towards securing running cost of vector control interventions especially transportation, fuel, manpower incentives, and maintenance of spray pumps.
- Inadequate permanent mosquito men for larval control, which greatly hampers larval source management in many states.

- Lack of enough and standard warehousing for insecticides, equipments, LLINs and other vector control commodities at national and locality levels.
- Poor documentation of implementation of and coverage with vector control methods.
- Insufficient office space at all levels.
- Insufficient vector surveillance system.

Opportunities

- The still viable global commitment towards fighting malaria/ TB, and HIV/AIDS.
- Availability of fund for main vector control interventions from the global fund and other international agencies like the Islamic Development Bank in Jeddah.
- Presence of a continuous technical support and guidance from WHO in addition to provision of some important equipments by the organization sometimes.
- Signing of Sudan government for the Abuja Declaration and endorsement of the country for the RBM initiative.
- Presence of a number of coordinating mechanisms at international, national, and state levels which can facilitate for increasing coverage with vector control interventions and sustainability of interventions.
- Presence of a large and still growing number of TV and radio stations at both national and state levels, which can be a means for raising community awareness to have a share in vector control interventions.
- Wide distribution of farmer field schools in Sudan can facilitate involvement of agricultural communities in implementation of vector control interventions.
- Recent reorganization of the structure of the FMOH which favours more integration with other programmes in the ministry.
- Presence of research and training institutes in the country (e.g. Blue Nile National Institute for Communicable Diseases and Public Health Institute).

Threats

- Increasing cost of malaria vector control interventions coupled with the perceived understanding of some state governments that funding malaria

vector control interventions is a responsibility of the FMOH, and the dependence of these states on federal support.

- Lack of viable and regular mechanisms at state level for monitoring commitment of local governments towards availing needs of vector control interventions and taking necessary measures for correction.
- High turnover of qualified staff.
- Difficulty in recruitment of mosquito men in some states due to low salaries.
- Security limitations in some parts of the country impede implementation of vector control interventions.
- Interruption of continuity of funds from the global fund and other partners.

5.10. Conclusions

Decentralization efforts of IVM led by the NMCP early post adoption of Sudan of RBM initiative, coupled with continuous international and national support to SMCPs succeeded in establishment of reasonable infrastructure of malaria vector integrated management at state level. Yield of these efforts was increasing coverage with main vector control interventions, positive impact of malaria vector control interventions on malaria morbidity in the last 12 years, and bringing success stories in reality in some states. These achievements open a window of opportunity for more acceleration of vector control interventions towards universal coverage.

Increasing coverage with some vector control interventions (e.g. larviciding and intermittent irrigation in irrigated schemes) and sustainability of sufficient malaria vector surveillance are to remain a challenge for effective IVM.

5.11. Recommendations

- Expedite up-scaling of LLINs and IRS to the targeted States/localities in order for the agreed targets to be achieved by 2015
- Develop an updated integrated vector management strategy and implementation plan, which is guided by evidence, based decision making and is based on strong inter-sectoral and intra-sectoral participation

- Setting a national strategic plan for IVM with special focus on vector control methods other than IRS and mosquito nets, in order to cope with the NHSSP 2012 – 2016.
- Updating IVM policies, standards, and guidelines according to state of the art and communicating updated documents to malaria control departments at state and locality levels and to other relevant stakeholders.
- Implementing an intensive mobilization plan for states, localities, and other stakeholders through the already set coordinating mechanisms, to increase coverage with IRS and LLINs, and increase implementation of environmental vector control methods and larviciding.
- Conduct routine LLIN utilization and tracking surveys so to assess behavioral impact of IEC (Information, Education and Communication) campaigns and make the necessary revisions needed to ensure high LLIN utilization
- Finding means and ways to sustain functioning malaria vector surveillance systems in all states.
- Mobilize resources to establish adequate and standard warehouses and enough space for malaria departments at national, state, and locality levels.
- Develop and implement a system for timely documentation of IVM operations at all levels of malaria control programme.
- Enhance entomological surveillance system to incorporate all vector borne diseases at the state and locality level by further capacity building and upgrading infrastructure
- Develop a mapping system for insecticide resistance and vector distribution so as to guide the National technical advisory committee in developing a comprehensive, pre-emptive and context specific insecticide resistance management strategy, which centres on the judicious use of insecticides
- Consolidate and expand larval source management to urban settings with emphasis on supervision to prepare for pre-elimination phase and sustain the gains made through the Malaria Free Initiative (MFI) in Khartoum.
- Conduct geographical reconnaissance and pre and post entomological surveys for IRS campaigns.

- Extend inter-country and cross border collaboration to other countries (Ethiopia and Eritrea, Central Africa, Chad, South Sudan) – focusing on vector surveillance, insecticide resistance monitoring and vector control interventions
- Develop and implement insecticide resistance management tactics where emerging resistance is reported.
- Conduct routine monitoring of LLIN durability for appropriate replacement
- Monitor new agricultural projects, and assess its effect on malaria burden and ensure protection of affected population.
- Strengthen supervision of the IVM departments at national, state, and locality levels for the increasing vector control activities implemented by the private sector in some states.

6. MALARIA CASE MANAGEMENT

6.1. Background

Early diagnosis and prompt treatment of malaria cases is one of the main strategies of malaria control in Sudan, following principles of the RBM initiative adopted by the country. Despite the considerable achievement made in reducing the burden of malaria in the country, this strategy still has a crucial role to play in reducing morbidity and mortality of the disease even more in the progress towards the pre-elimination phase of malaria control in the country.

The predominant malaria parasite in Sudan is *P. falciparum*. Other species like *P. vivax*, *P. ovale* and *P. malariae* occur in certain foci in the country, but as data about prevalent parasites is mostly obtained from studies and not through the routine health information system, a wider distribution of these species cannot be ruled out. Quality of malaria case management services does not only impact morbidity and mortality of the disease, but it also directly impacts quality of information generated from surveillance systems and hence monitoring of disease trends, and decisions concerning malaria control interventions.

6.2. Policy and Guidance for Malaria Case Management

6.2.1. Treatment Services' Cost Payment

In general, disease case management services in public health facilities in Sudan are payable since 1991 after introduction of user fees system in the country. Payment is either direct out-of pocket money or through the health insurance system. Exceptions for this are emergency services in public hospitals for the first 24 hours, caesarean sections, and disease management services for children under five years of age. Despite declared policy, there is a huge between - states variation in implementation. In some states (Khartoum), additional services are fully supported; management of diabetic children under 15 years of age, while in some other states services which are supposed to be exempted from fees are fully paid. In the light of the above policy, malaria case management services for children under five years of age are fully supported, while services for other age groups are fully paid, with the exception of anti-malaria drugs for uncomplicated malaria which is supported by the GFATM to be

availed in public health facilities free of charge since 2005 as well as Quinine for severe malaria cases in some locality hospitals.

6.2.2. Diagnosis of Malaria

Management of malaria cases in all health facilities is supposed to be according to the National Protocol for Diagnosis and Treatment of Malaria (NPDTM), which was developed in 2000, updated in 2004 and in action to-date since the last update. According to the protocol, a malaria case is defined as “Any fever ≥ 37 degrees (c) with laboratory confirmation of presence of the asexual (ring) stage of malaria parasite in the peripheral blood sample from the patient”. Laboratory confirmation of presence of the malaria parasite should be by standard malaria microscopy, which is the golden standard for laboratory diagnosis of malaria due to its high sensitivity and specificity and ability to identify plasmodia species and parasite density. Although malaria microscopy is the golden standard for diagnosis of malaria, but this is not stated in NMCP case management policies. Rapid Diagnostic Tests (RDTs) are not to be used for laboratory confirmation of malaria cases in health facilities where malaria microscopy is available, and should only be used in health facilities lacking malaria microscopy; mainly basic health units (dispensaries) in addition to use by volunteers working in home management of malaria. Furthermore, RDTs are now widely used by the private sector together with microscopic diagnosis which is against the national malaria control programme strategy. Available RDTs in the market also lack a clear system for its quality assurance and monitoring.

Before 2008, RDTs used to be provided only by NGOs and some private clinics. In 2008, a large scale to expand the use of RDTs was established with support of Islamic Development Banks loan, WHO, UNICEF and the GF. According to NMCP data, out of 3,492 targeted health facilities, 80% were covered with RDTs facilities. Continuous supply with RDTs is a major challenge for this expansion.

6.2.3. Anti-malaria Drugs Policy

Till 2004, anti-malaria drug policy in Sudan was using Chloroquine and Sulphadoxine - Pyrethamine (Fansidar) for treatment of uncomplicated malaria

and chloroquine-resistant malaria cases respectively, and Quinine for treatment of severe malaria. Based on the background of the widespread chloroquine-resistance and on evidence from research, the country has changed its anti malarial drug policy to Artemisinin-based Combination Therapy (ACT) in 2004. So, the current treatment protocol selected Artesunate plus Sulfadoxine-Pyrimethamine (AS/SP) to be the first line treatment for uncomplicated malaria and Artemether-Lumifantrine (AL) as the second line treatment. Recommended treatment options for severe malaria are either parenteral quinine or Artemether. In emergency situations and epidemics and whenever hospital admission of cases could have faced some difficulties, Artemether injection could be the suitable option for treatment of severe malaria cases.

A national treatment guideline was developed to give orientation about the new anti-malaria drug policy, printed in form of books, booklets, posters, A4 table sheets and flowcharts and distributed to care providers in public and private health facilities all over the country (an estimated 35,000 piece). Furthermore, training manuals and job aids were developed for different care providers (medical doctors, medical assistants, and nurses) in English and Arabic languages. Management of malaria in children, malaria in pregnancy, and other non *falciparum* malaria were well addressed in treatment guidelines.

6.2.4. Treatment of Uncomplicated Cases of Malaria

The stated policy for treatment of uncomplicated cases of malaria is to treat uncomplicated cases at the primary health care level (health centres and basic health units) using the first and second line drugs mentioned above.

6.2.5. Treatment of Severe Cases of Malaria

Cases of severe malaria should be treated at hospitals which have the setup capable of dealing with side effects of severe forms of the disease. A section in the national protocol for diagnosis and treatment of malaria (NPDTM) was devoted to diagnosis and treatment of severe malaria cases.

After a successful pilot in 2003, NMCP adopted a project to improve management of cases of severe malaria in hospitals. Aim of the project was to reduce malaria mortality in hospitals, ultimately reducing malaria case fatality rate. The project was based on training of care providers including nurses, provision of essential supplies and equipment for severe malaria management including improving laboratory diagnosis, and free of charge severe malaria medications including Quinine injections, Quinine tablets and IV fluids. The project then expanded to cover additional hospitals all over the country, and later on focus was on rural hospitals. Project is still going on but no available data to show total number of hospitals covered and staff trained.

To make use of missed opportunities in reducing mortality due to severe malaria in cases referred to hospitals from the primary health care level especially basic health units, the NPDTM included rectal Artesunate for all age groups as a pre-referral anti malarial drug option alternative for intramuscular Quinine. Training of medical assistants on how to use Artesunate suppository was done, but no available data to show percentage covered by training.

6.2.6. Home-based Management of Malaria (HMM)

In 2003, a hospital based study was conducted in Sudan looking into time of presentation of malaria cases (*Malik et al, 2005*). The study revealed that late consultation was clearly noticed, where almost 70% of studied cases sought malaria treatment after 24 hours of the illness. Causes of late consultation included far distance, lack of money, and transportation difficulties. In the malaria treatment-seeking behaviour study in Sudan (*Malik et al, 2006*), results showed that the main health-seeking behaviour is to consult the nearest health facility or health personnel together with using traditional medicine or herbs. The majority of mothers with febrile children reported to start self-medication before visiting a health facility. The choice between using health services or traditional/self-medication determined by the accessibility of health facilities, affordability of user fees, satisfaction with health services, and believe in traditional medicine. Results of MIS 2005 showed that only 34.0% of sample has

early treatment seeking behaviour regarding management of fever, while in 2009 the percentage was 39.0% and in 2012 47.0%

Due to the negative implications of these findings on malaria morbidity and mortality, and as per WHO strategy recommendation for HMM, Sudan NMCP has implemented a pilot project for HMM to study its feasibility and acceptability in the case of Sudan. The pilot was financially and technically supported by WHO headquarters (TDR), EMRO, and Sudan government.

The first pilot, in Um Adara area in South Kordofan state in 2007, involved 20 communities and was based on using RDTs for diagnosis of malaria and treating malaria cases based on ACTs (*NMCP data*). A total of 20 community volunteers were selected and trained on transmission of malaria, symptoms and signs of the disease, prevention, role of communities in prevention and treatment of malaria, RDTs use, treatment of uncomplicated and severe malaria including dose of ACTs, indication for use of Artesunate suppositories, and the way of application.

Results of the pilot were very encouraging regarding reduction of malaria mortality, and received high acceptability by both volunteers and their communities (*Elmardi et al, 2010*). One of the lessons learnt from Um Adara study was the need to do something for fever cases that showed up and found negative for malaria.

A second pilot expanded the project in 2008 to study feasibility of treating other childhood illnesses like Acute Respiratory Infections and diarrheal diseases beside malaria was initiated (*NMCP data*). This time the pilot was totally supported by the local government of North Kordofan state to cover 65 communities. A total of 65 Community volunteers were enrolled in the pilot. Again the findings were more supportive.

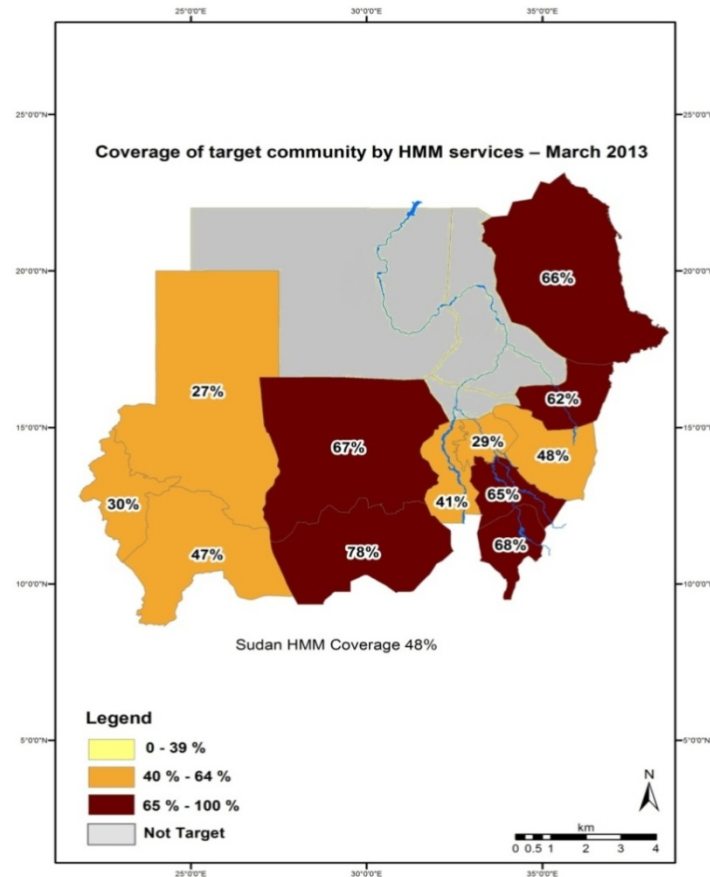
A joint mission from WHO headquarters and EMRO evaluated results of the two pilots in 2008 and assisted the NMCP in developing a HMM policy (*NMCP data*). The policy stated the need for expansion of HMM services based on RDTs for diagnosis of malaria and ACTs for treatment of cases. The policy also stated the importance of involving treatment of other common health problems beside malaria.

Based on accessibility HMM services were linked to the health system, where community volunteers were linked to a nearby health administration as a system for supply with RDTs and free anti-malaria drugs and for reporting. On average 60% of volunteers receive their supply from locality malaria administration, 33% from the directorate of pharmacy in the state ministry of health, and 7% have their supply delivered to them by the locality malaria administration (*NMCP data*). A basic package to facilitate delivery of HMM services by community volunteers was developed. It included a cabinet, bicycle, torch, stationeries, job aids, and supportive tools. Manuals for training and guidelines for community volunteers were developed, printed and widely distributed for use. Community mobilization and advocacy were always considered as an essential component of HMM.

With support of the global fund, UNICEF, local and national governments, HMM services have expanded to reach 1,131 communities (villages, nomads, IDP camps ...etc) (Figure 34) that gives coverage of 48% of the total targeted communities up to date of the report (*NMCP data*).

HMM services face a number of challenges. According to NMCP data for 2012, only 50% of volunteers (650 volunteers) were still serving their communities. Drop-out of community volunteers is a main challenge. An assessment for some of volunteers who dropped out found a drop-out rate of 17.5% (*NMCP data*). Expansion of HMM to include management of common health problems beside malaria was not widely implemented, due to financial limitations in covering costs of additional training and supplies.

Figure (34): Coverage of targeted communities in Sudan by HMM services



6.2.7. Malaria in Pregnancy

Pregnant women are one of the high risk groups for malaria and received special consideration in malaria control interventions. Interventions targeting malaria in pregnancy were mainly based on three elements: effective case management, prevention through ITNs, and intermittent presumptive treatment (IPTp). Management of uncomplicated and severe malaria were well addressed in the NPTDM in terms of selecting the suitable drug depending on gestational age and pregnancy status. Training manuals for care providers highlighted the scenarios and case studies to focus on managing malaria in pregnancy.

In the period from 2004 to 2010 IPTp strategy was implemented in 9 states where malaria burden was considered to be high. As results of MIS 2009 showed that all target states no longer have a high malaria burden and are actually hypo-endemic, impact of IPTp strategy was questionable and the

strategy was no longer in the national strategy since 2010. Pregnant women and children under five years of age were the only targets for free ITNs distribution throughout the period from 2004 to 2010 when universal coverage with LLINs (1 net for 2 persons) was adopted in Sudan following support from the global fund.

6.2.8. Malaria Chemoprophylaxis

Malaria chemoprophylaxis is part of the NPDTM and is advised for groups that are at higher risk of malaria; travellers from malaria free areas (visitors), people with sickle cell disease, splenectomised individuals, children on steroids or immunosuppressive drugs and expatriates and Sudanese returning from non-malarious areas. Recommended drug is Mefloquine and alternative is Atovaquone-Proguanil (Malarone) for those who cannot take Mefloquine. No available data to show utilization of malaria chemoprophylaxis services by target risk groups.

6.2.9. Treatment of Non-falciparum Malaria

Although available data show that malaria parasites other than *P. falciparum* are present only in certain foci in Sudan especially the eastern part of the country (*P. vivax*), yet there are increasing concerns in the country that *P. vivax* is more prevalent than what is thought. Thinking of these concerns became more louder few years after the comprehensive peace agreement in Sudan in 2005.

Concerns arise from the fact that there are no arrangements yet to deal with cases of vivax malaria in relation to availability of suitable drugs. Much work needs to be done to encourage malaria parasite species differentiation in health facilities' laboratories so that reported malaria parasite species can give a clearer picture about prevalence of malaria parasites other than *P. Falciparum* and could better guide malaria case management.

6.3. Organization of Malaria Case Management Services

Malaria case management services are integrated into the package of management services for common diseases and conditions at the primary health and secondary care levels, in public and private health facilities.

At the very basic level of health provided by the ministry of health there is the basic health unit (BHU) in rural areas, headed by a medical assistant in best situations or a nurse and in some BHUs there is additional staff mostly either one of a vaccinator, village midwife, or a nutritional educator. BHUs provide some or all of a very basic package of health services, namely treatment of common diseases and conditions including cases of malaria, wound dressing and stitching of cut wounds, vaccination of children and women in reproductive age, antenatal care and family planning. In most BHUs there is no laboratory for quite a long time and diagnosis of disease cases is mostly done on clinical grounds. Prior to implementation of free anti-malaria drugs policy in Sudan in 2005, supplies of the BHUs other than vaccines were mostly provided by their heads, including anti-malaria drugs, so some of the services are charged especially drugs and wound dressing. With start of implementation of free anti-malaria drugs policy, BHUs became target health facilities for the free drugs supply system in all states. In 2008, the NMCP managed to introduce RDT use in BHUs for diagnosis of malaria cases, as part of the expansion plan of RDT use. Medical assistants were trained to use the test and report malaria cases and RDTs and drugs consumption to the specific health administration, but no available data to show the number of medical assistants trained.

Integrated Management of Childhood Illness (IMCI) was adopted in Sudan in late 1990s to improve handling of children under five years of age presenting to primary health care level with fever with a special focus on malaria. Medical assistants in BHUs were an important target group for training on this approach. In relation to malaria case management, BHUs are to provide treatment for uncomplicated cases of malaria and refer severe cases to the nearest hospital after giving recommended prereferral treatment.

Up in the chain of primary health care level are health centres which could be urban or rural, headed in urban areas mostly by a medical officer (General Practitioner) and in rural areas mostly by a medical assistant and staffed with a

wide range of health personnel than in BHUs, and provide a more comprehensive package of essential services than BHUs, including malaria case management. Health centres are equipped with laboratories doing malaria microscopy as part of the essential package of laboratory services, in addition to a pharmacy providing essential drugs including free anti-malaria drugs. Health centres have a supply system for all services' commodities.

Like BHUs, health centres are to manage cases of uncomplicated malaria and are in a better position than BHUs in handling cases as they have a short stay ward where intravenous fluids can be given for needy cases. Severe cases of malaria should be referred to the nearest hospital after giving recommended prereferral treatment.

At the hospital level, there are rural hospitals and teaching hospitals. Rural hospitals provide services at the level of a medical officer, and in relation to management of malaria cases they are in a better situation than health centres, having admission facilities and ambulance services. Severe cases of malaria can be managed in rural hospitals as there are clear practice guidelines that can be used by medical officers, and still they have to refer more complicated cases to teaching hospitals, usually in big cities, where there are specialists, a wider range of laboratory services, and more patient supportive services.

Referral system of malaria cases is supposed to be in line with current FMOH guidelines for referring of disease cases. Disease cases should present first to BHUs or health centres and to rural hospitals for those living in their vicinity. Difficult cases from BHUs should be referred to the nearest rural health centre or rural hospital, while cases from urban health centres should be referred to the nearest teaching hospital. Patients should not report to teaching hospitals unless they are referred from urban health centres or rural hospitals. In reality this system is mostly not in place; cases of uncomplicated malaria can report directly to hospitals and be handled bypassing the primary health care level. A number of factors underline poor compliance to referral system guidelines, most important of which is inaccessibility to primary health care services due to gaps in coverage of population with facilities leading to far distance to facilities, unpaved roads especially during rainy season, and security issues. Other factors

include the fact that most health centres do not provide services on a 24-hours basis, in addition to economic and social factors.

Other public health facilities, which are mostly hospitals, include military, police, Ministry of Higher Education and Research, and intelligence department hospitals. These hospitals have good facilities for management of cases of malaria and mostly provide services to workers in the specific sector and their families. Generally there are difficulties facing federal and state ministries of health regarding compliance of care providers in these hospitals to national malaria treatment guidelines.

Private hospitals and clinics and NGOs' health centres also have good facilities to manage cases of malaria. Care providers in these facilities are mostly willing to comply to national malaria treatment guidelines.

In some states (Gezira & Khartoum) special reference centres experienced in differential diagnosis of fevers were established to support health centres and BHUs in dealing with difficult to diagnose cases of fever wondering between health facilities.

In Gezira, a number of medical doctors underwent training in the former Blue Nile Health Institute for Training and Malariology, had a Diploma in Malariology and started providing services for such cases in the early start of rolling back malaria in the county but did not continue for long.

More recently in Khartoum state, following the marked reduction of malaria case load by the end of 2005, some difficulties in diagnosing cases of malaria were observed in the primary care level. Some cases of fever were diagnosed as cases of malaria and received treatment, but they did not improve and were wondering between health facilities each time given a different diagnosis. The idea of providing supportive reference services for health centres to establish a diagnosis for such cases then arose in 2006. Reference centres were supposed to rule in or out diagnosis of malaria in such wondering cases, and establish a diagnosis for the fever if malaria is ruled out.

An advice was sought from a WHO expert who visited the state in 2006 in a mission to monitor progress of the KMFI. The expert advised sending some medical doctors to have a master degree in Clinical Tropical Medicine in

Thailand, the best place currently for such studies. Two medical officers were sent in 2007 to Mahidol University in Thailand to have such a degree.

Two reference centres were established in Khartoum and Bahri localities equipped with a reference laboratory with laboratory technologists experienced in quality assurance of malaria microscopy. The laboratory was also equipped with facilities for investigating causes of fever other than malaria, and the clinic was also equipped with necessary equipments and the free anti-malaria drugs. Services were provided to patients free of charge, with exception of few investigations that sometimes need to be done outside the centres as they were not available, in addition to drugs for treatment of conditions other than malaria which should be sought by the patient. A referral system was established between these centres and health centres in the state, where criteria were developed for refer of cases. Brochures about the centres and cases' referral criteria were printed and distributed to medical officers and assistants in health centres all over the state.

Reference centres started working in 2010 and continued through to 2012, when they both stopped. Monthly reports of performance of centres used to be prepared and sent to the SMCP. The main obstacle for continuation of service provision by these centres was drop out of the two consultants after denial of the state ministry of health to support them to upgrade their certificate to a Medical Doctorate in Medicine from the National Sudanese Medical Specialization Board as planned when they were selected for the task. Reference centres were not recognized by the Health Insurance Department in Khartoum State. So, patients having health insurance coverage were facing difficulties in being compensated for payments they made for investigations outside the centres or drugs for conditions other than malaria. A third obstacle was the high turnover of medical officers in health centres so that new medical officers were not aware of patient referral criteria and some patients come directly to the centres for first contact

6.4. Coverage with Malaria Case Management Services

Coverage of populations with malaria case management services follow coverage with health services, especially at the primary care level. Overall aim

of FMOH regarding coverage with primary health care services is to ensure close-to-client care as much as possible. According to current FMOH standards for coverage; the specific population is said to be covered if they have a basic health unit, health centre, or a rural hospitals within 5 kilometres reach.

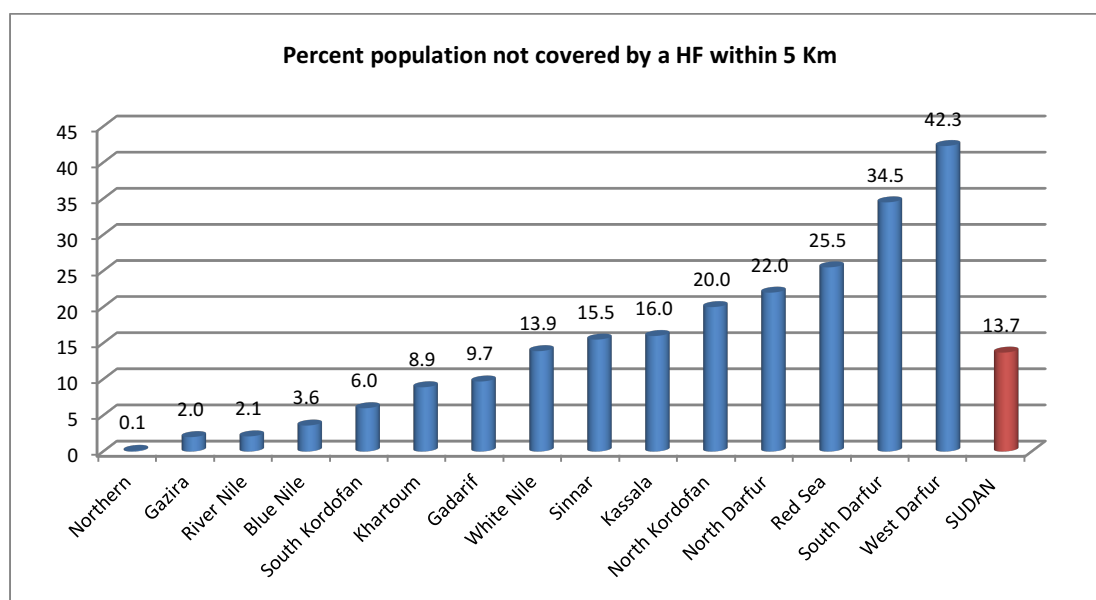
Using the above standard and according to 2011 Primary Health Care Map Survey, overall coverage of Sudan's population with primary health care facilities by the end of 2012 is 86.3% (Figure 35). States mostly affected by poor coverage include the five Darfur states due to security barriers, and Red Sea due to the large number of nomads.

Gaps in coverage with primary health care services were behind the justification for the NMCP to introduce HMM to minimize negative implications of these gaps on malaria morbidity and mortality.

Comparing results of MISs 2009 and 2012 shows that in spite of the decline in percentage of population receiving treatment for fever from governmental health facilities from 70% in 2009 to 63% in 2012, yet governmental health facilities remain the main source for population to receive treatment for fever. In both surveys an equal percentage of population received treatment of fever from hospitals and health centres (29% - 30%), while percentage of population receiving treatment from basic health units dropped from 11% in 2009 to 3.5% in 2012. Approximately an equal percentage of population receive treatment from community health workers in both surveys; 6% in 2012 compared to 7% in 2009. Of the remaining percentage 18.8% receive treatment from private health facilities, pharmacies or drug stores in 2012 compared to 15.7% in 2009, while 8.8% receive treatment from shops in 2012 compared to 5.7% in 2009.

These findings provide evidence for importance of ensuring continuous availability of anti-malaria drugs in governmental health facilities and expanding community case management services in remote areas and utilizing drug stores' and shops' keepers in these areas to provide case management services by giving them necessary training and supplies.

Figure (35): Gaps in coverage of Sudan's population with Primary Health Care facilities - 2012



6.5. Human Resources and Capacity Development for Malaria Case Management

Malaria case management services are provided by medical doctors in health centres and hospitals and medical assistants in BHUs. Other medical staff involved in service provision includes laboratory technologists, sisters and nurses. Undergraduate training of these cadres has some gaps concerning malaria management in relation to practical approach of diagnosis (Case Definition), standard methods for diagnosis, current policies regarding management of cases and prophylaxis, and nursing of severe cases in hospitals. These gaps were believed to negatively affect quality of patient care, and ultimately will affect malaria morbidity and mortality.

To address these gaps, the NMCP developed the NPDTM as the national malaria treatment guidelines early following start of rolling back malaria in Sudan (2000). Based on this protocol a standard 3 days basic training course on malaria case management was designed for doctors and medical assistants. Another 5 days basic training course on standard malaria microscopy was designed for laboratory technologists. A one day training course on nursing of severe cases of malaria was designed for sisters and nurses.

At the start, training of target staff in health facilities used to be conducted by trainers from the NMCP and other collaborating institutions, where a number of

medical doctors were trained through training of trainers courses (TOT) to train doctors, medical assistants, sisters, and nurses, and another number of laboratory technologists were trained to handle training of laboratory technologists. No available data to show number of trainers targeted and number actually trained.

Following establishment of SMCPs, a number of physicians, medical officers, and laboratory technologists (no available data for number) from each state were trained to be able to conduct training at state level, in line with NMCP plans to capacitate SMCPs. Towards 2005, most training courses on malaria case management for target health personnel used to be conducted by SMCPs with assistance from NMCP in some states.

No available data to show coverage of target health personnel above by training in malaria case management and microscopy.

Refreshment training courses for medical doctors and assistants were conducted following change of anti-malaria drugs policy in 2004, and for medical assistants starting from 2008 following introduction of RDTs use in BHUs (80% coverage). No available data to show coverage of target health personnel by refresher training.

One of the major difficulties facing malaria case management training programme is the high turnover of health personnel, especially doctors.

Malaria treatment guidelines (NPDTM) and standard malaria microscopy guidelines were printed in form of booklets for health personnel and posters and widely distributed to health facilities all over the country.

6.6. Quality Assurance (QA) of Malaria Diagnosis and Anti-malaria Dugs

6.6.1. Quality Assurance of Malaria Microscopy

A national quality assurance programme for malaria microscopy was established decades back with the objective of assuring quality of malaria microscopy in health facilities. The programme experienced continuous improvement in structure, functions, and ways of implementation seeking better performance. A national reference laboratory was established for this purpose and then a reference laboratory was established in each state when

SMCPs were established. States' reference laboratories were supported, through WHO, GF, UNICEF and the government, with teaching microscopes and basic supplies and equipment. In some states (Khartoum), reference laboratories at locality level were established (2010). After establishment of state reference laboratories, role of the national reference laboratory turned into rechecking a sample of slides rechecked by state reference laboratories, instead of rechecking health facilities' slides.

A total of 45 laboratory technologists and 29 malaria microscopists at national and state levels were recruited and trained to conduct the programme. Fourteen of the laboratory technologists had the advanced malaria microscopy QA training course in Oman.

Supplies for QA programme were at one time, predominantly provided by WHO and UNICEF as well as the government of Egypt (for states in the Gambia partnership project). Now, most of the supplies are provided by the GF through UNICEF and directed by UNDP. Distribution is to states' reference laboratories and then to health facilities. Due to budgetary limitations supplies priority is given to communicable disease sentinel surveillance health facilities. In some states (Khartoum), health facilities other than sentinel facilities are enrolled in the QA programme based on malaria case load, and supplies are provided by the state ministry of health.

The QA programme covers all types of health facilities; public, private, and NGOs' health centres. The programme is based on a three by three (3 x 3) model; three steps, three interventions, and three scores (Table 16) for evaluation of health facilities' laboratories. The reference laboratory team visits health facilities' laboratories periodically to perform the evaluation using this model. Health facilities are asked to submit a certain number of randomly selected slides, from the pool of already diagnosed slides, regularly to be rechecked by the state reference laboratory. Health facilities are supplied with a stock of slides, Giemsa stain, and other consumables as an incentive to continue participating in the programme. Health facilities participate in the programme with varying degrees of adherence.

Based on results of health facility laboratory assessment and scored sensitivity and specificity, one or more interventions should be implemented to improve quality of malaria microscopy in target health facilities; corrections in laboratory setup, corrections in supply with consumables, and basic or refresher training for target laboratory personnel.

Almost all health facilities use Giemsa stain with varying degrees of quality for malaria microscopy. No available data to show average annual coverage of health facilities by the QA programme for the period 2000 – 2012, but the number of facilities that participated in the programme varied from one year to the other according to available budget.

No available data to show average annual coverage of laboratory personnel by refresher training in malaria microscopy as part of malaria microscopy QA programme interventions for the whole review period. Yet, NMCP data for the last 3 years show that a total of 913 laboratory personnel had refresher training, mostly conducted by states' reference laboratories.

No available data to show average number of slides rechecked annually by reference laboratories and results of sensitivity and specificity of malaria microscopy for the whole review period, yet available data show that a total of 26,871 slides were rechecked in 2011. Results showed that average sensitivity of malaria microscopy was 98.5% (range 94.4%-100%) and average specificity was 96.9% (range 32%-100).

Two national institutes cooperate with the NMCP in training on malaria microscopy; professor Elgadal National Institute in Sinnar city, which is mainly doing basic malaria microscopy and has managed to graduate 1,716 malaria microscopists during the period 2000 – 2012, and the Blue Nile National Institute for Communicable Diseases in Wad Medani city, which is specialized in advanced training modules.

An attempt to establish national malaria slides bank was initiated but not succeeded to end the task of having a functioning slides bank. This is due to budget limitation.

Table (16): Three by three model for improvement of malaria microscopy

Steps	Components	Elements
Assessment	Lab. Setup	classification to A, B, or C
	Adherence to SOPs	classification to A, B, or C
	Sensitivity & Specificity	classification to A, B, or C
Implementation	Provision of basic S&E	-
	Provision of job aids	-
	Training	basic, refresher and advanced training
Supervision, Monitoring and Evaluation	labs of class A	to be visited once a year
	labs of class B	to be visited twice a year
	labs of class C	to be visited thrice a year

6.6.1. Quality Assurance of Anti-malaria Drugs

Following change of anti-malaria drugs policy in 2004, a three tier system to assure the quality of anti-malaria drugs was then implemented. Components of the system include a system for registration of anti-malaria drugs with quality check, post marketing drug surveillance, and monitoring drug efficacy. Drug registration is the responsibility of the National Medicines and Poisons Board (NMPB). The other two components of the system are maintained by collaboration between the NMCP and the Drug Monitoring and Research Department.

A rigorous system for registration of anti-malaria drugs that involves a process to assure quality products is now in place. Steps of the process include, but not restricted to, visiting the manufacturer site, assessing the raw materials, and checking each batch procured to the country.

Monitoring efficacy of anti-malaria drugs was started in 2004. Six sentinel sites were selected in Khartoum, Gezira, Sinnar, Kassala, Kosti, Damazine, and Obeid. Efficacy studies could not be maintained in Khartoum and Obeid due -frequently- to the very low number of cases and consequent failure to satisfy WHO inclusion criteria for such studies. Sentinel sites are functioning annually to assess efficacy of AS/SP and AL, with more emphasis on first line drugs. Efficacy studies are validated by PCR testing to differentiate between reinfection and recrudescence. Results showed that lowest efficacy level reached for both AS/SP and AL is 92%, while molecular markers for SP showed a very high level of resistance.

A post marketing drug surveillance system was established in 2005 as a result of collaboration between NMCP and NMPB, at first in four states and later on expanded to involve all states. Samples of all first line anti-malarial drugs brands are collected from different dispensing sites (public; hospitals, health centres, basic health units and private; health facilities, pharmacies, drug stores) to be analyzed at the national pharmacy laboratory. In 2005 the system captured one brand that did not comply with the standard and was stopped. The main challenge facing post marketing drug surveillance system is the delay in drugs analysis due to the low capacity of the national pharmacy laboratory.

Sudan is an active member of the Horn of Africa Network for Monitoring Anti-Malarial Treatment (HANMAT), a network established by the Eastern Mediterranean Region of the WHO and involves Djibouti, Eritrea, Ethiopia, Somalia, South Sudan, Sudan, and Yemen. The network has a regular annual meeting facilitated by WHO (EMRO) where member countries could share their situation and experience, receive up date from the national community, align and standardize their policies and strengthen inter-country collaboration.

6.6.2. Pharmacovigilance

Pharmacovigilance system was established by the NMCP and then shifted to the general directorate of pharmacy. The system is not well - functioning and needs further support and strengthening.

6.7. Performance of Malaria Case Management System

Performance of malaria case management services in health facilities is monitored through the routine MOH monitoring system. At the national level, the NMCP conducts supervisory visits to selected health facilities in states quarterly using a standard checklist. At state level, case management departments also conduct periodic visits to health facilities for the same purpose, with different periodicities between states.

In some states (Khartoum), there is a third level for monitoring malaria case management services; the Preventive Medicine Departments at locality level.

Performance of malaria case management system is reviewed in three sections; situation of malaria microscopy, coverage of target health facilities with anti-malaria drugs, and compliance of care providers to manage malaria cases according to the NPDTM.

Results of the Outpatient Malaria Quality of Care Survey (OMQCS) conducted in 2009 in a sample of 247 health facilities showed that in 64.4% (159) of assessed health facilities there is either an available microscope or RDT facility on day of the survey. In 53.8% of health facilities a microscope is available, of which only 80% were functioning. NMCP data for 2012 showed that only approximately 46.8% of public health facilities (5883) were having malaria microscopy, with 100% coverage for hospitals and about 36.2% for health centres (Table 17). These findings might explain the high percentage of malaria cases diagnosed on clinical basis as shown in the epidemiology chapter above.

According to NMCP data for 2012, average coverage of target BHUs with RDTs facilities was 80%, with states' coverage ranging between 36% - 100% (Figure 36).

Comparing results of MISs 2009 – 2012 showed that access to malaria diagnostics increased from 53% in 2009 to 63% in 2012. At state level access in 2012 varied between 27% - 84% compared to 18.9% - 72.3% in 2009. In almost half of the states percentage of population with fever having access to malaria diagnostics increased substantially in 2012 compared to 2009 (Blue Nile, Gedarif, Gezira, Kassala, North Kordofan, Northern, Red Sea and West Darfur). Increase in percentage of population having access to malaria diagnostics in 2012 could be explained by increasing coverage of governmental health facilities having no malaria microscopy facilities by RDTs in 2012 compared to 2009. Access in urban population increased from approximately 67% in 2009 to 78% in 2012, while in rural population access increased from approximately 42% in 2009 to 53% in 2012. Urban-rural disparity in access to malaria diagnostics matches the known higher coverage of urban populations in Sudan by health facilities compared to rural populations.

No available data to show coverage of private health facilities with malaria microscopy facilities, likewise no available data to show results of assessment of laboratories in public and private health facilities according to the 3x3 model, and there is neither available data about availability of consumables in these facilities nor available data about compliance of laboratory personnel to SOPs of standard malaria microscopy.

According to OMQCS – 2009, almost two thirds of assessed health facilities have stocks of 1st line anti-malaria drugs on day of the survey, 17.7% have stocks of 2nd line drugs, and almost one third have 3rd line drugs (Table 18). Concerning sustainability of anti-malaria drugs supply, 19% and 17.4% of assessed health facilities have stock-out of AS/SP 50 mg blister and AS/SP 100 mg blister respectively during the last 3 months prior to the survey. NMCP data for 2012 showed that average coverage of health facilities with 1st line anti-malaria drugs is 78% and coverage ranged between 80% - 100%, with exception of less than 50% coverage in only one state (West Darfur) (Figure 37).

Results of MISs 2005, 2009, & 2012, showed that access to ACTs, defined as the percentage of febrile cases treated with ACTs out of the total sample treated with anti-malaria drugs within the last two weeks before survey, increased from 10.5% in 2005 just after change of anti-malaria drugs policy to approximately 44% in 2009 and 48% in 2012. At state level, access increased substantially in 2012 compared to 2009 in 6 states (Gezira, Khartoum, North Kordofan, Red Sea, River Nile and West Darfur), decreased substantially in 3 states (Blue Nile, Kassala and North Darfur) and in the rest of states no significant change in access. No available data to show coverage of private health facilities and private pharmacies with anti-malaria drugs, but available data from the National Medicines and Poisons Board and the Central Medical Supplies shows that considerable quantities of anti-malaria drugs are imported.

Table (17): Average coverage of public health facilities in Sudan with malaria microscopy – 2012

Health facility type	Total Number	Doing malaria microscopy	Coverage (%)
Hospitals	910	910	100%
Health centers	4912	1780	36.2%
Others	61	61	100%
TOTAL	5883	2751	46.8%

Figure No (36): Map of coverage of Target public health facilities in states with RDTs - 2012

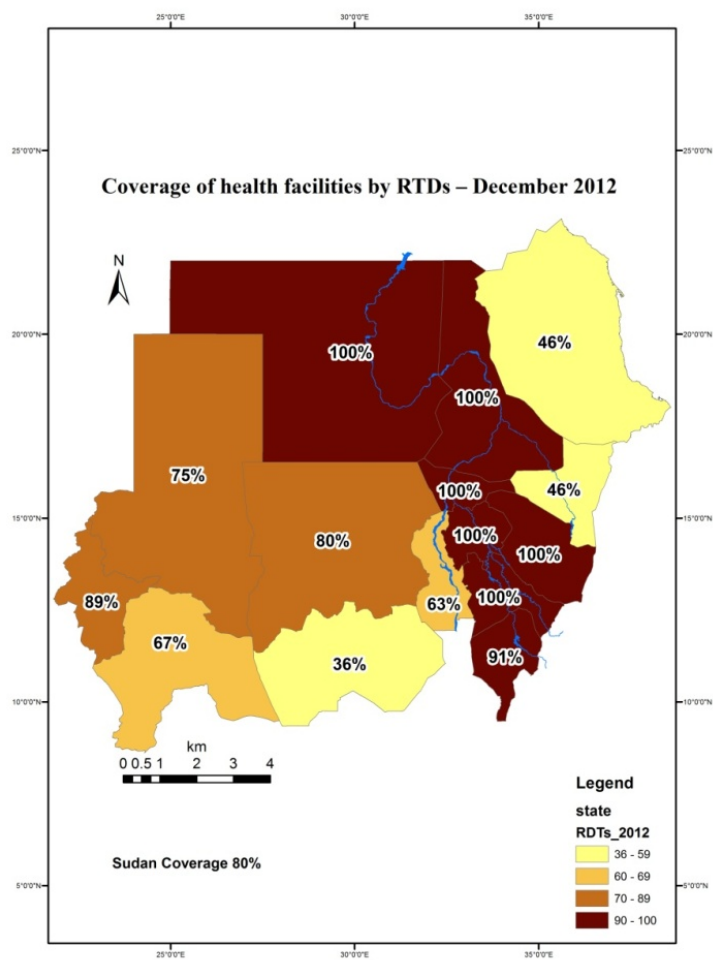
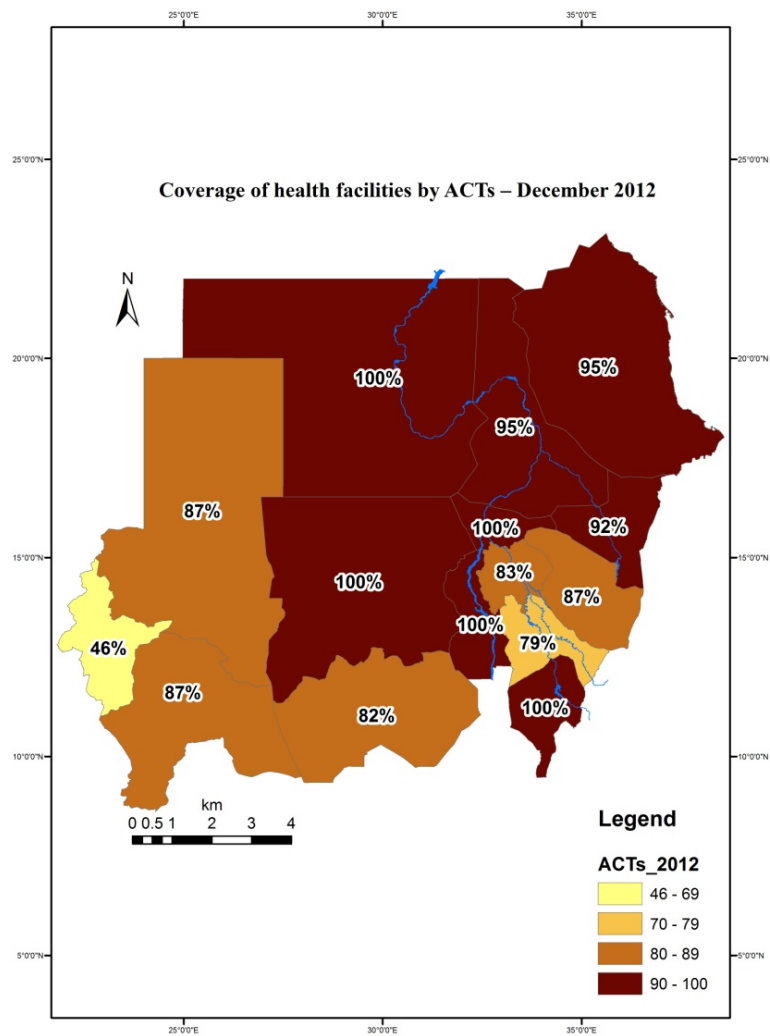


Table (18): Average coverage of public health facilities in Sudan with anti-malaria drugs – OMQCS

2009

Drugs	No of health facilities with available stocks	% of health facilities with available stocks
AS/SP 50 mg blister	165	66.8%
AS/SP 100 mg blister	160	64.8%
Coartem	44	17.7%
Quinine tablets	88	35.6%
Quinine injection	94	38.1%
Artemether injection (40 mg)	125	50.6%
Artemether injection (80 mg)	144	58.3%

Figure (37): Map of coverage of health facilities in states with first line anti-malaria drugs – December 2012



As checklists used in monitoring of malaria case management services in health facilities is mostly focused on inputs of services, monitoring reports will not give information about compliance of care providers (doctors and medical assistants) to the NPDTM when managing malaria cases. Such information is mostly found in health facility assessment surveys done every few years. The only available information about such an issue is from the 2009 OMQCS.

In the 2009 OMQCS 315 care providers were interviewed. Results showed that 40.6% (128) of care providers had training in malaria case management, 15.7% of them in the period 1999 – 2002, 21.3% in the period 2003 – 2005, and the majority (54.3%) in the period 2006 – 2009. Training was mainly funded by the government. Concerning access of care providers to malaria treatment guidelines, 40.6% have access to national malaria treatment guidelines in the health facility, and 47% have access to malaria management table chart. Budgetary limitations and high turnover of care providers, especially doctors could probably explain the relatively low percentage of trained care providers.

99.4% of care providers reported that they have heard about the change in anti-malaria drugs policy for children and adults. However only 82.7% reported correctly that the recommended anti-malaria is AS/SP. 97.5% and 94.6% of care providers reported that they have heard about change of anti-malaria drugs policy for pregnant women in the 1st, 2nd, and 3rd trimesters. However only 4.9% and 27.5% respectively reported correctly that recommended anti-malaria in the 1st trimester is SP and AS/SP in the 2nd and 3rd trimesters. Gaps of knowledge of care providers about new anti-malaria drugs policy could be explained by the low coverage of care providers with training in malaria case management and low access to malaria treatment guidelines.

For assessment of actual practice of care providers in the light of national treatment guidelines, a total of 1678 attendants presenting to health facilities with fever on day of the survey. Of these only 3.1% had their temperature measured, while in fact 38.1% of them had a temperature $\geq 37.5^{\circ}\text{C}$. Malaria microscopy was requested for 43% of patients (721), of which blood films were actually performed for 97.5% of them (703), and 35.7% (251) of blood films were stated as positive for malaria parasite.

95.6% of patients with positive blood films, 21.6% of patients with negative blood films, and 23.3% of patients who did not have blood films performed received anti-malaria treatment making a total of 565 patients, while on the basis of the NPDTM 1155 patients should be treated as cases of uncomplicated malaria i.e. only 48.9% of malaria cases presenting to health facilities on day of the survey were picked up by care providers. Only 70.1% of patients who received anti-malaria treatment were prescribed AS/PS, while the rest were prescribed other anti-malaria monotherapies.

No available data to show compliance of care providers in private health facilities to national treatment guidelines.

It is obvious from above results that there are considerable gaps in knowledge of care providers about malaria case management according to the NPDTM and actual practice in case management, almost 5 years after change of anti-malaria drugs policy. Low coverage of care providers with basic and refresher training courses could be a main cause for these findings. Some care providers had training on malaria case management long time ago before change of anti-malaria drugs policy. High turnover of care providers especially doctors renders coverage with training low and there is a need to accelerate training of care providers and develop and sustain a system to train new care providers coming in health facilities on the NPDTM. Monitoring system is a good tool to support care providers and improve performance of malaria case management if it is sustained according to a reasonable periodicity. Monitoring system, especially in states, should be refined to capture gaps in knowledge and malpractice in relation to malaria case management, and sustained periodic supervisory visits to health facilities should be secured. As some states are approaching the pre-elimination phase of malaria control, much more focus from the NMCP needs to be given to malaria case management strategy to achieve objective of early diagnosis and prompt treatment of cases and feed surveillance and health information systems with quality data for monitoring and evaluation of progress towards set targets.

6.8. Results of Field Visits to States' Case Management Departments

Results of interviews with SMCP personnel in 6 selected states in May 2013 showed that all states have policies and guidelines for malaria case management, and all conduct internal auditing for assessment of compliance to NPDTM in management of malaria cases at health facility level. All states have a department, a sub-committee or a working group specialized in malaria case management and responsible for supervision, training, quality assurance of malaria microscopy, and for setting guidelines for medical supplies.

Five states have a plan for training in malaria case management, five have materials for training, and three states conducted training in malaria case management in the previous years.

Regarding availability of materials and equipment, majority of states reported availability of materials and equipment for malaria microscopy and few reported shortages in stains, oil, and microscopes. Majority of states reported shortages in supply with anti-malaria drugs.

Some states reported conflict between the SMCP and state Revolving Drug Fund (RDF) authority regarding utilization of the car, where RDF authority claims restricting car utilization to anti-malaria drugs distribution and should not be utilized for other malaria control activities.

6.9. SWOT Analysis of Malaria Case Management Services

Strengths

- Update of anti-malaria drugs policy in Sudan in the right time to keep the early diagnosis and prompt treatment strategy effective.
- Availability of well-developed malaria treatment guidelines to support care providers in service provision.
- Presence of a capacity to conduct training of care providers in malaria case management, and laboratory technologists in malaria microscopy at state level.
- Availability of well-structured training courses in malaria case management for care providers and in malaria microscopy for laboratory technologists.
- Continuity of training of care providers in malaria case management from the local component despite budgetary limitations.

- Presence of a setup at state level for monitoring of malaria case management services, which can be improved to further improve case management services.
- Presence of a well-established system for quality assurance of malaria microscopy and a viable system for monitoring and quality assurance of anti-malaria drugs.
- Mostly good coverage of populations with primary health care facilities, facilitating close-to-client malaria case management services.
- Availability of free anti-malaria drugs which if prescribed according to guidelines will foster management of malaria cases according to treatment guidelines, and the high coverage of health facilities with ACTs according to NMCP data for 2012.
- Introduction of free RDTs in health facilities with no malaria microscopy facilities to support care providers in keeping pace with the NPDTM, and the high coverage of target health facilities with RDTs.
- Presence of a special focus on management of severe malaria and malaria in pregnancy in malaria treatment guidelines and in training.
- Introduction of HMM in remote areas to bridge the gap in coverage of populations with primary health care services, and using an integrated approach in HMM service delivery.

Weaknesses

- Poor documentation of malaria case management activities especially training of care providers, laboratory technologists, and nursing staff and activities of the quality assurance programme.
- Low coverage of care providers and laboratory technologists with training in malaria case management and malaria microscopy.
- Low coverage of health facilities with malaria microscopy mainly due to lack of equipment especially microscopes.
- Low coverage of health facilities with national malaria treatment guidelines.
- Poor adherence of care providers in public health facilities to the NPDTM, especially regarding diagnosis of malaria cases and anti-malaria drugs prescription.

- Lack of information about quality of malaria case management services in the private sector coupled with lack of a system for monitoring malaria case management services in this sector, at all malaria control programme administrative levels.
- Lack of information about coverage of private health facilities and pharmacies with anti-malaria drugs.
- Lack of recent data about quality of malaria case management services in health facilities.
- Lack of performing species differentiation of malaria parasite as a routine part of malaria diagnosis which has an impact on quality of care, prescribing anti-malaria drugs without specifically knowing the causative species.
- Lack of national slides bank
- Lack of an injectable form of 1st line anti-malaria drugs to foster prompt treatment in cases with severe vomiting.

Opportunities

- Presence of a considerable number of private health facilities providing malaria case management services, bridging the gap in population coverage with primary health care services, and which need close monitoring to make the most out of such setting.
- Presence of a significant percentage of population receiving treatment for fever from community health workers, drug stores and shops according to MIS 2012, settings that can be utilized properly to provide community case management services.
- Presence of institutes specialized in training in malaria microscopy, Professor Elgadal National Institute and the BNNICDs.
- Presence of a considerable number of medical laboratories faculties, into which curricula standard malaria microscopy training could be injected so that laboratory technologists have a basic course in malaria microscopy when graduated.

- Presence of the Sudanese Medical Council, with which arrangements can be made to capture doctors for training in malaria case management prior to temporary and permanent registrations in the council.

Threats

- Stoppage or interruption of the global fund for malaria control activities.
- High turnover of staff both at administrative and health facility levels, especially doctors in health facilities.

6.10. Conclusions

In the last 12 years following Sudan's adoption of RBM initiative, considerable achievements have been made in well-establishing a set-up for implementation of early diagnosis and prompt treatment of malaria cases strategy, as an integral part of malaria control interventions.

Well-developed malaria treatment guidelines with special focus on severe cases and pregnant women were communicated to all malaria control programme administrative levels and to care providers in health facilities. Well-structured training courses in malaria case management and malaria microscopy were developed, and SMCPs were capacitated to conduct training at state level. Malaria RDTs use was expanded in health facilities lacking malaria microscopy facilities, free of charge, to encourage adherence to treatment guidelines. Anti-malaria drugs policy was updated in the right time following widespread chloroquine-resistance in the country, to keep prompt treatment strategy viable. Anti-malaria drugs are now provided free of charge in public health facilities and a system for procurement and supply of health facilities is in place. HMM was implemented in remote areas poorly covered by primary health care services, bridging coverage gaps. Well-established systems for quality assurance of malaria microscopy and anti-malaria drugs are in place.

Yet, still there are gaps in implementation of the strategy. Low coverage of care providers and laboratory technologists by training in malaria case management and microscopy, and low coverage of health facilities by malaria treatment guidelines result in care providers deviating from standard care. Almost two thirds of health facilities are lacking malaria microscopy facilities. This in addition to

other factors might have lead to poor adherence of care providers to standard treatment guidelines. Malaria microscopy, when available is missing malaria parasite differentiation hampering species surveillance and quality of care. Despite the considerable number of malaria cases seen in the private sector, there is no system yet to have information about quality of malaria case management services in this sector.

As some states are now approaching the pre-elimination phase of malaria control, means to accelerate bridging of gaps identified in malaria case management performance are urgently needed to keep moving forwards rolling back malaria in the country.

6.11.Recommendations

- Increase rapidly coverage of RDT and ACT up to 100% in all primary health care facilities. Quality of malaria microscopy requires more attention with enforcement of the SOPs.
- Develop and implement an intensive plan to train care providers and laboratory technologists in health facilities, in malaria case management and microscopy with continuous re-orientation of all health workers as guidelines are updated
- Develop and implement a system for training of newly coming care providers and laboratory technologists in health facilities, in malaria case management and microscopy.
- Rapidly expand the access to HMM volunteers in villages and reduce their attrition rate through appropriate incentives and revision of selection criteria to include female volunteer wherever is possible while going for community health assistant in line with the national health policy
- Develop and implement a plan to optimally utilizing community health workers and other community settings (Drug stores and shops) to provide community case management services.
- Arrange with stakeholder institutions to inject training in standard malaria microscopy in curricula of medical laboratories faculties.

- Arrange with the Sudanese Medical Council to capture doctors for training in malaria case management prior to temporary and permanent registrations.
- Strengthen the health personnel capacity on diagnosis, treatment, recording, referral, and community mobilization for both *P. falciparum* and *P. vivax*.
- Setting and implementing a crash plan to avail malaria microscopy facilities and malaria treatment guidelines in target health facilities.
- Revitalize monitoring system at all malaria control programme levels to push forwards adherence of care providers to standard treatment guidelines and laboratory technologists to standard malaria microscopy, especially malaria parasite species differentiation.
- Increase periodicity of OMQCS to be conducted every two years regularly.
- Assessment of quality of malaria case management services in private health facilities using the same tools used for such assessment in public health facilities.
- Assessment of availability and cost of anti-malaria drugs in private pharmacies.
- Conduct a study among febrile patients attending public and private health facilities, to collect data about prevailing malaria parasites species.
- Emphasize performing malaria parasites species differentiation routinely as part of malaria microscopy and develop a system for reporting of identified species.
- Establishment of malaria slides bank
- Establish a compulsory QA mechanism of all imported and locally manufactured equipment and reagents for lab.
- Enforce regulation for accreditation of private sector regarding laboratory and case management
- Develop and implement a system for timely documentation of case management activities especially training quality assurance programme activities.

7. Information, Education and Communication for Malaria Control

7.1. Background

As part of acceleration of malaria control activities following adoption of Sudan of the RBM initiative, a national department for Information, Education, and Communication (IEC) was established. Objectives were to put malaria control as a priority in national development agenda, make it a concern for decision makers and politicians, and attract funding for malaria control through advocacy and partnership building with different stakeholders. Other objectives are to assure adherence of care providers and health workers to standards through effective communications and to empower and mobilize communities to enhance proper malaria services utilization and community participation.

The department is considered as the national governing and technical advisor for state IEC departments, concerning advocacy and communication for malaria control.

Concomitant with establishment of SMCPs, a department for IEC was established at state and some locality levels, with the mandate of advocacy and communication for malaria control among decision makers at state and locality levels and among other stakeholders in addition to mobilizing communities to have their share in malaria control.

In some state ministries of health presence of an IEC section in the SMCP and malaria department at locality level is an issue of concern in relation to integration of IEC services, in order to make optimum utilization of available resources. In these states, there is a department for health promotion in the organogram of the General Directorate of Preventive Medicine which also hosts the Malaria Control Programme. The issue in these states is why we need a separate IEC section for malaria while there is a department for health promotion in the general directorate with the mandate of working in this field for all preventive programmes? At locality level, there was a section for IEC in the malaria department for some years, while there is no such section to have the responsibility of implementing IEC activities for other preventive programmes throughout these years. Some revision for organogram of IEC departments at all levels needs to be done in the light of the integrated approach for health service delivery.

7.2. Policy, Guidance, and Planning

The issue of policy and guidance is not written in an explicit document; however there are RBM advocacy guidelines which are available for staff use and reference. Both of the national five years malaria control strategic plans 2002 – 2006 and 2007 – 2011 did not contain explicit IEC targets. According to national IEC Department, there was a strategy for IEC 2003 – 2007 parallel to national malaria strategic plans but no evaluation for achievements was done.

7.3. IEC Human Resources and Capacity Building

At national level staffing of the IEC Department is mostly complete, 5 personnel are available for most of the review period representing 100% of required. In most SMCPs only one IEC personnel is available while 3 personnel are required. At locality level one IEC personnel is present in only three states; Khartoum, Gezira, and White Nile.

According to national IEC Department, there was short course training for IEC personnel at national and state levels but not documented.

Regarding support of state IEC departments with IEC equipment, TVs and videos were distributed for 10 states but no available data to show numbers distributed.

7.4. Organization of IEC Activities

At the national level, the IEC department is responsible for implementation of IEC activities among national stakeholders and through national institutions. These include arrangement of public events, holding meetings and workshops with other related federal ministries and with federal civil organizations and private sector, and broadcasting messages to the public through the national TV and radio and other national radio stations. Other activities include printing of IEC materials such as posters, pamphlets and booklets and distribution of materials for national institutions in addition to SMCPs for the purpose of distribution at state and locality levels.

At state and locality levels, departments are responsible for implementation of IEC activities at state, locality, and community levels in collaboration with state, locality institutions and community organizations. These include meetings and workshops

at state and locality levels, distribution of IEC materials at state, locality, and community levels, broadcasting messages through state TV and radio stations, and different IEC activities at community level (e.g. Lectures, common meetings, mobile theatres ...etc).

7.5. Performance of IEC Activities

A major limitation severely impeding implementation of IEC activities at all levels, is the severe lack of resources, while these activities are known to be demanding. Most of the already scarce resources are directed to vector control and case management activities.

At state and locality levels, there is even considerable lack of human resources; hence most of implemented IEC activities are of the indirect type and only very few activities are of the direct type and at community level.

There was no clear data/document showing indicators of access and coverage with behavioural change communication services, so it is not known what were the target mass-media activities planned and number of activities actually implemented. Use of mass-media to advocate for malaria control in Sudan seems to be prevailing. There were a series of well-designed mass-media programmes especially through radios. Available data show that short radio spots have been broadcasted through the radio for two weeks, stopped for a while and then re-broadcasted (*NMCP annual report 2005, NMCP data 2010, 2011, 2012*).

Use of TV seems to be rare apart from short advertisements; no systematic TV productions took place. Use of metallic billboards was documented but is not that comprehensive.

Communities were involved in designing of mass-media messages; involvement was through participatory media channels e. g. mobile theatres and community radio project. No available data to show achievements in mobilizing communities for malaria control.

Use of social media was not clearly observed, which represents a missing opportunity for the NMCP, where engagement in effective social media programmes can support malaria control efforts by disseminating information about key recommended behaviours.

Concerning printing of IEC materials, millions of posters and leaflets in different format have been printed (Table19). A mobile malaria IEC exhibition was developed with support of Shikan Insurance Company (*NMCP annual report 2005*). This exhibition was used mainly by university students for health education purposes during their rural residency experience. Also there were no already set targets for number of IEC materials to be printed and population to be covered.

Of the important public events used to be arranged by the national IEC department, is celebration of the Africa Malaria Day on the 25th of April every year, which was then called the World Malaria Day in 2007. Objectives of the day are advocating for malaria control and mobilizing resources. Invitations for the day are sent to the presidency cabinet and to other related federal ministries and stakeholders. Each year a specific theme is agreed upon with stakeholders. Later, celebration of the day was taken outside Khartoum, each year one of the states is selected to host the day, while the Ministry of Health – Khartoum State continued to organize its own celebration on the occasion through 2005 – 2008.

In 2011, the NMCP led an attempt to use basic school teachers and students to advocate for malaria control. A total of 11,000 teachers in 11,000 basic schools were trained to deliver health education messages to students, so that students will in turn convey these messages to their families and to others where they live. There is no data to show performance of school teachers post training.

In some states where there is a school health programme in the ministry of health (Khartoum), the SMCP made efforts to inject malaria control activities into this programme. Some of these activities included the use of basic school children during autumn season to drain accumulations of rain water around their schools or treat accumulating water with oil, a programme called “A water pool for every student”. In 2006, a total of 10,000 notebooks and 10,000 school timetables on which printed health education messages about malaria control were distributed for school children in Khartoum State (Khartoum State Malaria Control Programme annual report 2006). Overall, integration of malaria control activities with the school health programme has not yet reached the stage of continuous implementation of activities and mostly activities are implemented in association with certain occasions.

A case study was implemented in Eldamazin city – Blue Nile State in 2006 (Figure 38) to increase ITNs utilization using Communication for Behavioural Impact (COMBI) approach, which yielded good results but no available data to show actual results of the study.

IEC activities implemented in direct contact with communities with aim of pushing adoption of behaviours supportive for malaria control are not part of routinely implemented activities, and usually implemented with campaigns of LLINs distribution or IRS.

7.6. Outcome of Promotion Activities

Collective implementation of IEC activities by all NMCP departments among different stakeholders especially decision makers and politicians has resulted in a number of achievements, facilitating more for acceleration of malaria control activities.

Malaria control since an early time following adoption of Sudan for RBM initiative became a priority in the national development planning. More funds were allocated from the National Ministry of Finance annually to support SMCPs with vector control equipments, insecticides, and transportation means (*NMCP*). A considerable number of partnerships were built with different stakeholders, as mentioned in programme management theme above.

Khartoum State Government showed high commitment to malaria control by launching and sustaining KMFI through allocating a monthly budget for malaria control activities since 2002 to – date. A number of other state governments; Gezira, Northern, Red Sea, River Nile, and White Nile agreed to engage their states in the “State Malaria Free Initiative” to replicate Khartoum State experience in their states. The local governing laws 2003 and 2007 stated clearly that vector control is the responsibility of the locality government, and since 2003 there is a malaria control department or focal person or working group in most of localities.

During celebration of the International Malaria day, April 2011, his Excellency, president of the republic declared exemption of all malaria related equipment and assets from taxes and customs, free airing time for all malaria mass-media activities via national radio and TV, in addition to ordering a financial incentive for malaria staff ; a two months’ salary bonus. While during celebration of the Africa Malaria

Day in Khartoum State in 2006, his Excellency, the Wali of the state declared a state governmental decree to all state locality governors to offer permanent jobs to all health officers and mosquito men already appointed with temporary jobs (Khartoum State Malaria Control Programme annual report 2006). In Gedarif, donations that totalled to 300,000 SDG were provided as a support for the state Malaria Control Programme during celebration of the Africa Malaria Day organized in the state in 2005 (*NMCP annual report 2005*).

In partnership with the NMCP, the Investment Bank purchased and distributed a total of 400,000 bed nets to the public at a low cost.

Pushing communities to adopt behaviours supportive for malaria control is to remain challenging for NMCP. Results of MIS 2012 as discussed above showed that household utilization of LLINs is far lagging behind net ownership (Table 14) and only two fifths of population have malaria treatment early seeking behaviour.

Table (19): Quantities of printed IEC material 2000 – 2012

Type of Material	Number of Format	Number Printed
Posters	9	300,000
Pamphlet	4	400,000
Cartoon	90	200,000
A4 Sheets	2	8,000,000
Training Manual	3	250,000
Iron Panels	1	6,000
School Time Table	2	2,190,000

Figure (38): A volunteer calling for the erection of ITNs before sunset, Blue Nile state 2006



7.7. SWOT Analysis

Strengths

- Strong political commitment
- Presence of tangible results for IEC activities for malaria control through a decade.

Weaknesses

- Lack of using strategic planning approach in IEC for malaria control.
- Poor documentation for implemented IEC activities.
- Lack of updated policies and guidelines concerning IEC activities for malaria control.
- Lack of clear vision about effective ways in mobilizing communities to participate in malaria control activities.
- Few resources are available for implementation of IEC activities, especially at state and locality levels.
- Lack of training for staff at state and locality levels.
- Lack of a well-structured feedback mechanism from the audience regarding IEC activities.
- Presence of a number of IEC departments in the FMOH and some state ministries of health working in the field of preventive medicine results in improper utilization of available scarce resources.

Opportunities

- Decision of his Excellency, President of the republic, to give free airing time for malaria mass-media activities through national radio and TV.
- The growing number of radio and TV stations, especially at state level.
- Presence of a large number of university students' health associations and school health programmes in a number of states that can be used as vehicles for communication of malaria control health education messages.

Threats

- Continued weak malaria control programme focus on IEC strategy.
- High turnover of staff, especially at state and locality levels.

7.8. Conclusions

Despite achievements in mobilizing decision makers, politicians, and NGOs and partnership building with different stakeholders for malaria control, yet major gaps do exist regarding performance of IEC activities. IEC strategy is not receiving programme focus as do vector control and malaria case management strategies. Implemented malaria control national strategic plans did not contain explicit IEC targets. Little resources are allocated for implementation of IEC activities. State and locality IEC departments are still under-capacitated. IEC activities are mostly implemented through mass-media and direct community activities are implemented only as part of programme campaigns and not as a routine.

Documentation of implemented IEC activities is poor, especially community mobilization for malaria control. Community is still far away from programme target behaviours supportive of malaria control.

Increasing number of private and state radio and TV stations, the still willing main private companies to support health projects, presence of school health programmes in some states in addition to a considerable number of university students associations are all opportunities supportive for IEC activities for malaria control and need not be missed in coming years.

7.9. Recommendations

- Emphasis should be made on having explicit strategic IEC targets as part of NMCP strategic plans.
- Updating policies and guidelines concerning malaria control IEC activities, and communicating documents to state and locality IEC departments.
- Increase and sustain funding commitment to IEC, BCC and social mobilization in order to produce quality results with robust evidence
- Conduct focused research in different states to update and prepare more state and target population specific malaria messages and IEC materials
- Establishment of a national technical working group for IEC, COMBI, and social mobilization with clear terms of reference.
- Build capacity all malaria staff and partners with different approach to adopt the COMBI approach to malaria behavior change communication.

- Use KABP survey results to adapt IEC material and campaigns supported by a network with research institutions in order to build in-country research capacity on KAP surveys
- Develop and implement a system for timely documentation of implemented IEC activities.
- Revising organogram of IEC departments in preventive programmes at all levels towards achieving integration of preventive IEC activities.
- Develop and implement a plan for capacity building of state and locality IEC departments, especially regarding staffing, training and provision of equipment.

8. Surveillance, Monitoring & Evaluation System

8.1. Background

Malaria surveillance is an important complementary part of malaria control. It serves to closely monitor trends of malaria morbidity and mortality thereby informing malaria control programmes at all levels about impact of control interventions and where to accelerate control interventions if trends are increasing, and give alarm when malaria epidemic thresholds are approached, enabling the programme to plan early enough and mobilize resources to abort malaria epidemics in the right time. The system also enables the programme to monitor progress in achievements towards RBM and MDGs concerning malaria.

Malaria surveillance system was piloted in Khartoum State in 1996, where a weekly report about malaria morbidity and mortality is collected from all public health facilities in the state and compiled by province (now locality). Vector control interventions used to be intensified in the rainy season according to malaria trends shown by the weekly report. Due to the difficulty and impracticality of collecting reports from all public health facilities, and the fact that public health facilities do not represent all geographical areas of the state, a sentinel surveillance system for communicable diseases was established in 1998 including NGOs' health centres, to strengthen the system in terms of geographical representation. Since establishment of the system malaria administration was able to intervene in the right time especially during the rainy season so that the state no longer witnessed any malaria outbreaks and the last one was in 1998.

Malaria surveillance system in the NMCP was established in July 2001. The system started by 197 sentinel sites in 12 states. At first all sentinel sites reporting to state epidemiology department were included. Later on criteria were developed for selection of sentinel sites; should represent all districts, all hospitals and IDPs should be covered, covering areas that witnessed previous epidemics and recurrent natural disasters, and health centres and BHUs that have high attendance. According to these criteria the number of sentinel sites decreased to 45 sites in 2004 and increased gradually to 99 sites in 2005, 127 in 2007, 147 in 2010 and 154 sites in 2011. The number of sentinel sites reached in 2011 is the number now reporting to the NMCP.

8.2. Policy, Guidance, Organization, and Coordination

At both national and state levels there is a special surveillance system for malaria, in parallel to the communicable disease surveillance system centred in the epidemiology departments at both national and state levels. In the NMCP, malaria surveillance is centred in the M&E department and at state level M&E focal persons in SMCPs mostly are responsible for malaria surveillance.

Few years following establishment of malaria surveillance system in the NMCP there were concerns in the FMOH cabinet about integrating the malaria and other communicable disease surveillance systems relating to vertical programmes into the already well-established communicable disease surveillance system centred in the epidemiology department in the FMOH. Feedback reports can be sent weekly from the epidemiology department to other stakeholder departments. According to NMCP, malaria surveillance will be transferred from the malaria control programme to the Epidemiology Department depending on readiness of the latter.

Weekly epidemiological reports are sent from sentinel sites to the M&E focal person in the SMCP. If needed, reports are verified with focal persons at health facility level, corrected and then data entered and compiled at state level. Comparisons are made with previous week data and the same week in the previous year to assess trend of malaria whether increasing or decreasing and assess compliance to laboratory confirmation of malaria cases and malaria parasite positivity rate. Feedback is sent from SMCP M&E focal person to sentinel sites by phone. Starting from 2011 locality malaria departments started to have their own sentinel sites which are more than those selected by the SMCP. In some localities, weekly sentinel sites' reports are first sent to locality malaria departments, and a copy is sent electronically to the SMCP M&E focal person.

At national level, SMCPs focal persons send a copy of weekly reports of sentinel sites selected by NMCP to the M&E department in the programme electronically. Verification of reports is done and data entered and compiled by states. Analysis of weekly report is done according to certain indicators. Feedback is sent each Tuesday to the federal minister of health, undersecretary, Director Generals of state ministries of health, all NMCP departments and SMCPs.

Weekly assessment of trend of malaria at both national and state levels is not based on statistical operations to judge whether there is true increase or decrease in disease trend. In only 3 or 4 states malaria epidemic thresholds are established at sentinel sites level and used in monitoring impendence of malaria outbreaks. No malaria epidemic thresholds are used at national level.

According to NMCP, data is relatively complete and average sentinel sites reporting is more than 90%. Reporting rate significantly improved after SMCPs were provided with faxes in round 2 of the global fund and internet devices in 2009 in round 7 of the fund. Now all SMCPs and 82% of locality malaria departments (152) have wireless internet devices (mDSL Sudani) charged annually by Global fund.

A set of weather data for a subset of states (6 states) is collected from the National Metrological department to be utilized in forecasting trends of malaria in the country, but utilization is not yet optimum i.e. No link is made yet between malaria epidemiological data and the metrological data so that an alert threshold is established. Due to budgetary limitations, now metrological data is not received regularly from Metrological Department.

There is a viable coordinating mechanism with the Health Management Information System Department (HMIS) in the FMOH. Since 2006 there are joint quarterly meetings with the department, copies of quarterly and annual statistical reports which are based on collecting data from all public health facilities are sent to NMCP. Malaria indicators are discussed and approved jointly with the department, and HMIS is represented in a number of M&E committees. As HMIS statistical reports have a wider capturing for malaria morbidity and mortality, they are used for assessment of progress of NMCP towards achievement of set targets.

Epidemiological information generated by surveillance system is mostly used for action at national and state levels of malaria control programme and locality level in some states. Neither sentinel sites nor vector control personnel working in catchment areas of sentinel sites make true utilization of such information to make corrective actions at health facility level or in vector control operations. No arrangements yet are made at this level of the health system for exchange of information for utilization, though in few localities there is information exchange.

In some states (Khartoum), malaria surveillance is integrated with the communicable disease surveillance system hosted in the state epidemiology department. Weekly sentinel sites reports are sent to the Preventive Medicine Department at locality level, where they are verified and compiled by administrative unit level. Compiled report is then sent electronically to the state Epidemiology Department to prepare state weekly epidemiological report compiled by localities and then state level. Weekly feedback report is sent from locality Preventive Medicine Departments to locality malaria control department and from state Epidemiology Department to SMCP for corrective actions in vector control operations.

Accuracy of sentinel sites data is verified during NMCP supervision visits to states, where a sample of sentinel sites are visited. Completeness and correctness of registration are checked and data of some sentinel sites reports already received by the national M&E department are compared with sentinel sites registries.

Focal persons in sentinel sites received training in notification, early detection of epidemics, and rapid response, but no proper documentation for coverage.

Monitoring & Evaluation (M&E) System

History of establishment of the M&E system in the NMCP dates back to the year 2000 when the RBM initiative was launched. M&E unit was poorly structured. The state affairs department was held accountable to M&E issues including routine reporting on a monthly basis on major program interventions. This department tackled many other issues at the sub-national level including capacity building, planning and supervision of implemented activities.

In September 2004 an M& E department was established in the NMCP. A focal person was also appointed in four states (Khartoum, Gezira, North Kordofan and Unity state); unity state is now part of the Republic of South Sudan. In addition to national staff, 16 participants from all 16 states were trained in M&E. A unified national M& E plan was developed aligned with national strategic plan 2005 – 2011, with clear M&E logical framework, in addition to four states M&E plans. More IT equipment is provided at national and state levels.

NMCP Monitoring and Evaluation Department hosts core and vital malaria programme functions. There are documented terms of reference for the department: 1) supervising development of strategic and annual plans of action 2) preparation of quarterly and annual programme performance reports regarding implementation of plans, supervision, and feedback 3) supervise development of programme policies and guidelines 4) conduction of surveys, reviews, researches, and preparation of reports 5) facilitate for research institutions 6) write proposals for fund raising, especially for the global fund rounds 7) arrange for and maintain supervision of SMCPs 8) development and maintenance of malaria programme data base 9) assure quality of data and information used by programme departments 10) develop national malaria emergency plans especially for rainy season and malaria outbreaks, including estimation of buffer stocks 11) capacity building of state and locality malaria control programmes.

8.3. Supervision

Supervision for monitoring implementation of malaria control activities according to programme guidelines is a crucial function of the NMCP. There is standardized checklist at national and state levels. Supervision system targets visiting each state twice a year; visits scheduled quarterly. Supervision teams include all programme departments in addition to staff from other SMCPs for training and sharing experience purposes.

After each visit gaps in performance are identified, recommendations and actions for improvement are made, and role of each partner specified. Feedback after end of the visit is given to Director General of State Ministry of Health and SMCP, in addition to a written feedback report sent to them later. Supportive supervision from SMCPs is generally not strong enough, mostly due to unavailability of running costs.

8.4. Performance of Surveillance and Monitoring & Evaluation System

In addition to the weekly surveillance data collected by the M&E department, other data is collected according to standard format to feed periodic reports of performance indicators used in turn to monitor performance of malaria control programme at all levels. These regular reports include:

- Monthly report from SMCPs showing implementation of malaria control activities in the state.
- Quarterly and annual reports of Implementation of the NMCP for target activities against plans of action.
- Annual surveillance report for the World Malaria Report (WMR).
- NMCP quarterly and annual reports submitted to WHO and UNDP according to global fund performance framework.

Other M&E activities include a quarterly review meeting with all SMCPs' coordinators and programme stakeholders, every time being held in a different state. Objectives of the meeting include; follow up of performance at state level, update state programmes and give feedback about progress towards set targets, sharing information and experience between states and strengthening political commitment at state level. In one of the meetings performance annual reports and coming year plans are discussed, while in the bi-annual meeting autumn season and emergency preparedness plans are discussed. In the period from 2000 – 2012 a total of 28 such meetings could be held. Feedback on quarterly basis is given to the federal minister of health, undersecretary, state ministers of health, and SMCPs. Following establishment of the NMCP M&E unit, two comprehensive M&E System Strengthening (MESS) analyses were done in the period 2006 – 2011 as requirements for strengthening M&E system prior to each phase within obtained global fund rounds. The first in the period 2006 – 2010 with the main objective of supporting, updating and developing the malaria program M&E plan 2006 – 2010 and round 7 grant of the global fund 2008–2012. The second was in May 2011 with the objective of updating the plan for phase 2 of round 7 grant of the global fund. Objectives of MESSs included; assessment of strengths of national malaria control programme M&E plan, assessment of capabilities of HMIS and programme M&E units in relation to collection and analysis of data and reporting and finally assessment of programme reporting system by programme area. According to evaluation using global fund format performance of NMCP in implementation of MESS recommendations is satisfactory.

A number of measures were in place to ensure quality of collected data. A written regulation states that health indicator surveys, malaria indicator surveys whether

health facility-based or household surveys should be conducted by teams involving international and national experts in epidemiology and surveillance. All surveys conducted using WHO and RBM methodologies and standards. SMCPs are asked on a quarterly basis to provide documents to M&E department to verify reported data. NMCP and SMCPs systematically review reported data for completeness and quality. During the period 2006 – 2010 that coincides with global fund round 2, considerable efforts were made from the M&E department in supervision; follow up of grant activities, and timely preparation of performance reports which resulted in grant closure with country A1 rating which makes the country eligible for additional funding and subsequently complementary malaria components Round 7 and 10 grants.

8.5. Malaria Surveys, Pilot Projects, and Research

In the FMOH there is a federal governing body responsible for facilitating collaboration with research institutes and researchers and monitoring conduction of researches by different MOH departments according to standards. This governing body was the Research Department in the FMOH till the end of 2011, and the Public Health Institute starting from 2012 to - date. The NMCP coordinates with the governing body concerning research conduction.

In the period 2001-2010, more than 60 operational researches were conducted by NMCP staff. Areas of focus in malaria case management include efficacy, quality, sensitivity, pharmacokinetics, markers for resistance, pilots and feasibility of case management interventions (HMM), and RDTs stability and implementation challenges. Intermittent Presumptive Treatment for pregnant women was piloted in White Nile State, which later became a malaria programme treatment policy. In vector control focus areas include socioeconomic inequity in demand for vector control methods, KAP and determinants for malaria control interventions utilization, barriers and retention, efficacy studies for biological methods of vector control and ITNs, monitoring insecticides resistance, effect of mass distribution of ITNs on malaria transmission and biological studies on malaria vector. This is in addition to a number of academic researches facilitated by NMCP. Results of these researches were utilized for improvement of performance of malaria control activities, e.g.

change of anti-malaria drugs policy in 2004, and informing implementation of IPTp and HMM strategies.

Of the important researches conducted are the following:

- Base line survey for Behavioural Promotion for Malaria Prevention and Treatment Project in White Nile State in 2004.
- Malaria prevention and treatment indicators survey in 2006.
- Knowledge, attitude, and practice towards malaria control and prevention in Darfur in 2006.
- The Sudan Household Surveys (SHHS) in 2006 and 2010.
- The three MISs in 2005, 2009, and 2012.
- Annual malaria prevalence surveys in Khartoum and Gezira in the period 2000 – 2011.
- The Outpatient Malaria Quality of Care Survey in 2009.

Researches conducted by the NMCP are augmented by student researches undertaken by training Institutes (mainly the BNNICDs), universities and clinicians, many of which remain unpublished. A systematic literature search identified 308 published papers in PUBMED for [Malaria* AND Sudan] that were published between 2001 and 2012. Of these, 63 papers were obtained in full text; and 38 were judged of high relevance to the MPR thematic areas.

A major weakness in research area in the NMCP is weakness of archiving system and malaria researches database and having research results published.

8.6. Results of Field Visits

Interviews with SMCP coordinators showed that all states have malaria surveillance system generating weekly reports, and 5 states use information generated for evaluation of vector control operations. Five states have malaria maps of detailed information about disease distribution. All states regularly monitor malaria mortality in governmental hospitals. All states have a unit for monitoring and evaluation. In five of the states personnel in the M&E unit had training in epidemiology. Some states have partners in surveillance; organizations facilitating surveillance and providing information, people committees notifying malaria cases, and Sudan Telecommunication Company providing some communication equipment.

8.7. SWOT Analysis of Surveillance & Monitoring & Evaluation System

Strengths

- Existence of a national M&E plan adjusted to international standards.
- Well-established malaria surveillance system in place at health facility, locality, and state levels.
- Easiness of reporting using electronic facilities at national, state, and locality levels, and regular and high reporting rate from sentinel sites.
- Approach of using sentinel surveillance system information for close monitoring and rapid response actions for malaria control and malaria statistics from the routine health information system for impact evaluation.
- Standardized reports format at all malaria control programme levels.
- Existing data management unit at all levels with well-organized structure.
- Availability of report hard copies as a back-up system.
- Clear written instructions on reporting modalities (who /when/ how).
- Existence of a system for regular periodic feedback to the FMOH cabinet and SMCPs and other stakeholders.
- Conduction of a considerable number of operational researches to improve performance of malaria control activities and fill information gaps in the surveillance and health information systems regarding impact evaluation, especially the MISs.
- Conduction of MESS analyses to strengthen performance of NMCP.

Weaknesses

- Delay of reporting from some states and health facilities in hard-to-reach sentinel health facilities.
- Low coverage of focal persons and doctors in sentinel sites by training in surveillance as well as the high turnover of staff.
- Poor capacity of surveillance personnel at health facility and locality levels especially regarding data analysis.
- Malaria epidemic thresholds are not yet established at concrete and reasonably smaller geographical levels, and so capacity for early detection of malaria epidemics through surveillance system is lacking.

- Lack of a system to avoid double counting of malaria cases, for cases attending more than one health facility.
- Private sector is not part of malaria surveillance system and not covered by malaria M&E activities.
- Data check techniques are not used such as double entering and post-entry check.
- Poor feedback mechanisms from SMCP to lower levels in some states.
- Poor documentation of M&E activities and lack of written SOPs and guidelines for the M&E system at state level.
- No clear system to monitor and assess the quality of malaria service at all levels
- No system for electronic backup for computerized data and information especially at state and locality levels.
- NMCP research data base is not well-established.
- Poor monitoring of malaria control interventions' client satisfaction.

Opportunities

- Integration of malaria surveillance into the existing communicable disease surveillance system centred in the Epidemiology Department in the FMOH and state ministries of health which will ensure optimum utilization of fragmented resources and sustainability of malaria surveillance.
- More strength is awaiting malaria surveillance by including private health facilities in the system.
- Underutilized locality level in communicable disease surveillance and specifically malaria surveillance, in relation to data analysis and use of thresholds in monitoring malaria trends.
- Underutilized state level regarding planning for M&E activities, evaluation of implementation of plans, and research conduction.
- Existence of a number of training and research institutes interested in malaria research.
- High concerns of WHO and other organizations supporting the NMCP regarding existence of a well-functioning M&E system in the programme, and the technical support that can be provided by these organizations.

- Availability of a variety of means of communication i.e. wide coverage of cell phones, availability of internet at very low cost.

Threats

- Over-dependence on Malaria Indicator Surveys has led to poorer emphasis on strengthening surveillance and routine information systems.
- Poor commitment of some state ministries of health and almost all localities towards maintaining malaria surveillance system.
- High turnover of surveillance staff especially at locality level and lack of motivation of surveillance staff at both health facility and locality levels.

8.8. Conclusion

A well-established malaria surveillance system is in place at all malaria control programme levels. Generated information is utilized at national and state levels of the programme. An effective NMCP monitoring and evaluation system is in place and undergoing continuous improvement in collaboration with expert partners. Effective coordination mechanisms between malaria control programme M&E Department and HMIS Department in the FMOH do exist, in addition to a viable system for supportive supervision for SMCPs and strong communication and feedback channels with state programmes. Research is well utilized in filling information gaps and improving performance of malaria control interventions.

Yet, gaps in performance do exist and need to be bridged towards an even better performance. Surveillance staff at health facility and locality levels lack motivation and have poor capacity, especially regarding data analysis and utilization of information generated. Malaria epidemic thresholds are not established yet at concrete and reasonably smaller geographical levels, and so capacity for early detection of malaria epidemics using surveillance system is lacking. Research data base is not well-established.

8.9. Recommendations

- NMCP to ensure active participation and coordination with HMIS for implementation of health information system reform strategy and Integrated disease surveillance for strengthening IDS

- Develop and implement a phased plan for integration of malaria surveillance into the communicable disease surveillance system at national, state, and locality levels with necessary arrangements for regular feedback to malaria control programme at all levels.
- Reassess malaria sentinel surveillance for decision on distribution number of sites and modality of work of this system particularly in view of integration approach in FMOH in coordination with epidemiology department
- Develop and implement a crash plan for training of focal persons in sentinel sites in surveillance, data analysis, early detection of epidemics and rapid response.
- Develop and implement a system for refresher training for focal persons and basic training for focal persons newly coming into sentinel sites.
- Improve capacity of surveillance personnel at state and locality levels regarding data checking techniques, data analysis and development and use of epidemic thresholds.
- Design arrangements for coordination between sentinel sites and vector control personnel in the grass root level of service delivery, in order to be able to use surveillance system information to direct vector control operations at catchment area level.
- Develop malaria epidemic thresholds at reasonably smaller geographical levels in collaboration with SMCPs and emphasize use of epidemic thresholds in monitoring disease trends.
- Compile and analyze all RDTs and Artemisinin-based Combination Therapies (ACTs) reports to Central Medical Supplies (CMS) by health facility starting from the year that is available and triangulate with HMIS, malaria sentinel sites data and health facility and household surveys
- Establish a system for electronic backup of computerized data and information at all programme levels.
- Establish a malaria data management system including a robust and user friendly database, at the first stage, for state level then to expand to the localities

- Ensure documentation, information sharing and reporting on periodic basis and publishing comprehensive annual malaria report and research results
- Develop and implement a plan for gradual involvement of the private sector in malaria surveillance.
- Establish a malaria programme research database and a system for regular update of the database.
- Introduce and strengthen a supportive supervision, on job training and coaching approach to strengthen capacity of staff to use generated data for programme planning and management
- Develop and implement a plan for strengthening capacity of M&E units in SMCPs.
- Establish a steering committee for research for leading the malaria research agenda

9. Malaria Epidemic Preparedness and Response

9.1. History of Malaria Epidemics in Sudan and Predisposing Factors

Malaria epidemics are a priority in areas of unstable malaria transmission. Thus, when aggressive control programmes have achieved low transmission, there is a high risk for resurgence and rebound associated with annual and cyclical weather and climatic factors at the same time as decreased access to and coverage with malaria control interventions. Extreme climatic events, such as drought and floods, and civil disturbances lead to emergency situations in which the population is more vulnerable to malaria, and malaria control services have broken down. A good example for this scenario is what happened in Gezira State following cessation of the Blue Nile Health Project operations in 1990. Prevalence of malaria was reduced from over 20% to less than 1% during life span of the project. After cessation of the project vector control operations, a widespread malaria epidemic hit Gezira State in 1990s during the rainy season.

Historically; Sudan has a history of frequent malaria epidemics in epidemic prone areas which are located in the hypo and meso- endemic zones. Urban epidemics are well documented in Khartoum State in the years 1981, 1988, 1994 and 1998. A number of factors played a role: increased rainfall, spread of irrigated agriculture within the city limits, construction of new urban colonies without proper facilities for drainage, influx of refugees and IDPs, and insufficient supply of drugs.

In Gedarif State a malaria epidemic in 1978 followed the war in Ethiopia with influx of refugees across the border to Kassala and Gedarif states, and two other epidemics followed heavy rainfall in 1993 and 1998. In the western part of the country and North Kordofan two epidemics were reported in 1999 due to poor storage of water (*A. Aal et al 2012*). More recently a malaria epidemic in Shabasha – White Nile State in January 2009 was reported; yet the main problem appears that many outbreaks are not recognized early.

In the period from 1970 – 2009 a total of 26 malaria epidemics affected 9 states; White Nile, Gezira, Gedarif, Kassala, Khartoum, Red Sea, River Nile, North Kordofan, and Northern States (Table 20). White Nile, Gezira, Khartoum, and Gedarif States were the most affected, shouldering 69% of attacks (18 epidemics) while Red Sea, Kassala, and Northern States were the least affected (Table 21). In 6 of the states; White Nile,

Gezira, Gedarif, Khartoum, River Nile, and North Kordofan the same areas were affected each time. Affected areas were mostly in or neighboring agricultural schemes. No available data to examine timing of these epidemics in relation to seasons of high transmission; autumn and winter. For the period 1970 – 1999, average interval for cycling of epidemics for all states is 2 years, while for the period 2001 – 2009 it is 8 years. With exception of White Nile which witnessed a malaria epidemic in 2009, last year for occurrence of epidemics was 2001 (Kassala). The long interval for the last epidemic in the country compared to the average interval could be explained by acceleration and expansion of malaria control activities in the country coinciding with this interval and following adoption of RBM initiative; NMCP was established followed by state and locality malaria control programmes, states and localities were supported by a considerable number of cars to sustain malaria control activities, states were supported by provision of insecticides, vector control equipment, and anti-malaria drugs before the rainy season every year, surveillance system was established at national and state levels, free anti-malaria drugs were provided in public health facilities, KMFI was established and similar acceleration activities were implemented in Gezira State, and in Northern and River Nile states malaria control activities were accelerated as part of the Gambia Project which is supported by the Government of Egypt. At state level, average interval for cycling of epidemics ranged between 5 – 11 years.

Factors predisposing for malaria epidemics include low immunity of population in hypo – endemic areas, climatic factors, rains, floods, drought and famine, spread of resistance of *P. falciparum* to anti-malaria drugs, increasing resistance of vectors to insecticides, migration of population from low to high endemic areas and vice versa, instability in the bordering countries and refugees' influx into hypo-endemic areas, civil and armed conflicts in the county, establishment of large agricultural projects, socio-economic factors, deforestation, very high population density in some towns and developmental schemes, and poor household water retention methods.

Table (20): History of malaria epidemics in Sudan 1970 – 2009

Years	Affected States	Affected Provinces (Localities)	Affected Areas
1970	White Nile	Kosti	Elrank
1974	Gezira	Gezira	Barakat
1975	Gezira	Gezira	Barakat

1976	Gedarif	Elrahad	Elfao
1978	White Nile	Kosti	Elrank
1981	Khartoum	Khartoum North	Eldroshab, Elgaili, Elseleit
1985	Red sea	Port Sudan	Tokar
1988	White Nile, River Nile, Khartoum	Kosti, Eldamar, Atbara Khartoum North	Elrank, Elzeidab, Atbara Eldroshab, Elgaili, Elseleit
1990	Gezira	Gezira	Barakat
1992	North Kordofan	Elsheikan	Khortagat
1993	Gedarif	Elrahad	Elfao
1994	Khartoum	Khartoum North	Eldroshab, Elgaili, Elseleit
1995	Gezira	Gezira	Barakat
1998	White Nile, River Nile, Gedarif, Khartoum	Kosti, Eldamar, Elrahad	Elrank, Elzeidab, Elfao
1999	White Nile, North Kordofan	Kosti, Elsheikan	Elrank, Khortagat
2001	Kassala, Northern	Kassala, Algolid	Kassala, Algolid
2009	White Nile	Elduweim	Shabasha

Table (21): Analysis of malaria epidemics by states

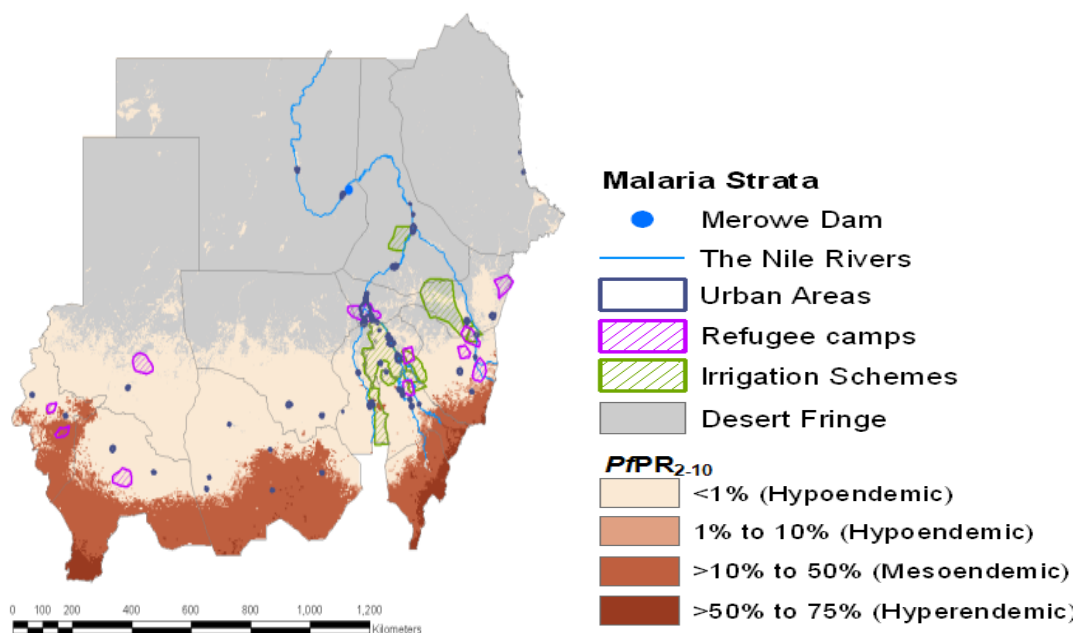
States	Years of Epidemics	Number of Attacks	Areas Affected	Average Interval of Cycling
White Nile	1970, 1978, 1988, 1998, 1999, 2009	6	Elrank 4 attacks and Shabasha 1 attack	8 years
Gezira	1974, 1975, 1990, 1995	4	Barakat	5 years
Gedarif	1976, 1993, 1998	3	Elfao	11 years
Kassala	2001	1	Kassala	-
Khartoum	1981, 1988, 1994, 1998	4	The 4 attacks were in Eldroshab, Elgaili, Elseleit	6 years
Red Sea	1985	1	Tokar	-
River Nile	1988, 1998	2	Elzeidab 2 attacks and Atbara 1 attack	10 years
North Kordofan	1992, 1999	2	The 2 attacks in Khortagat	7 years
Northern	2001	1	Algolid	-

9.2. Malaria Epidemic Risk Mapping

States at risk of malaria epidemics are those in epidemic prone areas usually in the hypo and meso-endemic zones with unstable transmission of malaria. According to MIS 2012, all county states were hypo-endemic with exception of Gedarif State which was meso-endemic for malaria transmission and so they are all epidemic prone (Figure 39). Though in some states (Northern) there are some localities that are considered to be malaria – free according to NMCP, yet malaria epidemic risk map is shown by states

and not extended down to locality level. There are reliable estimates for population in epidemic prone areas; population census for 2008 updated for the specific year by adding growth rate for that year. NMCP has a system to update malaria epidemic risk map based on MIS results, which are not necessarily conducted every two years, last time for update was following finalization of MIS 2009 results.

Figure (39): Malaria risk map (Noor, 2012)



9.3. EPR Policy, Guidance, and Planning

NMCP has written policy and guidelines for malaria epidemic preparedness and response “Guidelines for malaria epidemics at local level” with clearly written roles for national and state levels. Guidelines are showing how malaria epidemics are suspected, process of investigation and confirmation of malaria epidemics, recommended interventions based on malaria control strategies for containment of malaria epidemics and monitoring of epidemics.

There are annually update contingency plans for malaria emergency preparedness and response at both national and state levels, states sending a copy of their plans to NMCP. Plans include quantities of needs for preparedness and response (buffer stock).

9.4. Organization of Malaria Emergency Preparedness and Response

There are multiple measures implemented on a regular basis to prevent malaria epidemics. IRS is a main preventive measure in target areas, implemented in two rounds coinciding with the two malaria peak seasons; autumn and winter. According to NMCP, limitation here is that right timing of campaigns is sometimes missed due either to delay in procurement of insecticides through the global fund or unavailability of running cost supposed to be allocated by target state governments. Coverage of population by LLINs is an ongoing intervention aiming at universal coverage by 2015. Prior to the rainy season every year FMOH provides support to all states in form of insecticides, spray hand pumps and machines, malaria microscopy equipment and consumables. Quantities provided to states include quantities needed for routine interventions in addition to 10% more that should be kept as a buffer stock for emergencies at both national and state levels.

Concerning anti-malaria drugs, a quantity equivalent to one quarter needs is kept as a buffer stock at the level of CMS. At state RDFs a buffer stock is also kept for emergencies but no available data to show exact quantities. Emphasis is always made on keeping buffer stocks at national and state levels. Buffer stocks of all emergency preparedness and response commodities are kept at state level and no such stocks at locality level yet. Before rainy season and for hard to reach areas, health facilities that may have difficulties in accessing the higher levels for monthly supplies with ACTs and RDTs are given a enough stock to cover the period of the rainy season in order not to facing stock out.

As monitoring trends of malaria through surveillance system does not yet involve using epidemic thresholds for early detection of epidemics, guidelines for locality and state malaria surveillance focal persons for early detection include; observation of an abnormal increase in number of malaria cases or deaths, abnormal presentation of cases, rumors from people's committees and communities, government officials or other stakeholders especially NGOs. Once a malaria epidemic is suspected, locality malaria control department has to ring the bell for SMCP for a joint investigation according to NMCP guidelines, towards confirmation of malaria epidemic. Once a malaria epidemic is confirmed, SMCP should immediately notify NMCP.

At both national and state levels there are already established committees headed by NMCP and SMCPs coordinators, and these are members in committees headed by Undersecretary in the FMOH and Director Generals of state ministries of health at state level. Committees also include members from different relevant departments, for containment of emergency situations especially epidemics. These committees are called by NMCP and SMCP for containment and monitoring the epidemic according to national guidelines. Teams from NMCP may join SMCP and locality teams for assistance and supervision of containment efforts.

Once a malaria epidemic is confirmed in a certain area a case definition should be established for surveillance and management of cases purposes. Cases reported according to established case definition should straight away be given treatment according to NMCP treatment guidelines and drug policy and need not be sent to the laboratory for confirmation.

Malaria epidemics are monitored through daily epidemiological reports according to a standard national format. Daily reports are sent from target health facilities to locality malaria coordinator, from which to state malaria surveillance focal person and then to NMCP. According to guidelines, reports should continue for quite some time after containment of epidemic to ensure containment. Surveillance of malaria cases during epidemics does not involve active case-based surveillance.

9.5. Human Resources, Capacity Building for Epidemic Preparedness and Response

At national level, there is a unit for coordination of malaria epidemic preparedness and response (focal person) in the Surveillance and M&E Department and at state level the M&E unit is responsible for epidemic preparedness and response. Malaria epidemic preparedness and response units bear the responsibility of day-to-day work of epidemic preparedness and response namely; development of contingency plans in collaboration with other malaria programme departments, estimation of quantities of preparedness and response commodities and follow up procurement and reception, always ensuring availability of a buffer stock. When a malaria epidemic is suspected, the unit leads investigation team in collaboration with IVM, Malaria Case Management and IEC Departments. Once a malaria epidemic is confirmed, the unit is responsible for

daily monitoring reports till containment of the epidemic and after in addition to coordinating containment efforts between departments.

According to NMCP Surveillance and M&E Department, almost 100% of malaria programme epidemic preparedness and response focal persons at national and state levels had training in emergency preparedness and response in the period 2002 – 2010.

Training was started early in 2001 in the form of in-service training during supervisory visits for state epidemic focal persons and statisticians in sentinel sites. In 2002, rapid response team training was organized by NMCP and BNNICDs for 25 participants from all 16 states. Training targeted emergency contingency planning, detection and containment of epidemics, and rapid response. Following this training, training in forecasting and early detection of malaria epidemics was organized for 80 participants from 5 selected states (Khartoum, Kassala, North Kordofan, Northern and Sinnar States); 5 state surveillance focal persons, 25 medical doctors, 25 laboratory technologists and 25 statisticians from sentinel sites.

After 2006 and up to February 2010 there was intensive work in malaria epidemic preparedness and response with the objective of early detection of malaria epidemics and adequate response within 2 weeks of initiation, targeting establishment of a system for early warning and early detection of epidemics in the five selected states above and other states. A total of 415 participants were trained; 119 participants from sentinel sites in rapid assessment and appropriate response, 65 statisticians from sentinel sites shot courses in early detection of epidemics, 231 medical doctors, laboratory technicians and statisticians from sentinel sites in early detection of epidemics (Table 22). TOT training was organized for 23 national and state surveillance and M&E personnel. More 166 statisticians from sentinel sites in 10 states were trained in early detection of epidemics. There was continuous turnover of staff, and no available data to show current number of trained personnel.

Other activities under the objective includes collection and analysis of historic malaria morbidity and mortality data from selected 65 sentinel sites in 9 states (Gedaif, Kassala, Sinnar, North Kordofan, West Darfur, South Darfur, North Darfur, White Nile and South Kordofan) to assess possibility of establishing malaria epidemic thresholds. Teams from NMCP visited selected states and jointly with state teams developed and

updated states contingency plans for malaria epidemics. Field visits were organized for situation analysis regarding setup of early warning and early detection of malaria epidemics and as a result a total of 35 new sentinel sites were added in six states.

Table (22): States sentinel sites personnel trained in early detection of epidemics in 2010

States	Number of Sentinel Sites	Number of Sentinel Sites Personnel Trained
Gezira	13	30
Sinnar	13	31
Gedarif	12	26
Kassala	16	48
White Nile	16	48
North Kordofan	15	48
Total	85	231

9.6. Performance of Malaria Epidemic Preparedness and Response

Performance regarding implementation of preventive measures; IRS campaigns, coverage of population with LLINs, household utilization of LLINs, and support provided to states prior to the rainy season every year was already examined in programme management and prevention and vector control chapters above.

Regarding performance in relation to response to epidemics, no available data to assess response to reported epidemics before 2001 since no epidemics occurred in the period 2001 – 2009 and the only available data is for the 2009 malaria epidemic in Shabasha – White Nile State. People's Committees of Shabasha wrote in newspapers about increase of febrile cases in the area, while an NGO personnel living in the area contacted the NMCP notifying increase in number of febrile cases. NMCP contacted SMCP investigating about notifications received and directed state programme to start investigating the fever cases and environmental conditions in the area. A team from NMCP joined the state programme team, a number of small scale community surveys were conducted in addition to more environmental conditions investigation. Investigation concluded that increase in cases of fever was due to a malaria epidemic. Response plan was supported by more insecticides from NMCP in addition to part of containment running cost. White Nile State Government and Locality Government had

to allocate fund for the rest of the running cost. Free anti-malaria drugs were already available in health facilities. Epidemic was monitored by daily reports from health facility level up to the NMCP, and could be contained within a period of two weeks from notification.

An IEC plan, which is part of national and state contingency plans, is implemented prior to the rainy season and during epidemics. It involves; broadcasting through TV and radio stations of selected key messages designed by NMCP, delivering lectures in schools and at residence where necessary, printing and distribution of posters and leaflets. During the period 2006 – 2009, National Malaria Week used to be implemented in all states in September every year. The week was in the form of a health education campaign to mobilize institutions and communities to share malaria control activities in the rainy season. Key messages were broadcasted through TV and radio stations, TV and radio interviews organized with key national and state malaria control programme personnel, mobile theatres were conducted, and printed IEC materials distributed.

9.7. Impact of Malaria EPR System

Collective malaria control measures accelerated post adoption of RBM initiative, especially in relation to seasons of peak malaria transmission might have impacted behaviour of malaria epidemics.

In the period from 2000 – 2009 three states were affected by malaria epidemics (Kassala, Northern, White Nile) while in the preceding 10 years (1990 – 1999) 11 malaria epidemics were reported from 6 states, 10 of them reported from 5 states, each state experiencing two attacks during the period (Table 18). Five of the six states affected by malaria epidemics during the period 1990 – 1999 did not witness epidemics for the last 12 years, and last times for reported epidemic attacks in these states were in 1995 (Gezira), 1998 (Gedarif, Khartoum, River Nile), and 1999 (North Kordofan). The two states affected by malaria epidemics in 2001, did not experience such attacks in the next 11 years. Looking into the interval for cycling of epidemics in the country, interval increased from 2 years in the period 1970 – 1999 to 8 years in the period 2001 – 2009.

No available data to compare performance regarding malaria morbidity and mortality in each epidemic, and average time needed to contain the epidemic.

9.8. Results of Field Visits to SMCPs

Interviews with SMCP coordinators in six selected states in May 2013 showed that all states have emergency coordinators and emergency committees. Five states have emergency plans and emergency working group. Five states have personnel who were trained in emergency preparedness. Most of coordinators mentioned that materials and equipment for emergency are available in reasonable amounts, however sometimes shortages may occur regarding spray pumps, fuel, staffing, anti-malaria drugs and RDTs. All coordinators mentioned that they have partners that support SMCP at times of emergencies; international and national NGOs, Civil Defence Administration and locality People's Committees.

9.9. SWOT Analysis of Malaria EPR System

Strengths

- Availability of malaria epidemic preparedness and response plans at national and state levels updated annually.
- A system for malaria surveillance at national and state levels is in place, representing the base for early detection of malaria epidemics.
- Presence of a system supported by Sudan Government, for providing states with malaria epidemic preparedness commodities prior to the rainy season every year.
- Development of an accumulative experience in malaria control programme at national and state levels in preventing occurrence of malaria epidemics in states known to experience frequent epidemics in the 1990s era in addition to experience in containing malaria epidemics within target time period.
- Development of good experience in malaria control programme at national and state levels regarding picking up of rumours about malaria epidemics reaching to confirmation of presence of an epidemic.
- Presence of a system for provision of public health facilities with free anti-malaria drugs.

Weaknesses

- Malaria surveillance system not yet involving use of epidemic thresholds for early detection of malaria epidemics.
- Lack of an early warning system for prevention of malaria epidemics.
- Delay of implementation of some main interventions preventive of malaria epidemics (IRS) due to limitations in availing governmental running cost or delay in procurement of insecticides.
- Poor commitment of some state and locality governments towards allocating running cost of additional vector control interventions during rainy season.
- Delay in release of running cost needed to implement preventive or containment measures at times of malaria emergencies, especially at state and locality levels.
- Poor documentation of malaria epidemics witnessed in the country in the past period.
- Continuous turnover of trained staff.

Opportunities

- Strong political commitment towards preventive and containment measures in emergency situations.
- Support from Global Fund for implementation of main malaria epidemic preventive measures; IRS campaigns and universal population coverage with LLINs.
- Presence of previous experience in some large scale irrigated agricultural schemes (Gezira) in implementation of IRS campaigns.
- Developing experience in some agricultural schemes in using focal irrigation techniques that do not result in creation of malaria vector breeding sites.
- Presence of some international and national NGOs mandated and experienced in supporting efforts for prevention and containment of malaria epidemics.

Threats

- Stopping of or interruption of Global Fund support for IRS campaigns and free LLINs distribution.

- Increasing development of new urban settings in big cities without an infrastructure supportive of vector control and new large scale irrigated agricultural and developmental schemes without in-built vector control methods.
- Lack of seasonal mosquito men and other workers needed to implement additional preventive measures during the rainy season or at times of malaria epidemics, due to low payments.

9.10. Strategic Directions in Malaria EPR System

It is evident from above analysis that malaria control efforts in Sudan in the last 12 years succeeded in decreasing attacks of malaria epidemics compared to the pre-RBM period. With decreasing malaria morbidity and hence population exposure to the disease, population immunity to the disease gets more compromised. This situation coupled with changing and unstable climatic factors in the county and neighbouring countries increase risk of malaria epidemics in the coming years. Much more focus should be given to early detection and prevention of malaria epidemics.

Surveillance system should be equipped with malaria epidemic thresholds at reasonably small geographical boundaries e. g, administrative unit and use these thresholds in disease monitoring. Enough efforts should target linking malaria epidemiological data with metrological data reaching a model for forecasting malaria epidemics through alert thresholds. There should be more focus on states that experienced frequent malaria epidemics in the 1990s in terms of capacity building for state and locality malaria control programme personnel regarding early warning, early detection, preparedness and rapid response to epidemics. Needed investment should be made in institutionalizing concerns of prevention of malaria epidemics in state and locality governments rather than being personal concerns for some governors.

Some of the above concerns are met in the National Malaria Control Five Years Strategic Plan 2012 – 2016. Plan outcome target is “By 2015, 80% of malaria epidemics will be detected and properly responded to within 2 weeks of onset”. Output targets include the following:

- By 2015, all states will have updated epidemic control plan and epidemic stocks.

- By 2015, all epidemic detection sentinel sites will have trained staff for detection, reporting and control of epidemics.
- By 2015, 100% of sentinel sites will have epidemic detection charts and weekly reporting during transmission season.

9.11. **Conclusions**

After referendum of Sudan in 2011, all of the country states became epidemic prone. Exploring history of malaria epidemics in Sudan revealed that climatic factors, namely heavy rainfall and floods are the main predisposing factors for malaria epidemics. Other factors include; drought and famine, spread of resistance of *P. falciparum* to anti-malaria drugs, increasing resistance of vectors to insecticides, migration of population from low to high endemic areas, instability in the bordering countries and refugees' influx into hypo-endemic areas, establishment of large agricultural projects, socio-economic factors, deforestation, very high population density in some towns and developmental schemes, and poor household water retention methods.

Collective malaria preventive measures implemented in Sudan following RBM initiative resulted in decreased number of malaria epidemics, number of states affected and increased interval of epidemic cycling. A reasonable system for malaria epidemic preparedness and response at national and state levels is in place with good experience in applying preventive measures before and during seasons of peaking of malaria and in containment of malaria epidemics within target period of time.

Surveillance system is not yet equipped with methods of early warning of malaria epidemics and early detection of epidemics.

9.12. **Recommendations**

- Develop and implement a system for early warning and early detection of malaria epidemics.
- Build capacity to acquire and use needed information for short and long term epidemic forecasting in collaboration with meteorological department

- To standardize the use of simple malaria thresholds in all weekly epidemiological reports in all states to be used at health facility and locality levels
- Do the best efforts to document experience in management of previous malaria epidemics.
- Develop and implement a system for timely documentation of malaria epidemic preparedness and response activities especially management of malaria epidemics.
- Advocate, in collaboration with Ministry of Agriculture for using irrigation methods not conducive for breeding of malaria vector in irrigated agricultural schemes.
- To ensure epidemic contingency commodity stocks and emergency funds are not only planned but pre-positioned annually before the raining season.
- Invest much in capacity building of locality malaria control programmes' personnel in malaria epidemic preparedness and response, especially in states that experienced frequent epidemics in 1990s.
- Malaria program to jointly prepare annual preparedness plans with states, national and international NGOs for IDPs and refugee camps and localities for capacity building and increasing access through HMM volunteers and community leaders and primary health care facilities
- Advocate for prevention of malaria epidemics among state and locality governments targeting presasonal preparedness and development plans conducive for malaria control.

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Annex (1): List of contributors

MPR Steering Committee

No	Name	Position	Role in MPR
1.	Dr Igbal Ahmed Elbashier	Director of Public Health Institute	Chair
2.	Dr Elfatih Mohammed Malik	Epidemiologist, Malariologist	Member
3.	Dr Talal Elfadil Mahdi	Epidemiologist	Member
4.	Dr Mustafa Salih Mustafa	Human resource, management, and capacity building specialist	Member
5.	Prof Ali Haboor	Paediatrician	Member
6.	Prof Omer Zayed Baraka	Internal Medicine physician	Member
7.	Dr Ahmed Abdalla Mohamedani	Pathologist	Member
8.	Dr Abdul Hamid Eldirderi	Entomologist	Member
9.	Prof Badria Babiker Elsayed	Entomologist/Epidemiologist	Member

MPR Coordination & Secretariat Team (National Malaria Control Programme)

No	Name	Position	Role in MPR
1.	Dr Khalid Abdelmutalab Elmardi	Head of Communicable and Non-communicable Diseases Department – FMOH – former National Malaria Control Programme Coordinator	Chair
2.	Dr Mai Mahmoud Elhilo	Global Fund Section	Coordinator
3.	Dr Fahad Awad	NMCP Coordinator	Member
4.	Dr Asma Hashim Hassan Eltuhami	Head of Procurement and Supply – National Malaria Control Programme	Member
5.	Mr Abdalla Ahmed Ibrahim	Head of Surveillance and M&E Department	Member
6.	Mr Elrashid Mohamed Ali	Partnerships Coordinator	Member
7.	Mr Ibrahim Osman Mustafa	Monitoring and Evaluation Unit	Member
8.	Mr Mohamed Ahmed Abbas	Malaria –Free Zones Coordinator	Member
9.	Mr Hamouda Tyook	Integrated Vector Management	Member

Taskforce (partners and stakeholders)

No	Name	Role in MPR
1.	WHO	partners and stakeholders (Consensus working group)
2.	UNDP	
3.	UNICEF	
4.	CDF World Bank	
5.	Islamic Development Bank	
6.	Social Saving and Development Bank	
7.	Federal Ministry of Finance	
8.	Plan Sudan Organization	
9.	MSF – Belgium	
10.	Pancare Organization	
11.	SIDO Organization	
12.	GOAL Organization	
13.	SECS Organization	
14.	The Sudanese Red Crescent	
15.	BNNICD , University of Gezira	
16.	Endemic Institute, University of Khartoum	
17.	States Representatives	
18.	Health and Population Committee – Sudan National Council	

	(Sudanese Parliament)	
19.	Community Development Federation	
20.	Sudanese Environment Protection Organization	
21.	Women Union	
22.	Youth against Malaria Organization	
23.	National Council for Children Welfare	
24.	Sudanese National Radio Corporation	
25.	National Council for Press	
26.	Businessmen & Employers Federation	
27.	Amipharma Drug company	
28.	MM Pharma Drug company	

Inception (Phase one) PHI Team

No	Name	Position	Role in MPR
1.	Dr Bahaeldin Dafalla	PHI	Head of Inception team
2.	Dr Muna Ismail	PHI	Inception Focal person
3.	Dr Osama Ahmed	PHI	Member
4.	Dr Ahmed Asim	PHI	Member
5.	Mrs Afrah Abdeen	PHI	Member
6.	Mr Mahmoud Elwaseela	PHI	Member

Inception (Phase one) Consultants

No	Name	Position	Role in MPR
1.	Dr Nazar Elfaki	Directorate of Human Resource Development - FMOH	Programme Management, Surveillance, M&E
2.	Dr Abeer Abuzeid Mannan	El Neelein University	Advocacy, IEC
3.	Dr Tarig Abdalla	Ministry of Health - Khartoum State	Epidemiology, Prevention and Vector Control
4.	Prof Ishag Adam	University of Khartoum – Faculty of Medicine	Diagnosis and Case Management

PHI Phase Two Team

No	Name	Position	Role in MPR
1.	Dr Muna Ibrahim Abdel Aziz	PHI	Technical reviews and collation of Phase Two report
2.	Dr Firdous Yousif	PHI	consultant
3.	Dr Muna Ismail	PHI	Inception and external review focal person
4.	Ms Fathia Bela	PHI	PHI coordinator
5.	Dr Osman Mahal	PHI	Technical reviews
6.	Dr Nadia Elhussein	PHI	Systematic & technical reviews
7.	Dr Reem Gaafar	PHI	Systematic review
8.	Dr Hind Merghani	PHI	Systematic review, Phase Three tools
9.	Dr Eiman Elhag	PHI	Systematic review, Phase Three tools
10.	Dr Haifa Samir	PHI	Technical review

Phase Two Experts

No	Name	Position	Role in MPR
1.	Prof Abdelrahim Osman Mohamed	Consultant	Diagnosis And Case Management
2.	Dr FirdousYousif	Community Physician	Epidemiology and Emergency Preparedness
3.	Dr Salaheldin Mubarak Elkhalfifa	Environmental Health Department – FMOH	Prevention and Vector Control
4.	Dr Omer Elfaroug Habib Ali	Consultant	Programme Management, Surveillance, M&E

Phase Two Desk Review Team

No	Name	Position	Role in MPR
1.	Dr Firdous Yousif	Community Physician	Supervisor
2.	Dr Nazik Izzeldin	Community Medicine Registrar	Surveillance, M&E
3.	Dr Hiba Mustafa	Community Medicine Registrar	Epidemiology
4.	Dr Sohier Gabrallah	Community Medicine Registrar	Epidemiology
5.	Dr Hana Abdelrazig	Community Medicine Registrar	Case Management
6.	Dr Sara Badawi	Community Medicine Registrar	Case Management
7.	Dr Nada Mohammed	Community Medicine Registrar	Integrated Vector Management
8.	Dr Reem Abdelhalim	Community Medicine Registrar	Advocacy, IEC
9.	Dr Wafa Mohammed	Community Medicine Registrar	Program Management

Phase Three Team

No	Name	Position	Role in MPR
1.	Dr Abdel Moniem Mukhtar	Head of Research - PHI	Principal investigator
2.	Ms Fathia Bela	PHI	Second MPR coordinator
3.	Ms Eltaf Ibrahim	PHI	Data collection and analysis
4.	Ms Rehab Abdelbagi	PHI	Data collection and analysis
5.	Ms Siham Yagoob	PHI	Data collection and analysis
6.	Ms Nesreen Elamin	PHI	Data collection and analysis
7.	Dr Eiman Elhag	PHI	Data collection tools, report writing
8.	Dr Hind Merghani	PHI	Data collection tools
9.	Dr Osama Ahmed	Head of Epidemiology - PHI	Qualitative analysis

Phase Three External Reviewers

No	Name	Position	Role in MPR
1.	Dr. Shiva Murgasamillay	WHO-HQ	External Reviewers
2.	Dr. Huda Atta	WHO-EMR	External Reviewers
3.	Dr. Ghasim Zamani	WHO-EMR	External Reviewers
4.	Ms. Caroline Barwa .	WHO-EMR	External Reviewers
5.	Charles Paluku	WHO-AFRO	External Reviewers
6.	Dr. Kanako Ishida	GF-Geneva	External Reviewers
7.	Dr. Ryuichi Komatsu	GF- Geneva	External Reviewers
8.	Annet Odhiambo	FG- Geneva	External Reviewers
9.	Maxim Berdnikov	FG-FPM	External Reviewers

Overall Final Report Writing and Compilation of Thematic Reports (Phase four) Consultant

No	Name	Position	Role in MPR
1.	Dr Tarig Abdalla	Ministry of Health - Khartoum State, <i>thereafter moved to</i> Directorate General of PHC, FMOH	Final Report Writing

National Malaria Control Programme Facilitating Team

No	Name	Position	Role in MPR
1.	Mr. Ahmed Mohammed Nour	SM&E officer	Member
2.	Ms. Lubna Nawai	SM&E officer and states affairs	Member
3.	Dr. Asma H. Elhassan	PSM coordinator	Member
4.	Mrs. Azzah Tageldien	QA for Malaria Diagnosis	Member
5.	Mr. Sayed Ali	QA for Malaria Diagnosis	Member
6.	Mr. Tarig Elfaki	QA for Malaria Diagnosis	Member
7.	Dr. Mona Babiker	Case Management Department	Member
8.	Dr. Rahma Eltigani	Case Management Department	Member
9.	Dr. Msaab Siddig Elhag	Case Management Department	Member
10.	Mrs. Mey Mhammed	Financial nalaysit	Member
11.	Ms. NawalElsheikh	GIS focal person	Member
12.	Mr. Fazaa Abdallah	IVM officer	Member
13.	Mr. Siddig M. Ismaeil	IVM officer	Member
14.	Mr. Ali Abdallah	IEC and partnership officer	Member
15.	Mrs. Khadega Hamad	IEC and partnership officer	Member
16.	Ms. Tawadud Abdallah	IEC and partnership officer	Member
17.	Dr. Msaab Siddig Elhag	Case Management Department	Member

Other Contributors

No	Name	Role in MPR
1.	Planning Directorate – FMOH	Provision of information
2.	Department of Health Information – FMOH	
3.	Public Health Institute Library	
4.	Dr Tarig Abdelgadir – WHO	

Funding Agencies

No	Name	Role in MPR
1.	Global Fund	Funder
2.	WHO	
3.	Roll Back Malaria	
4.	Islamic Development Bank	
5.	FMOH	
6.	FMOF	

Annex (2): MPR phases

Phases	Steps	2012						2013			
		Feb /Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov	Dec	Jan	Feb/Mar	Apr/May	Jun/Jul
Phase-I- Planning and Preparatory phase	Step.1. Defining the need and TORS for a malaria programme review and developing terms of reference;										
	Step.2. Assign review coordinator, establish internal secretariat and the management team;										
	Step.3.a. Identification of multi-skilled internal review team;										
	Step.3.b. Identification of multi-skilled external review team;										
	Step.4. Develop review check list of activities and time table;										
	Step.5. Selecting national, state and localities sites for field observations;										
	Step.6.a. Develop a review plan and proposal with budget;										
	Step.6.b. Develop a review plan and tools;										
Phase-II- Thematic desk review phase	Step.1. Assembling of review reports and documents and conducting literature review;										
	Step.2. Updating of malaria data base and malaria country profiles;										
	Step.3. Updating of malaria epidemiology, trends and assessing programme impact;										
	Step.4. Updating data from malaria research studies and sentinel sites;										
	Step.5. Summarizing data and trends from malaria community, household and health facility surveys;										
	Step.6. Updating of malaria burden estimates and models										
	Step.7. Internal systematic/document review and preparation of technical and programmatic area overviews;										
Phase-III- Conducting central, state and localities field reviews and observations	Step.1. Briefing and team building between internal and external review team;										
	Step.2. Formation of sub-teams of technical working groups;										
	Step.3. Review and adapt data collection tools for field visits;										
	Step.4. Briefing and consensus on central, state and localities field visits;										

Phases	Steps	2012						2013			
		Feb /Mar	Apr/May	Jun/Jul	Aug/Sep	Oct/Nov	Dec	Jan	Feb/Mar	Apr/May	Jun/Jul
Phase-III- Conducting central, state and localities field reviews and observations	Step 5. Central visits to national institutions and organizations;										
	Step.6 State and localities field visits;										
	Step.7. Sharing of reports and presentations from central, state and localities visits and consensus on key findings;										
	Step.8. Preparation of draft report and aide-memoire;										
	Step.9. Preparation of power point presentation of key finding and recommendation;										
	Step.10. Presentation of review finding and recommendation and press release and press conference;										
	Step.11. Publishing the final review report										
Phase-IV- Follow up of implementation from programme review	Step 1. Finalize and publish report		To be designed as a separate plan after completion of the MPR (Phase								
	Step 2. Disseminate the review report										
	Step.3 Incorporate recommendation into annual operational and medium term strategic plans										
	Step.4. Monitor the implementation of the recommendations										

Annex (3): Data Collection Tool for Malaria Epidemiology, emergency preparedness and Response

Review the records, reports and results from surveys/researches, assessments reports, and describe the following:

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Describe the main malaria parasite species and other species											
Other parasite species											
Describe the clinical profile of patients by age group.											
Describe the clinical profile of patients by population distribution											
Describe the clinical profile of patients by severity											
Describe the malaria risk factors and geographic distribution at national level.											
Describe the environmental and climatic factors influencing malaria at national level.											
Describe the burden of malaria on the health system at national level.											
Describe socioeconomic impact of malaria at national level.											
Describe the severity and stability of Malaria at national level.											
State if there is mapping for endemicity and epidemic risk in place at national level.											
State if classification of malaria risk areas available, then indicate the starting dates, and criteria used for classification at national level.											
Describe examples of malaria emergencies and describe the characteristics											
State if there is a system for update of malaria risk areas at least every 2 years at national level.											
State if there is listing for states / localities hosting malaria risk areas at state and at national level.											
State if there is reliable estimates and annual update for population in malaria risk areas at national level.											
State if there is malaria risk populations categorized by age at state and national level.											
Describe the epidemiology of malaria epidemics and its determinants											
Mention the cycles of malaria epidemics and its patterns											
Describe examples of malaria emergencies and its characteristics											
Describe the stratification of malaria risk and transmission											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
Describe the level of immunity and vulnerability of malaria in areas of unstable transmission.											
Describe the risk and severity of malaria in areas of unstable transmission											
State the knowledge, attitude, behavior and practice with regard to malaria emergency and epidemic response											
State if there is focus for prevention of malaria epidemic through total coverage with pre-seasonal reasonable interventions (LLINS/IRS) for high at risk epidemic prone areas											
Mention availability of annually updated plan for epidemic preparedness											
State if emergency commodities stocks usually prepositioned in risk localities, states, and national levels.											
Mention if there are trained response teams for epidemic at national, state and locality levels											
State if there is weekly and monthly warning system during peak months in collaboration with the national metrological services											
State if there is weekly malaria reporting within the integrated diseases surveillance and response during peak season											
Mention if there is epidemic threshold in use at national, state, locality and health facility levels											
State if epidemic/s were detected within 2 weeks of notification											
State if there is response to epidemics within 1 week of notification											
State if there is epidemic assessment checklist											
State if there is case based surveillance system											
Mention the malaria diagnostic policy during emergency											
Mention the drugs used for malaria treatment during epidemic and emergencies											
Mention if using of insecticide treated sheeting is used for temporary shelters during epidemics											
Mention the delivery system and targets for LLINs and IRS during emergency and epidemics											
State if there is national focal person for emergency and response coordination											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
State if there is national policy, guidelines, and standard operating procedure during emergency and epidemics											
State if there is functioning working group for emergency and epidemics											
state if there is state focal person for emergency and epidemics											
State if there is more focus on capacity development at national, state and locality level for emergency and epidemics											
State if there is sentinel surveillance system in place at national, state and locality level											
Mention if there are well designed key messages targeting malaria control during epidemics and emergencies											
Describe types of materials and media being used for messages dissemination during malaria epidemics and emergencies											
Describe methods for community involvement and mobilization being used.											

Annex (4): Data Collection Tool for Malaria Programme Management

Review the records, reports and results from surveys/researches, assessments reports, and describe the following:

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Policies											
Strategy											
Targets											
National malaria control manuals											
Guidelines on major interventions											
National strategic plan											
Business plan											
Annual operational planning											
Project proposals, to e.g. the United States Agency for International Development, the United Kingdom Department for International Development, the World Bank and the Global Fund											
Indicators and targets											
Monthly reports											
Quarterly reports											
Annual reports											
Publications											
Performance indicators											
Performance targets											
Supervision checklist and schedule for Programme and main interventions											
Annual reviews on monitoring of programme Performance											
Periodic reviews, evaluations and audits of Programme performance											
Structure, systems and management											
Degree of verticality and of horizontal integration											
Malaria programme within the sector-wide approach											
Manager or director and deputy of the National Malaria Control Programme											
Team leaders and focal point for:											
<i>Malaria diagnosis and treatment</i>											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
<i>Vector control</i>											
<i>Epidemics and emergencies</i>											
<i>Advocacy, information, education and communication and community mobilization</i>											
<i>States affair and capacity building</i>											
<i>M&E</i>											
<i>PSM</i>											
<i>National administrator, finance officer, supply and logistics officer</i>											
<i>National operational units at locality level; type and organization</i>											
Type of personnel and job descriptions by level and by operational unit											
Organogram of staff by level and operational unit											
Training modules											
Training institutions											
Economic impact for families and households and at country level											
Cost of malaria (illness, absenteeism, early mortality)											
Cost of malaria control to the health sector and the national economy											
Malaria and poverty											
Malaria and the work force											
Malaria and agriculture											
Cost-benefit of control											
Domestic budget and sources of financing											
International budget and sources of financing											
Equipment specifications and ideal numbers											
Equipment maintenance workshops											
Protective gear (specifications and numbers)											
Transport specifications and ideal numbers											
Transport maintenance workshops											
Analysis of strengths, weaknesses, Opportunities and threats with regard to malaria programme management											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
Progress and performance of malaria programme management in achieving annual and strategic targets											
Key issues, challenges and problems in malaria programme management for scaling-up delivery											
Suggested solutions and priorities for action in malaria programme management and supporting research											
National standard specifications for malaria commodities											
Methods and software for estimating commodities required											
Estimates in the malaria strategic plan											
Estimates in the annual plan for the annual malaria season											
Current comparative national and international unit costs of malaria commodities											
Domestic budget and sources of financing for commodities											
International budget and sources of financing for commodities											
Annual and quarterly national procurement cycles and systems											
National or ministry of health procurement agency											
National procurement tender specification and decision system											
State procurement system in place and limitations											
Emergency procurement system to address national stock-outs											
International procurement agency support, specifications and procurement systems											
Storage and delivery system at national, state and locality levels											
Storage and distribution system at national, state and locality levels											
Quality control method used in tendering for all malaria commodities											
Batch quality control method during delivery of malaria control commodities											
National, regional and global quality control centres used for different malaria commodities											
National stock control cards for commodities at storage and delivery points											
Malaria control programme stock control cards for commodities at storage and delivery points											
Malaria control programme monthly and quarterly reporting on malaria commodities											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
National procedures to address shortages or expired stocks of malaria commodities											
National malaria commodities management guidelines											
Training modules											
Procurement plan											
Research priorities in malaria programme management											
Main researchers and research team in malaria programme management											
Research field sites and stations and research programmes in place											
Regional and international collaboration in research on malaria programme management											
Analysis of strengths, weaknesses, opportunities and threats with regard to malaria commodities management											
Progress and performance in malaria commodities management in achieving annual and strategic targets											
Key issues, challenges and problems in malaria commodities management											
Suggested solutions and priorities for action in malaria commodities management and supporting											
Involvement of nongovernmental and community-based organizations											
National commission for malaria control											
Malaria expert advisory technical committee											
Expert subcommittee and working groups on malaria intervention areas											
Quarterly meetings and annual malaria conference with state representatives											
RBM task force											

Annex (5): Data Collection Tool for Malaria Case Management and Chemoprophylaxis

1. Check for availability of the following documents (yes/no):

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Policy and guidelines for parasitological diagnosis											
Guidelines for clinical diagnosis (microscopy, RDTs)											
Guidelines for treatment of uncomplicated vivax malaria											
Protocol for treatment of severe malaria (specific treatment, pre-referral treatment, adjunctive treatment)											
Guidelines for treatment of malaria in pregnancy											
Policy/guidelines for treatment of seasonal malaria chemoprophylaxis in children											
Guidelines for home-based management of malaria											
Policy/guidelines for screening and treatment of infection in antenatal care clinics											
Guidelines for intermittent preventive treatment of malaria in pregnancy at national, locality, units, health facility and community levels.											
Protocols for chemoprophylaxis for travelers.											
Guidelines for management of HIV-positive women											

2. Show following indicators by years

Total suspected malaria cases (per 1000 per year) (all levels)											
Total confirmed Malaria cases (microscopy or RDT) per 1000 per year (all levels).											
<i>Proportion of malaria cases confirmed by microscopy or RDT</i>											
Total no of inpatient malaria cases (per 1000 per year) (all levels).											
Total no of inpatient malaria deaths (per 1000 per year) (all levels)											
<i>Malaria specific death rate (per 1000 per year) (all levels)</i>											
Deaths of children < 5 years from all causes (per 1000 children < 5 years per year) (all levels)											
Total number of blood samples examined											
number of blood slides or RDT results found positive for malaria parasites											
<i>Malaria test (slide or RDT) positive rate (all levels)</i>											
Number of children examined in blood surveys											
Number of all children aged 2–9 years found to have malaria parasites											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
The malaria parasite rate in children 2-9 years											
<i>Malaria parasite incidence (national and state levels)</i>											
Proportion of children < 5 with fever receiving ACT treatment according to national policy within 24 hours of onset (national and state levels)											
Total number of blood smears or rapid tests performed with species differentiation.											
Total number of blood smears or rapid tests results found positive for <i>P. falciparum</i> .											
<i>Prevalence of P. falciparum proportion at all levels</i>											
Proportional mortality rate from malaria in hospital, all age groups (% hospital deaths due to Malaria) (all levels).											
Numbers and proportions of children < 5 years of age and pregnant women in Epidemic- prone areas shown by area											
Proportion of outpatients with suspected malaria who have laboratory diagnosis at all levels.											
Proportion of pregnant women who received at least two doses of intermittent preventive treatment (national, state, locality and health facility levels).											
No. and proportion of suspected malaria cases (clinical or fever cases) tested for malaria parasites by microscopy or RDT (all levels).											
No. of cases of malaria seen or attended by home management agents (all levels).											
No. of malaria cases managed in health facilities (national, state, locality and health facility levels)											
No. of cases of malaria in children < 5 treated within 24 hrs (national, state, locality).											
No. of pregnant women receiving intermittent preventive treatment at second antenatal care visit (national, state, locality, health facility)											
Overall Malaria incidence during Winter season at national and state level.											
Overall Malaria incidence during Summer season at national and state levels											
Overall Malaria incidence during Autumn season at national and state levels											

3. By reviewing the records, reports and results from surveys/researches, assessments reports, describe the following:

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
State the main malaria parasite species and other parasite species											
Describe mostly affected population group											
Describe the geographical distribution of malaria											
Describe the clinical types of malaria											
Describe the population at risk of malaria and population targeted for diagnosis and treatment of malaria											
Describe the knowledge, attitude, behavior and practice of different communities with regard to diagnosis and treatment and malaria in pregnancy.											
State the % budget allocated for malaria case management from domestic and foreign sources											
State the coverage of malaria cases with malaria case management											
State the prevalence of malaria infection and mortality in pregnant women											

Annex (6): Data Collection Tool for Surveillance, Monitoring and Evaluation System and Research

Review the records, reports and results from surveys/researches, assessments reports, and describe the following:

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
Mention if the national malaria control and elimination targets are well defined											
Mention if strategic and annual targets are clearly stated and if there is annual review for assessing progress as a routine work											
Mention if there are well defined malaria indicators											
Mention the sources of data collection and frequency of collection											
State if there is a system for routine reporting for outpatient and inpatient (suspected and confirmed) cases and deaths											
State the availability of integrated disease surveillance systems including malaria variables (integrated disease surveillance and response and health sector monitoring and evaluation)											
Describe the type of the integrated disease surveillance whether cases and deaths are reported weekly or monthly.											
Mention whether the source of surveillance data includes all health facilities or selected sentinel health facilities											
Describe if the surveillance system is dedicated for malaria or if it is part of the information system											
State availability of malaria epidemic surveillance system, and whether includes epidemic threshold and database or not.											
Describe if there is a system for routine LLINs delivery and stock reporting											
Describe if there is a system for routine IRS delivery and stock reporting											
Describe if there is a system for routine RDTs and ACTs delivery and stock reporting											
Describe if there is a system for routine commodities stock reporting											
Describe if there is a system for malaria laboratory routine reporting of slides and RDTs.											
Mention years and reports of malaria prevalence surveys											
Mention dates and report of malaria community and household surveys											
Mention dates and report of malaria health facility surveys											
Mention dates and report of malaria KAP, quality of service, Quality of anti malaria drugs, ... Surveys											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mention dates and reports of any other evaluations or reviews for malaria											
State if WHO malaria data-base is in place											
Mention the date of the last update of the malaria data base											
State if the WHO summary country profile is in place or not.											
State if state malaria profile are in place.											
Mention if monthly, quarterly and annual reports are regularly submitted											
State if reports from surveillance of drug and insecticide resistance available.											
State if there is country report or dashboard in use											
State if there are reports of sub-national and national reviews and planning meetings											
State if there are computers, software and internet network at national, state and locality levels											
State if there is a country web-site and if it is frequently updated											
State if a web-based reporting is used											
Mention and give evidence for research in this area as a priority											
State if there are research projects and programmes in place											
State if there are units of malaria research in research institutions and if there are specified institutions with a major concern in malaria											
State national universities which has research programmes on malaria											
Describe if there is any regional or international collaboration in research in this area											
State if there is a focal point for M&E at national and state levels											
State if there is a technical working group for M&E											
State if there is link with national bodies, e.g. health sector M&E, integrated disease surveillance and response, Central Bureau of Statistics											
Describe the qualification and skills and experience of members of M&E team											

Annex (7): In-depth Interview tool for Malaria programme director and programme staff for Programme Management Theme

Question / Indicator	Response
analysis of strengths, weaknesses, opportunities and threats with regard to malaria programme management	
progress and performance of malaria programme management in achieving annual and strategic targets	
key issues, challenges and problems in malaria programme management for scaling-up delivery	
suggested solutions and priorities for action in malaria programme management and supporting research	
analysis of strengths, weaknesses, opportunities and threats with regard to malaria commodities management	
progress and performance in malaria commodities management in achieving annual and strategic targets	
key issues, challenges and problems in malaria commodities management	
suggested solutions and priorities for action in malaria commodities management and supporting	

Annex (8): In-depth Interview tool for Malaria programme director and programme staff for Malaria Case Management Theme

1. Strengths, Weaknesses, Opportunities and Threats Analysis

Question / Indicator	Response
What are the strengths, weaknesses, opportunities and threats with regard to malaria case management and prevention?	
Do you think there is any progress and performance in malaria case management delivery?	
State the key issues, challenges and problems in malaria case management and prevention	
Write down any suggested solutions and priorities for action in malaria case management and prevention?	
Ask and write suggested solutions and priorities for action in prevention and treatment delivery and supporting operational research	

2. Interview and Verify the availability of the following:

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Describe the structure and functions of national and sub national malaria control programme in relation to case management											
Describe delivery structure and functions of malaria programme at health unit level											
Describe malaria control programme activities at community level and structure and functions.											
State if there is national malaria laboratory specialist											
Verify if there is malaria case management specialist											
State if there are national treatment focal points working on malaria case management: pediatrician, obstetrician, general physician, pharmacist											
State if there is functioning national malaria case management committee											
State if there are officers and focal points responsible for malaria diagnosis and treatment at community, locality, state and national levels											
State if there is malaria commodity and logistic system showing (annual requirements, safety stocks, time and quantity for reordering)											
State if there is management and distribution system for antimalarials medicines and diagnostics materials.											

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	201
Describe the main areas for training in malaria case management											
State the type of health workers targeted by training on case management, what are the training methods.											
Describe the key messages, media being used with regard to malaria diagnosis and treatment											
Describe the methods applied for community involvement and mobilization with regard to diagnosis and treatment											
State if there is sentinel sites for monitoring malaria treatment failure, antimalarial drug resistance and checking quality and stability of antimalarial drugs.											
State if there is principal researchers and research teams on diagnosis and treatment for malaria parasite control at state and field levels.											
State if there is regional and international collaboration in research on diagnosis and treatment.											
Describe the main areas for training in malaria case management											
State the type of health workers targeted by training on case management, what are the training methods.											
Describe the key messages, media being used with regard to malaria diagnosis and treatment											
Describe the methods applied for community involvement and mobilization with regard to diagnosis and treatment											
State if there is sentinel sites for monitoring malaria treatment failure, antimalarial drug resistance and checking quality and stability of antimalarial drugs.											
State if there is principal researchers and research teams on diagnosis and treatment for malaria parasite control at state and field levels.											
State if there is regional and international collaboration in research on diagnosis and treatment.											
Describe the main areas for training in malaria case management											
State for the target for pregnant women at risk of severe malaria per states											
State if services provided for pregnant women in antenatal clinics											
methods for institutional collaboration on reproductive health, making pregnancy safer and HIV prevention programmes											
State if there is functioning national subcommittee on prevention and treatment of malaria in pregnancy											
State if there is link/coordination with guidelines for reproductive health, making pregnancy safer and HIV prevention											

Annex (9): In-depth Interview tool for Malaria programme director and programme staff for Surveillance and Monitoring & Evaluation system and Operational Research

Question / Indicator	Response
Strengths, weaknesses, opportunities and threats with regard to malaria surveillance, information, surveys and operational research	
Progress, performance and key achievements of the surveillance, monitoring and evaluation operational research system	
Key issues, challenges and problems in malaria surveillance, monitoring, evaluation and operational research	
Suggested solutions and priorities for action in the area of malaria surveillance, information, surveys and operational research	
Strengths, weaknesses, opportunities and threats with regard to malaria epidemics and emergencies	
Progress, performance and achievements in malaria epidemics and emergencies	
Key issues, challenges and problems in malaria epidemics and emergencies	
Suggested solutions and priorities for action in malaria epidemics and emergencies, including supporting operational research	

Annex (10): Interview Guide

- You must notify the participant about the objectives of the MPR of NMCP
- Written informed consent must be taken prior to the interview
- You must conduct the interview in a room suited for that purpose
- Interview should be held without interruption during a single session
- The interview must be recorded by a high-quality audio recording
- Document the **respondent** name and position at the beginning of the interview
- Write a code for the interview
- The complete recording of the interview must be delivered only to an authorized representative of the Public Health Institute

Interview Questions:

Basic Data:

1. Name:
2. Position:
3. Total number of years of work at the NMCP

Questions about Management and Supplies:

4. Do you have national policies of the NMCP?
5. Do you regularly receive the changes in the national policies? How frequent?
6. Are there any legal or legislative impediments/ obstacles that restrict the activities of the program? Specify?
7. Is there clarity in defining the terms of reference and responsibilities of the program within the Ministry of Health?
8. Is there clarity in defining the terms of reference and responsibilities within the malaria program?
9. How effective is the applied management system? Explain?
10. Do you have a system of follow-up? Explain?
11. How regular are the follow-up meetings?
12. Is there documentation and archiving system for these meetings?
13. How is the coordination between the specialized committees and working groups within the program?
14. Do you have trained staff in program or project management? How many?
15. Do you have a system to determine the required quantities of materials and equipment? Explain?
16. How effective is this system?
17. Do you have a system for the provision of materials and equipment? Explain?
18. How effective is this system?
19. Do you have staff responsible for the provision of materials and equipment?
20. Do you have specific agencies to provide these materials and equipment? Explain?
21. How reliable are these agencies?
22. Do you have a system to transport the materials and equipment? Explain?
23. How effective is this system?
24. Do you have a system for the storage of these materials and equipment? Explain?
25. How effective is this system?
26. Do you have a system for distribution of materials and equipment? Explain?
27. How effective is this system?
28. Do you have a system to get rid of the expired materials and equipment? Explain?
29. How effective is this system?
30. Is there a division of roles and responsibilities with the partner organizations in the program? Explain?

31. Is there a division of roles and responsibilities with partners in the private sector? Explain?
32. Is there a division of roles and responsibilities with other partners in the community? Explain?
33. How effective are the existing partnerships?
34. Do you have any successful experiences in the field of management and provision of supplies you would like to tell us about it?
35. Do you have any unsuccessful experiences in the field of management and provision of supplies you would like to tell us about it?
36. Do you have any other information in the field of management and provision of supplies you would like to tell us about it?

Questions about Malaria Vector Control (Mosquitoes):

37. Do you have policies, guidelines or protocols on vector control?
38. If yes: Does these documents contain separate specific section on larva control?
39. Is there an internal review of the degree of your compliance with the policies or guidelines or protocol on the vector control?
40. Is there an external review of the degree of your compliance with the policies or guidelines or protocols on the vector control?
41. Do you have a unit or a subcommittee or working group for the vector control?
42. If the answer is yes: Does this unit or sub-committee or working group have specific tasks? What are these tasks?
43. Do you have qualified or trained personnel in the field of vector control? How many are these employees?
44. Did any of your staff participated in training courses in the field of vector control during the past three years? How many are these employees?
45. Are there training courses in the field of vector control that are held regularly / periodically?
46. Did the participation in the training courses in the field of vector control have positive impact on vector control activities?
47. Do you have specific sentinel sites to collect accurate and current data on the vector?
48. Do you have any information/data on the sites/locations of the vector?
49. Do you have any data on the breeding sites of the vector?
50. Do you have any data on the prevalence of the insecticides resisting vector?
51. Have you during the past three years conducted any research on the vector?
52. How many campaigns to spray the flying vector by chemical insecticides have you made in the past year?
53. What is the extent of community participation in the campaigns to spray flying vector by chemical insecticides that you made in the past year?
54. What is the current percentage of coverage of the state or region with the program of larva control?
55. Who are your partners from the community, organizations, and the private sector in the vector control?
56. What are the roles of these partners?
57. How many LLIN that you have distributed the last year?
58. How many ITNs that you have distributed the last year?
59. Did you distribute LLINs to pregnant women? Where?
60. What is the current ratio of population coverage with LLIN?
61. What is the current ratio of population coverage with ITNs?
62. What is the percentage of the population that properly uses LLINs in your opinion?
63. Do you have any success experiences in the field of vector control you would like to tell us about?
64. Do you have any failure experiences in the field of vector control you would like to tell us about?
65. Do you have any other information in the field of vector control you would like to tell us about?

Questions about the IEC activities:

66. Do you have policies, guidelines or protocols on IEC activities?
67. Is there an internal review of the degree of your compliance with the policies or guidelines or protocols on IEC?
68. Is there an external review of the degree of your compliance with the policies or guidelines or protocols on IEC?

69. Do you have a unit or a subcommittee or working group for the IEC?
70. If the answer is yes: Does this unit or sub-committee or working group have specific tasks? What are these tasks?
71. Do you have materials for IEC? What is the type of these materials?
72. What type of mass media do you use in IEC?
73. How many hours of broadcasting on radio and television were devoted to malaria last year?
74. Who are your partners from the community, organizations, and the private sector in IEC?
75. What are the roles of these partners?
76. How many public meetings that you organized for IEC last year?
77. How many participants approximately were in these meetings?
78. Have you organized special IEC meetings for pregnant women last year? How many?
79. Do you have any successful experiences in the field of IEC you would like to tell us about?
80. Do you have any failure experiences in the field of IEC you would like to tell us about?
81. Do you have any other information in the field of IEC you would like to tell us about?

Questions about Case Management:

82. Do you have protocols/ guidelines on the diagnosis and treatment of malaria cases?
83. Isothere an internal review of the degree of your compliance with the protocols on case management?
84. Is there an external review of the degree of your compliance with the protocols on case management?
85. Do you have protocols on case management for pregnant women?
86. Do you have a unit or a subcommittee or working group especially for case management?
87. If the answer is yes: Does this section or this sub-committee or working group have specific tasks? What are these tasks?
88. Do you have a plan of action for training in case management?
89. Do you have training materials for case management?
90. How many of your staff and the staff of the State Ministry of Health received training on protocols for case management?
91. Do you have trainers on case management? How many?
92. Have you organized workshops or courses on case management for health cadres last year?
93. If the answer is yes: How many were these courses? How many participants were enrolled?
94. Are there training courses in the field of case management that are held regularly / periodically?
95. Did participation in training courses on case management have positive impact on cases management?
96. Do you collect data periodically on case management?
97. Did you conduct studies on the effectiveness of case management?
98. If yes, describe how did you conduct these studies? What are the results?
99. Do you have the necessary materials and equipment for the diagnosis?
100. If there is shortage in this field identify its type and causes?
101. Do you have the necessary materials and equipment for the treatment?
102. If there is shortage in this field identify its type and causes?
103. Who are your partners from the community, organizations, and the private sector in the field of case management?
104. What are the roles of these partners?
105. Do you have any successful experiences in the field case management you would like to tell us about?
106. Do you have any failure experiences in the field of case management you would like to tell us about?
107. Do you have any other information in the field of case management you would like to tell us about?

Questions about Epidemiology:

108. Do you collect data on the prevalence of the disease?
109. To what extent this data covers all cases of disease in your area?

110. How accurate and valid are these data?
111. Are there periodic collection and analysis of this data? Do you have weekly or monthly summary reports of these data?
112. Are these data used in the planning of future activities of malaria control?
113. Are these data used in the assessment of ongoing activities of malaria control?
114. Do you have a surveillance system? How effective is this system?
115. Does this surveillance system provide a weekly report on the spread of the disease in the epidemic season?
116. Does this surveillance system provide information about the weather/ climate?
117. Do you have periodic reporting of epidemiological indicators in your areas?
118. Do you have periodic reporting of deaths from malaria in governmental health facilities?
119. Do you have periodic reporting of deaths from malaria outside government health facilities? Explain?
120. Do you have a map or detailed reports on the epidemic distribution within your area?
121. Do you have a system of periodic renewal of information about the epidemic areas?
122. Do you have a unit or a subcommittee or working group for the surveillance system?
123. If the answer is yes: Does this unit or sub-committee or working group have specific tasks? What are these tasks?
124. Do you have a trained staff in the field of surveillance system? How many?
125. Who are your partners from the community, organizations, and the private sector in the field of surveillance system?
126. What are the roles of these partners?
127. Do you have a system for rapid response to an epidemic? Can you describe this system?
128. To what extent can this system respond within a week to the reported cases?
129. Do you have any successful experiences in the field of epidemiology you would like to tell us about?
130. Do you have any failure experiences in the field of epidemiology you would like to tell us about?
131. Do you have any other information in the field of epidemiology you would like to tell us about?

Questions about Emergency Preparedness:

132. Do you have an emergency action plan?
133. Do you have an expanded emergency committee?
134. Do you have emergency working groups?
135. Do you have an employee responsible for the coordination of emergencies?
136. Do you have a trained staff in the field of emergency? How many?
137. To what extent do you have available materials and equipment for emergencies?
138. If there is shortage in this field identify its type and causes?
139. Who are your partners from the community, organizations, and the private sector in the field of emergency?
140. What are the roles of these partners?
141. Do you have any successful experiences in the field of emergency you would like to tell us about?
142. Do you have any failure experiences in the field of emergency you would like to tell us about?
143. Do you have any other information in the field of emergency you would like to tell us about?

Other Information and Comments:

144. Do you have any other information or comments?

Annex (11): Focus Group Discussion Guide

General Instructions:

- You must notify participants about the objectives of the audit for the national malaria control program.
- Consent forms should be completed in advance.
- Discussion should be held in a suitable room and without interruption during the interview.
- The discussion must be recorded by a high-quality audio recording.
- Name of the group must be mentioned and recorded at the beginning of the discussion
- Write the predefined code of each discussion group at the beginning of the discussion.
- Audio records of the discussion should be given only to authorized representative of the Public Health Institute.

Focus Group Discussion (FGD):

• Moderator tasks are:

- Promoting and guiding the discussion
- Make sure that everyone is participating in the discussion and no one is
- Resolving conflicts and moves the discussion tactfully forward also to convey it back to the point when it is drifted to other irrelevant topics.
- Start by welcoming the participants and introduce yourself.
- For icebreaking, ask each participant in the group to give a brief introduction to introduce himself.
- Take notes and record the discussion in the recording device.
- Written consent forms should be completed before initiated.
- Start by explaining the purpose of the discussion and why the participants had been chosen:
"Thank you for agreeing to participate, and we are very interested to hear your opinions on the work of the malaria control program ...
The purpose of this study is to review the work and evaluation of the program
Information that you provide to us is completely confidential, and we will not associate your name with anything you say in the discussion. "
We would like to inform you that the discussion will be recorded on tape so we can make sure all the ideas are documented. These tapes will be destroyed as soon as possible. You have the right to refuse to answer any question or to withdraw from the discussion at any time. All the information will be kept confidential. And we ask participants to respect each other's confidentiality.
- We have basic rules and general guidelines for discussion such as the importance that everyone talks frankly, and avoid talking at one time, and must remain the information provided in the group confidential, and must stay with the team, and please do not hold side conversations, turn off phones if possible, and be a moderator ready to interrupt to make sure that all topics were covered.
- Then, Introduce the MPR protocol summary to the participants and the seven domains.

Probing Points:

Prompts for the interviewer:

Please ensure the respondent covers these domains:

- Policies, guidelines, plan, protocols and M&E reporting and indicators
- Staff recruitment and staff capacities including training
- Vector maps and link to surveillance and research
- Interventions for vector control (LLINs, IRS, integrated vector control)
- Partnerships

Section One: Programme Management

What are the Strengths of the Malaria Control Programme with regards to programme management?

What are the Opportunities for the Malaria Control Programme with regards to programme management?

What are the Weaknesses of the Malaria Control Programme with regards to programme management?

What are the Threats to the Malaria Control Programme with regards to programme management?

Section Two: Programme Supplies

From your work, what are the Strengths of the Malaria Control Programme with regards to programme supplies?

From your work, what are the Opportunities for the Malaria Control Programme with regards to programme supplies?

From your work, what are the Weaknesses of the Malaria Control Programme with regards to programme supplies?

From your work, what are the Threats to the Malaria Control Programme with regards to programme supplies?

Section Three: Epidemiology and Programme Impact

What are the Strengths of the Malaria Control Programme with regards to epidemiology and programme impact?

What are the Opportunities for the Malaria Control Programme with regards to epidemiology and programme impact?

What are the Weaknesses of the Malaria Control Programme with regards to epidemiology and programme impact?

What are the Threats to the Malaria Control Programme with regards to epidemiology and programme impact?

Section Four: Vector control

From your work, what are the Strengths of the Malaria Control Programme with regards vector control?

From your work, what are the Opportunities for the Malaria Control Programme with regards vector control?

From your work, what are the Weaknesses of the Malaria Control Programme with regards vector control?

From your work, what are the Threats to the Malaria Control Programme with regards vector control?

Section Five: Case management

What are the Strengths of the Malaria Control Programme with regards to case management?

What are the Opportunities for the Malaria Control Programme with regards to case management?

What are the Weaknesses of the Malaria Control Programme with regards to case management?

What are the Threats to the Malaria Control Programme with regards to case management?

Section Six: IEC activities

From your work, what are the Strengths of the Malaria Control Programme with regards to IEC activities?

From your work, what are the Opportunities for the Malaria Control Programme with regards to IEC activities?

From your work, what are the Weaknesses of the Malaria Control Programme with regards to IEC activities?

From your work, what are the Threats to the Malaria Control Programme with regards to IEC activities?

Section Seven: Epidemic and Emergency preparedness

What are the Strengths of the Malaria Control Programme with regards to epidemics and emergency preparedness?

What are the Opportunities for the Malaria Control Programme with regards to epidemics and emergency preparedness?

What are the Weaknesses of the Malaria Control Programme with regards to epidemics and emergency preparedness?

What are the Threats to the Malaria Control Programme with regards to epidemics and emergency preparedness?

Section Eight: Wrap up

Finally, do you have any other information we did not cover that you think is relevant to the MPR?

Do you have any success stories to share?

Do you have lessons learnt from failures or things that could be improved?

Do you have any documents that you think we need to have? Please share them with us.

[Thank the respondent(s)]

Annex (12): Stakeholders Interview Guide

1-Name

2-Position

3 – What are your roles in supporting the NMCP?

4 -What are the contributions you have made to this programme during the last three years?

5 - What are the motivating factors for you to support the NMCP?

6 – From your experience, what are the strengths of the NMCP?

7 -From your experience, what are the available opportunities for the NMCP?

8 -From your experience, what are the weaknesses of the NMCP?

9 -From your experience, what are the threats faced by the NMCP?

10 - Do you have any suggestions for the improvement of work and collaboration between you and the NMCP?

Annex (13): List of National Malaria Control Programme Partners

No	Name of Partner	No	Name of Partner	No	Name of Partner
1.	Ministry of Finance	29.	UNICEF	57.	Golden Arrow
2.	Federal Ministry of Foreign Affair	30.	UNEFPA	58.	Shikan for Insurance
3.	Federal Ministry of Interior	31.	UNCHR	59.	CTC Company
4.	Federal Ministry of Agriculture	32.	HAC	60.	Remote Sensing Admin (U of K)
5.	Federal Ministry of Industry	33.	CORE	61.	Ginko
6.	Federal Ministry of Irrigation	34.	United Nation	62.	DAL for Food
7.	Islamic Development Bank	35.	CDF World Bank	63.	Nafidi Group
8.	General Administration of Taxation	36.	Plan Sudan Organization	64.	Youth against Malaria
9.	Custom Duties	37.	Hippocrates Co.	65.	Bucham Co.
10.	General Corporation of Measuring & Specification	38.	De-Tasi Group	66.	Binton Co.
11.	General Corporation of Metrology	39.	Canar Co.	67.	Elray Elam Newspaper
12.	General Corporation of Health Insurance	40.	MTN Co.	68.	Elahdath Newspaper
13.	General Corporation of Medical Supply	41.	Sudani Co.	69.	Elsahafa Newspaper
14.	National Medicine & Poison Board	42.	Thabit Co.	70.	Akhar Lahtha Newspaper
15.	Water Corporation	43.	Zain Co.	71.	Sudan Vision Newspaper
16.	Health & Emergency of Military Corps	44.	Afnan Co.	72.	Elahram Elyouam Newspaper
17.	Social & Saving and Development Bank	45.	Bancare Organization	73.	Elwatan Newspaper
18.	Social Insurance	46.	SIDO Organization	74.	Elgareda Newspaper
19.	Bank of Sudan	47.	GOAL Organization	75.	Rawa Co.
20.	Financial & Investment Bank	48.	MSF Spanish	76.	Elgabab Co.
21.	Sennay International	49.	Belgium	77.	Basgat Co.
22.	General Corporation of Radio	50.	SECS Organization	78.	Mashoair Group
23.	General Corporation of Sudan TV	51.	M&M. Farma		
24.	Ashorooq TV	52.	Elie Group		
25.	Blue Nile TV	53.	Amifarma Co.Ltd		
26.	National Council for Insecticides	54.	Nabil Business		
27.	WHO	55.	Sanofi Aventis		
28.	UNDP	56.	Novartis		