THE EFFECTIVENESS OF HOME BASED MANAGEMENT OF UNCOMPLICATED MALARIA USING ARTEMISININ COMBINATION TREATMENTS (ACTs) AND RAPID DIAGNOSTIC TESTS (RDTs) IN RURAL SENEGAL (WEST AFRICA):
PILOT STUDY IN THREE DISTRICTS

AN ABSTRACT
SUBMITTED ON THE FOURTEEN OF APRIL 2015
TO THE PAYSON CENTER FOR INTERNATIONAL DEVELOPMENT
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
OF THE SCHOOL OF LAW OF TULANE UNIVERSITY
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY BY

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**Introduction:** The Home-based Management of Malaria (HMM) is a cornerstone of malaria control in sub-Saharan Africa (SSA) and is recommended by WHO to provide prompt access to antimalarial treatment for children in under-served areas. Although HMM has been shown to reduce malaria morbidity and mortality with chloroquine, it has not been examined previously in the era of artemisinin-based combination therapies. The objectives of this study were to determine whether HMM reduced: 1] the time from when a mother or guardian realized her child was ill to the time when the child was brought for treatment and 2] malaria morbidity in children less than 5 years of age.

**Methodology:** This cross-sectional retrospective study (2008-2014) was performed in intervention villages (receiving HMM) and control villages (not receiving HMM) to examine the effectiveness of HMM.

**Key Results:** More mothers and guardians were informed about the malaria control activities performed (98% vs. 24%) in intervention than control villages ($p < 0.001$). Consistent with that result, mothers and guardians in intervention villages sought care for their sick children earlier than mothers in control villages ($p < 0.001$) and were more likely to obtain treatment from community health workers (CHWs) in their home villages. In contrast, more children were referred for malaria treatment to health posts and health centers from control than intervention villages ($p < 0.001$). Likewise, more children with complicated malaria were referred for treatment from control villages ($p < 0.001$), although those conclusions were limited by the small numbers of complicated (severe) malaria cases.
Conclusions: These results indicate HMM shortens the time mothers wait before taking their children to receive treatment. Because more children with uncomplicated or complicated malaria are referred for treatment from control than intervention villages, these results indicate that the availability of HMM treatment in the child’s home village reduces morbidity (the risk of severe malarial disease). However, additional studies with larger numbers of subjects will be necessary to determine if HMM reduces mortality.
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Acknowledgments

In Senegal, I am pleased to acknowledge my gratitude to the Ministry of Health, the Manager of the Senegal National Malaria Control Programme (Dr. Mady Ba) and his colleagues, the Heads of the Medical Districts where these studies were performed (Dioffior, Mékhé and Ranérou (Drs. Mama Moussa Diaw, Moustapha Amdy Faye and Hamady Ba) and the Directors of the Institute for Health and Development (Institut de Santé et Developpement) at the University Cheikh Anta Diop (UCAD) in Senegal (Professors Issakha Diallo and Anta Tal Dia).

In the United States, these studies were supported by the Payson Center at Tulane University, especially by Dr. Eamon Kelly, who provided a doctoral fellowship to support these studies in New Orleans and by Sheila Favalora who provided guidance on numerous occasions. In addition, the thesis research was guided by the individual members of the thesis committee: William E. Bertrand, Nancy B. Mock, Thomas P. Eisele, Joseph Keating, Janet Rice and Donald J. Krogstad.

I would like to express special thanks to my Chair, Dr. Donald Krogstad, who provided me wonderful support during the writing process. I wish for him a long, healthy and happy life. The lessons I have learned from him will help me transmit the knowledge and skills acquired from this research to future African leaders and contribute to African development.
Foreword

In 2008, the National Malaria Control Programme (NMCP) of Senegal performed a pilot study of the home-based management of malaria (HMM) in 20 villages each more than 5 km from the nearest health center in which it was difficult to obtain health care during the rainy season. Review of those results in 2009 revealed that: 1) community health workers (CHWs) performed and interpreted rapid diagnostic tests (RDTs) for malaria correctly and administered oral treatment with artemisinin combination therapies (ACTs) effectively and 2) the use of CHWs to perform these tasks was readily accepted by their communities. Based on the feasibility of this approach in those health districts (Mékhé, Dioffior, Ranérou), the NMCP scaled up the use of HMM from 20 to 1,000 villages across Senegal in 2014. Thus, although the pilot study confirmed the feasibility of this approach in Senegal, it did not answer the original questions: 1] whether HMM reduced the time from the recognition of illness to the time of seeking care and treatment? and 2] whether HMM reduced malaria morbidity? The purpose of the studies performed in this thesis research project was to answer those questions, especially for children less than five years of age, who are among the most vulnerable in the population.

We thank the Ministry of Health, especially the NMCP manager and the heads of the three medical districts who supported us during the process of collecting, analyzing and interpreting these data.
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<td><em>Plasmodium vivax</em> Blood Stages</td>
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<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>Artemether</td>
</tr>
<tr>
<td>ACT</td>
<td>Artemisinin Combination Treatment</td>
</tr>
<tr>
<td>AQ</td>
<td>Amodiaquine</td>
</tr>
<tr>
<td>AS</td>
<td>Artesunate</td>
</tr>
<tr>
<td>BCC</td>
<td>Behaviour Change Communication</td>
</tr>
<tr>
<td>CBO</td>
<td>Community Based Organization</td>
</tr>
<tr>
<td>CCHW</td>
<td>Community Care Health Worker</td>
</tr>
<tr>
<td>CHW</td>
<td>Community Health Worker</td>
</tr>
<tr>
<td>CM</td>
<td>Case Management</td>
</tr>
<tr>
<td>CMDs</td>
<td>Community Medicine Distributors</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>CQ</td>
<td>Chloroquine</td>
</tr>
<tr>
<td>DALY</td>
<td>Disability Adjusted Life Year</td>
</tr>
<tr>
<td>df</td>
<td>Degrees of Freedom (statistical calculations)</td>
</tr>
<tr>
<td>EIR</td>
<td>Entomological Inoculation Rate</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>HC</td>
<td>Health Center</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>HMM</td>
<td>Home-based Management of Malaria</td>
</tr>
<tr>
<td>HOMOPAK</td>
<td>Home and Package (antimalarial drug)</td>
</tr>
<tr>
<td>HP</td>
<td>Health Post</td>
</tr>
<tr>
<td>HRP2</td>
<td>Histidine Rich Protein 2</td>
</tr>
<tr>
<td>hrp2</td>
<td>Gene coding for histidine rich protein 2</td>
</tr>
<tr>
<td>hrs</td>
<td>Hours</td>
</tr>
<tr>
<td>iCCM</td>
<td>Integrated Community Case Management</td>
</tr>
<tr>
<td>IMCI</td>
<td>Integrated Management of Childhood illness</td>
</tr>
<tr>
<td>ITN</td>
<td>Insecticide Treated (Bed) Net</td>
</tr>
<tr>
<td>IPTp</td>
<td>Intermittent Preventive Treatment in Pregnancy</td>
</tr>
<tr>
<td>iRBCs</td>
<td>Infected Red Blood Cells</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>IRS</td>
<td>Indoor Residual Spraying</td>
</tr>
<tr>
<td>ISED</td>
<td>Institut de Sante et Developpement</td>
</tr>
<tr>
<td>L</td>
<td>Lumefantrine</td>
</tr>
<tr>
<td>LLIN</td>
<td>Long Lasting Insecticidal (bed) Net</td>
</tr>
<tr>
<td>MDG</td>
<td>Millenium Development Goal</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
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<tr>
<td>NGO</td>
<td>Non-Government Organization</td>
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<tr>
<td>NMCP</td>
<td>National Malaria Coordination Programme</td>
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<tr>
<td>OR</td>
<td>Odds Ratio</td>
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<tr>
<td>OTC</td>
<td>Over the counter (drugs)</td>
</tr>
<tr>
<td>PCR</td>
<td>Polymerase chain reaction</td>
</tr>
<tr>
<td>PPT</td>
<td>Pre Packaged (unit dose antimalarial) treatment</td>
</tr>
<tr>
<td>NMCP</td>
<td>National Malaria Coordination Programme</td>
</tr>
<tr>
<td>OR</td>
<td>Odds Ratio</td>
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<tr>
<td>OTC</td>
<td>Over the counter (drugs)</td>
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<tr>
<td>PCR</td>
<td>Polymerase chain reaction</td>
</tr>
<tr>
<td>PPT</td>
<td>Pre Packaged (unit dose antimalarial) Treatment</td>
</tr>
<tr>
<td>RBM</td>
<td>Roll Back Malaria</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomized Controlled (Clinical) Trial</td>
</tr>
<tr>
<td>RDT</td>
<td>Rapid Diagnostic Test (for malaria)</td>
</tr>
<tr>
<td>SMC</td>
<td>Seasonal Malaria Chemoprevention</td>
</tr>
<tr>
<td>SSA</td>
<td>Sub Saharan Africa</td>
</tr>
<tr>
<td>TDR</td>
<td>WHO Special Programme for Research and Training in Tropical Disease Research (TDR)</td>
</tr>
<tr>
<td>TTT</td>
<td>TreatMenT</td>
</tr>
<tr>
<td>UCAD</td>
<td>University Cheikh Anta Diop (Dakar, Senegal)</td>
</tr>
<tr>
<td>WAHO</td>
<td>West African Health Organization</td>
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<tr>
<td>WBI</td>
<td>World Bank Institute</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>WMR</td>
<td>World Malaria Report</td>
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Chapter I: Introduction to the Home-based Management of Malaria (HMM) in rural Senegal

1.1 Statement of the Problem

The home-based management of malaria (HMM) has been shown to reduce malaria morbidity and mortality with chloroquine. However, it has not been examined in the era of artemisinin-based combination therapies. Therefore, the goal of these studies was to examine the effect of HMM on malaria morbidity and mortality in rural Senegal where ACTs are now used for the treatment of malaria. According to Pagnoni (1), the evidence gaps that must be addressed to evaluate the role of HMM in the era of ACT treatment include:

- Feasibility and acceptability of integrating ACTs into HMM,
- Effectiveness of ACT treatment in HMM,
- Use of rapid diagnostic tests (RDTs) with HMM to avoid wide-spread presumptive use of ACTs,
- Incentives to provide CHWs and other health care providers with adequate remuneration for their work and ensure some uniformity of working conditions at the community level.

1.2 Study Objectives and the Importance of the Proposed Research
The purpose of this proposal is to examine the effectiveness of HMM using ACTs and RDTs in rural Senegal, six years after the pilot study started. There were two main objectives in this study:

1. **Time to seek care for children with fever**: The *first* objective was to determine whether HMM improved malaria outcomes, as exemplified in this objective by the time required for a mother or other caregiver to seek care for her child after she recognized that her sick child had a fever.

2. **Reducing Morbidity and Mortality**: The *second* objective was to determine whether HMM decreased either the frequency of severe malaria or the malaria death rate among children < 5 years of age.

The *underlying hypothesis* for the first and second objectives is that malaria morbidity and mortality among children < 5 years of age should decrease if mothers (and other caregivers) in intervention villages recognize fever more rapidly in their children and bring sick febrile children to health posts and Health centers for treatment more rapidly than mothers and caregivers in control villages (Figure 1, below).
1.3 Geography and Population of Senegal
Senegal is situated on the Atlantic coast of West Africa and has land borders with Mauritania, Mali, Guinea and Guinea Bissau. Senegal surrounds Gambia on three sides with the Atlantic Ocean on its fourth (western) side. Northwestern Senegal is Sahelian semi-desert and central and southern Senegal are open savannah. In contrast, the Casamance region south of The Gambia is covered by dense sub-tropical vegetation. The climate of Senegal is tropical with a rainy season from June to November and a dry season from December to May. Most malaria transmission is from August to December. *Plasmodium falciparum* is the most common malaria parasite and is transmitted by three species of the *Anopheles gambiae* complex. The population of Senegal was estimated at 14 million in 2014 of whom 16.5% were children < 5 years of age and had an estimated annual growth rate of 2.4% (Table 1, below).
Table 1: Endemicity and Burden of Malaria in Senegal
Source: World Malaria Report, 2013 (3)

<table>
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<th>Thousands</th>
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<tr>
<td>&lt; 5 years of age</td>
<td>2,406</td>
<td>19</td>
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<tr>
<td>≥ 5 years of age</td>
<td>11,343</td>
<td>81</td>
</tr>
<tr>
<td>Persons of all ages</td>
<td>13,749</td>
<td>100</td>
</tr>
<tr>
<td>Prevalence of positive thick smears</td>
<td></td>
<td></td>
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<tr>
<td>High (&gt; 1 per 1,000 persons by microscopy)</td>
<td>13,200</td>
<td>96</td>
</tr>
<tr>
<td>Low (0-1 per 1,000 persons by microscopy)</td>
<td>549</td>
<td>4</td>
</tr>
<tr>
<td>Parasite species found in humans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. falciparum</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>P. vivax</td>
<td>0%</td>
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</tr>
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1.4 The Senegal Health System

The Senegal health system is organized as a referral pyramid with three levels: 1] community level: Health Posts in communities and one or more Health Centers in each of the 74 health districts in Senegal, 2] regional level: one government-supported Regional Hospital in each of the 14 administrative regions of Senegal and 3] national level:

1. Health Districts (District Sanitaire). There are 74 health districts in Senegal, each of which has a network of health posts (postes de santé) and at least one Health Center (centres de santé). The District Health Centers have both outpatient and inpatient care facilities. They are responsible for the coordination of all government-supported health facilities in each district and for the implementation, monitoring and evaluation of all health programs in their district. Health Posts are located at the community level in urban areas and in the most populous rural villages. In more rural (less populous) communities, preventive and curative health care and referrals for more complicated problems are provided by community health workers (CHWs) at Health Huts (cases de santé).
2. **Regional Level** (Régions médicales). There are 14 administrative regions in Senegal, each of which has a government-supported Regional Hospital. These regional hospitals provide primary, secondary and tertiary inpatient and outpatient care. To complement this network of regional hospitals, the regions of Dakar, Diourbel and Saint-Louis have additional government-supported hospitals linked to universities and private institutions, for a total of 20 referral (secondary and tertiary care) hospitals in Senegal. However, the catchment areas for these hospitals are not well defined and individual patients are not required to use a specific regional hospital based on where they live.

3. **National Level.** The highest (national) level includes the Ministry of Health (MOH) and the National Institute of Health Research. The MOH sets overall health priorities for Senegal and is responsible for ensuring that diagnosis and treatment for priority diseases is available to as many people as possible. The National Institute for Health Research performs applied and basic research to improve the diagnosis, treatment and outcomes for the priority conditions identified by the MOH.

1.5 **Malaria Surveillance in Senegal**

Malaria surveillance is based on the regular collection of malaria morbidity and mortality records from all health districts, health centers, health posts and a number of health huts (cases de santé). A software program (RBMME=Roll-Back Malaria Monitoring Evaluation) for electronic reporting was introduced in 2005 and is currently available in all health districts and hospitals.
1.5.1 Malaria Epidemiologic Profile for Senegal.

Malaria is endemic throughout Senegal with seasonal transmission from June to November. Most cases of uncomplicated malaria are thought to be caused by *P. falciparum*, which is consistent with the high positivity rate for rapid diagnostic tests (RDTs) based on the histidine-rich protein 2 produced by *P. falciparum*. Since the introduction of HRP2-based RDTs in 2007, 96.5% of symptomatic individuals tested have been RDT-positive (4,5). As a result, the number of malaria cases reported each year to the National Malaria Control Programme (NMCP) has decreased from an average of 1.2 million in 2000–2006 to 701,460 in 2008 and 265,624 in 2014 (decreases of 42% and 62%, respectively) (4,5).

At the same time, the fraction of children with uncomplicated malaria among all outpatient visits for children less than 5 years of age decreased from 3.7% in 2008 to 1.9% in 2014. Likewise, the frequency of malaria as a cause of death for inpatients less than 5 years of age decreased from 11.1% in 2008 to 5.0% in 2014. Similar trends are apparent across all age groups in Senegal from 2008 to 2014 (6-9).
Chapter II: Background and Significance

2.1 Global Malaria Burden

Malaria is an internationally devastating disease affecting 97 countries and territories which means that half the world’s population is at risk (3.2 billion) (10). However, the burden of malaria is concentrated in sub-Saharan Africa. In 2012, there were an estimated 198 million cases of malaria, 81% of which were in sub-Saharan Africa. Likewise, 90% of the 600,000 malaria deaths across the globe were in sub-Saharan Africa and 78% were in children less than 5 years of age (10). Thus, the burden of this disease falls disproportionately on children below the age of five years in sub-Saharan Africa. As a result, 30% of the mortality in sub-Saharan Africa is attributable to malaria. Of the five species of Plasmodium that infect humans, *P. falciparum* accounts for most morbidity and mortality globally and is transmitted through the bite of the female Anopheles mosquito.

2.2 History of Malaria as a Human Pathogen

Malaria, which is a mosquito-borne protozoan disease, is older than recorded history and likely plagued prehistoric humans. The first record of treatment for malaria is from 1600 A.D. in Peru and used the quinine-rich bark of the cinchona tree (11). Malaria was recognized clinically by Greek and Roman physicians. The French physician Charles Louis Alphonse Laveran first identified the parasite under the microscope in 1880 and both Ronald Ross and Giovanni Grassi recognized the mosquito as the vector of malaria.
in 1897 (11). However, despite enormous efforts to control this disease, malaria remains one of the most important communicable diseases and is clearly the most lethal tropical parasitic disease (12). Approximately 40% of the world’s population lives in tropical and sub-tropical regions where malaria is endemic (12).

2.3 Plasmodia that Infect Humans and the Parasite Life Cycle

Human malaria results from infection with Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, Plasmodium malariae or Plasmodium knowlesi. Plasmodium falciparum causes the vast majority of deaths (13-16). Plasmodium knowlesi is the least common of these infections in humans and is seen primarily in East Asia.

The protozoan Plasmodium is transmitted to humans by mosquitoes of the genus Anopheles. The mosquito ingests the parasite during blood feeding from a human or other vertebrate with sexual stage parasites (gametocytes) in their blood.

The life cycle of Plasmodium is described below (Figure 7). Plasmodium parasites are protozoa of the phylum Apicomplexa (often referred to as sporozoans). These parasites exist in two hosts, have both sexual and asexual stages, alternate between haploid and diploid phases and must be able to survive in both their vertebrate and mosquito hosts. The life cycle of the parasite begins with the bite of an infected female
Figures 3-6: The four plasmodium species encountered on thick blood smears in Africa (13-16).

anopheline mosquito. The mosquito takes her blood meal from a vertebrate host (a human in this case) and injects both anticoagulant proteins and haploid sporozoites into the human blood stream. The sporozoites then travel to the liver within minutes where they
enter hepatocytes (liver cells) and mature. Within hepatocytes, the sporozoites undergo multiple asexual fissions, or schizogony to produce thousands of infective, haploid merozoites (13-16). Those merozoites are then released into the blood stream where they rapidly adhere to and invade host erythrocytes (human red blood cells).

Inside the erythrocyte, merozoites again begin to replicate and divide asexually. Each merozoite gives rise to 6-32 daughter merozoites (13-16) within 24-72 hours, depending on the parasite species. Ultimately the infected erythrocyte lyses and merozoites are released into the bloodstream where they invade additional red blood cells. This asexual cycle of replication continues until the patient dies or replication is slowed by the host immune response or antimalarial drugs. Lysis of erythrocytes with the release of a new generation of merozoites is linked to the periodic/cyclical fevers which are the most striking clinical feature (hallmark) of this disease.

The alternate developmental path for merozoites is differentiation into sexual stage parasites (macrogametocytes and microgametocytes) which do not destroy the erythrocyte while they are in the human host. When these sexual stage parasites are ingested by anopheline mosquitoes, they develop into male and female gametocytes. In the midgut of the mosquito, erythrocytes with gametocytes lyse to release male and female gametes which fuse to produce diploid zygotes (oökinetes). Please note that this is the only diploid stage in the entire life cycle of the Plasmodium parasite. After oökinetes undergo meiosis to form oöcysts, the now haploid oöcysts form haploid sporozoites which then migrate to the salivary gland of the mosquito (10). At that point, the cycle is ready to begin again. To understand the challenges biologists face in controlling this
disease by developing candidate vaccines and drugs, it is essential to understand the complex life cycle of the parasite which is shown below:

Figure 7: Life Cycle of the Malaria Parasite (11,13)

2.4 The Anopheline Mosquito Vector

Anopheles gambiae, Anopheles arabiensis and Anopheles funestus transmit most human malaria parasites and are found in Africa (17). Anopheles gambiae, the best known and most significant of the three, is one of sixty anopheline mosquitoes able to transmit malaria to humans (18). Anopheles gambiae is considered the most important vector in West Africa, because of its relatively long lifespan, anthropophily (preference for human blood meals) and endophily (tendency to bite humans inside their houses).
Adult *An. gambiae* mosquitoes normally rest during the day inside human habitats and emerge to feed at night (19). Their larvae often develop in temporary bodies of water, such as those found near agricultural sites or even in the flooded hoof prints of cattle (20). All these characteristics combine to make *An. gambiae* a highly successful vector in sub-Saharan Africa.

That this behavior is remarkable can be illustrated by comparing entomological inoculation rates (EIRs) for anopheline mosquitoes in Asia or South America to those in sub-Saharan Africa. Based on the EIR (an estimate of how often one person is bitten by infectious mosquitoes), EIRs in Asia or South America rarely exceed 5 infectious bites per person per year. In contrast, EIR estimates in sub-Saharan Africa may be more than 1,000 infectious bites per person per year (21). For example, Greenwood and Mutabingwa (21) have reported that hundreds of mosquitoes typically collect in rooms occupied by humans during a single night in sub-Saharan Africa. In The Gambia, 1-5% of these mosquitoes have sporozoites and are therefore infectious.

**Figure 8:** Photograph of Blood-Feeding *Anopheles gambiae* Mosquito (12)
2.5 The Human Host: *Homo Sapiens*

As noted above, malaria devastates millions of people each year and has been known for millennia. Despite the attempts that have been made to eradicate malaria, the disease burden remains high and the numbers of cases are likely to increase substantially in the future if new control methods are not developed and implemented (12). Aside from the human tragedy this predicts, limited economic growth is an important consequence for many malaria-endemic countries. For example, Gallup and Sachs (22) have reported that economic growth rates were 1.3% lower in malarious than non-malarious countries from 1965-1990. This corresponds to a 50% reduction in the per capita Gross Domestic Product (GDP) (23). In addition, Malaney and Sachs (12) have hypothesized that the relationship between poverty and malaria is reciprocal: that poverty increases malaria and malaria increases poverty. Additional factors that may contribute to increases in malaria include the demands of growing populations in malarious regions, weak public health systems, climate change (24), agricultural practices such as irrigation and dam construction (12) and increasing resistance to antimalarial drugs and insecticides (15).

The fact that malaria is a ‘disease of poverty’ also contributes to its persistence. To examine the impact of disease on human productivity, Kettler and Marjanovic (25) have defined “healthy years” as the years remaining after subtracting the years lost from premature death and the productive years lost because of disease in disability-adjusted life years (DALYs) from the expected life span. Diseases of poverty, such as malaria, human immunodeficiency virus (HIV)/AIDS, tuberculosis, African trypanosomiasis and leishmaniasis are responsible for 14 million deaths each year with 90% of cases in developing nations. They are responsible for half to two thirds of the healthy years
(DALYs) lost in the developing world (27). Yet, these diseases are frequently neglected because of the people they affect.

2.6 Clinical Symptoms, Signs and Syndromes

Most of the morbidity and mortality associated with malaria are caused by the lysis of infected red blood cells (iRBCs) during the asexual reproductive cycle of the parasite. Intense fever, occurring at 24-72 hour intervals is accompanied by nausea, headaches, muscular pain (myalgias), joint pain (arthralgias) and other symptoms. The characteristic fever spike is associated with increases in serum TNF-α levels that result from the release of parasite products during the lysis of infected red cells. Furthermore, a number of potentially fatal complications such as liver failure, renal failure, and cerebral malaria are associated with untreated *P. falciparum* infection. These complications result in large measure from the ability of parasitized red cells to bind to endothelial surfaces. This cytoadherence inhibits circulation and may be associated with localized oxygen-deprivation and hemorrhage.

2.7 The Rationale for Empirical Treatment

Empirical Treatment is usually the first option. In Africa, more than 70% of fever cases in rural areas are self-treated (28). This initial treatment is often empirical (based on symptoms in the absence of a definitive diagnosis) and typically uses drugs purchased in pharmacies on the advice of local pharmacists who procure goods and products for the local population and often recommend specific drugs and doses to their customers (28).
The empirical treatment of fever (in children or adults who have not had either a smear or rapid diagnostic test [RDT]) typically begins one day after the onset of symptoms. Visits to health facilities usually occur only if and after the initial treatment fails. Although most caregivers (especially mothers) realize that drugs bought in local shops are rarely effective, they are often forced to use them because of insufficient time, transportation or money to travel to health centers or hospitals.

As a result, the empirical treatment of fever is often unsuccessful and less than 15% of malaria cases may be treated correctly (28).

In addition, caregivers are often able to recognize symptoms consistent with uncomplicated malaria. However, in one community in Nigeria and two in Ghana (29), cases of uncomplicated malaria cases in children were frequently treated with aspirin or paracetamol but not with antimalarials (> 60% of patients). When antimalarial drugs were used, they were used at inadequate doses in more than 80% of cases (29).

Although the private sector is the major source of these drugs, the information provided about malaria treatment by vendors in the private sector may be inaccurate in up to 75% of cases (29). Insufficient information and financial conflicts of interest in the private sector help to explain why patients are often prescribed insufficient doses of effective drugs and may also receive ineffective or outdated drugs (29).

2.8 Early Treatment prevents Severe Disease and Death

Several studies have shown that the majority of malaria deaths occur within the first 48 hours of hospitalization for complicated or severe malaria (30-32). For this reason, early diagnosis and treatment for uncomplicated malaria may be the most
important strategy for the prevention and reduction of malaria mortality and morbidity. For example, Sirima et al. have shown in Burkina Faso that the rapid implementation of case management for uncomplicated malaria reduces the risk of severe malaria by half (27).

2.9 Home-based Management of Malaria as a Public Health Opportunity

- 50 to 70% of children who die at home had no recourse (access) to health services (27,28, 33-43):
  
  - Studies have shown that HMM decreases the frequency of progression from uncomplicated to severe malaria by > 50% and reduces morbidity in children under five years of age by 40%. In Burkina Faso, a Community Health Worker (CHW) program reduced severe malaria by 50% (27). In Tigray, Ethiopia, a community-based randomized control trial using CHWs reduced under five mortality by 40% in intervention areas compared to control areas without CHWs (28).
  
  - Better utilization of existing antimalarial drugs based on training CHWs and better pre-packaged (unit dose antimalarial) treatment (PPT) improve malaria control (44-48),
  
  - The education of mothers and caregivers about their role in providing antimalarial drugs leads to earlier treatment and thus saves lives (44-48),
  
  - Pre-packaging of unit dose treatments (PPTs) improves the safety and efficacy of antimalarial treatment (44-48) and
  
  - Local medicine sellers, village volunteers and school teachers (after they have been trained) provide an acceptable and efficient means of promoting HMM in local communities under the supervision of public health workers (44-48).
Chapter III: Review of the Literature

3.1 Home-based Management of Malaria: Concepts and Definitions

Although HMM is now an established term, the word ‘home’ is often misunderstood. HMM does not mean that antimalarial medicines are kept in the home waiting for disease to occur. Rather, ‘home’ means ‘close to home,’ so caregivers do not need to walk long distances for their children to receive care at health facilities. Medicines are kept by trained Community Health Workers (CHWs), ready to be provided to caregivers of sick children based on treatment instructions and appropriate counseling. Another goal of HMM is that antimalarial medicines must be available at an affordable price with limited out-of-pocket expenses (33). Thus, the goals of HMM are to provide economical access to antimalarial treatment close to the patients’ and caregivers’ homes.

For these reasons, the Home-based Management of Malaria (HMM) is a cornerstone of malaria control in sub-Saharan Africa and is recommended by WHO to provide prompt access to antimalarial treatment for children in under-served areas. HMM was developed by the World Health Organization and is based on studies supported by the Special Programme for Research and Training on Tropical Diseases (TDR). The goal of those studies was to improve access to life-saving medicines for people suffering from malaria. The HMM strategy was designed for the treatment of children under the age of five in malaria-endemic areas of rural Africa, where a majority of fever cases are due to Plasmodium falciparum malaria and occur during the rainy season. It is based on the hypothesis that adequate treatment delivered at home by caregivers soon after the onset
of symptoms (fever, chills) will reduce malaria morbidity and mortality at low cost and with a low cost–effectiveness ratio (34,35).

HMM is based on four fundamental elements:

1. **Provide effective, pre-packaged (antimalarial) treatment (PPT) which is user-friendly and unit-dosed close to the homes of the children who need it:**
   One of the challenges in large-scale malaria programs is the need to ensure supplies (the availability) of effective drugs. The parent or caregiver must have continuous access to effective drugs close to their homes provided as unit doses that are easy to use (most patients and many parents and caregivers are illiterate). The number of malaria cases treated is higher if pre-packaged drugs are available in the community rather than stored in health facilities at a distance from the village (32).

2. **Develop a network of resource persons (Community Health Workers=CHWs) who function as community medicine distributors (CMDs):**
   These CHWs should be available to dispense PPT to children with uncomplicated malaria in every village. Therefore, CHWs should learn to diagnose uncomplicated *P. falciparum* malaria using Rapid Diagnostic Tests (RDTs), to provide effective treatment and advice on treatment compliance and to recognize and refer children with complicated or severe malaria. CHWs should also be able to provide reports of their activities and to train mothers and other caregivers to provide antimalarial treatment at home. Professional health workers such as nurses at health posts should supervise the CHWs and the coverage, quality,
safety and impact of this strategy should be monitored and evaluated based on WHO guidelines. Specific indicators that should be monitored include positivity and treatment rates (percent positive RDTs for febrile children, percent of uncomplicated malaria cases treated with ACTs), adverse events and both treatment failures (from possible drug resistance) and treatment successes. Substantial effort should be committed to monitoring these data at the community level (32).

3. **Develop and implement a communication campaign** to raise awareness and disseminate health education messages about the correct treatment of malaria (32). The success of this strategy depends on the quality of the communication campaign for behavioral change. Its goal is to change the behavior of mothers and other caregivers in 3 ways:
   a] more rapid recognition of febrile illness in children with shorter times between the recognition of fever and the time when the child is brought for care and treatment,
   b] provide appropriate antimalarial treatment at home for febrile children with positive RDTs and
   c] rapid referral of children with severe or complicated malaria to health centers.

4. **Develop incentives** to retain the interest and participation of the stakeholders in this strategy, recognizing that HMM draws on a mix of resource persons at the community level to serve as CMDs (32). These individuals may include Community Health Workers (CHWs), mothers, private vendors, traditional healers and others. Some of these individuals are willing to serve without
compensation as volunteers, whereas others have financial motivations and needs. Because the lack of incentives (financial or personal) is an important cause of attrition among CMDs, development and testing of incentives that are effective and acceptable in the community are essential to minimize attrition among CMDs which otherwise has the potential to jeopardize the long-term success of HMM.

3.2 Previous Experience with HMM

Because Community Health Workers (CHWs) can provide care for a broad range of health problems, they are used to provide primary and community health care in many countries. CHWs are defined as “health workers carrying out functions related to health-care delivery, trained in some way in the context of the intervention and having no formal professional or paraprofessional tertiary education on [the basis of] which a certificate or degree has been conferred” (32).

In terms of malaria, previous studies have demonstrated that HMM reduces morbidity and mortality. Although HMM has been shown to reduce malaria morbidity and mortality in the chloroquine era, similar studies had not yet been performed in the era of artemisinin-based combination therapies (ACTs) (1).

3.2.1 Roles of Community Health Workers (CHWs) and Community Medicine Distributors (CMDs):

Based on the need for primary care, many countries in Africa have established community-based programs using CHWs to improve access to health care (37). The success of such programs in Asia and Latin America has been largely dependent on their
integration into the health system, with supervisory and administrative support provided by both national health authorities and the local community \((38,39)\).

The strongest evidence for the impact of HMM comes from three recent studies:

- In Tigray, Ethiopia, a community-based randomized controlled trial (RCT) used mother coordinators as CHWs to train, supervise and provide antimalarial medicines to the community. In comparison to control communities, communities with CHW mother coordinators had a 40% reduction in overall mortality among children under-five \((28)\).
- In Burkina Faso, a malaria control program using CHWs and locally prepared unit-dose prepackaged chloroquine produced a 50% reduction in the incidence of severe malaria in intervention communities compared to control communities \((27)\).
- In Zambia, during a seasonal malaria epidemic from May-October 2005, the malaria mortality rate in intervention districts with community health workers was 50% less than in districts without CHWs. During the two-year study period, a community-based approach with CHWs reduced the risk of malaria-related mortality by 37% \((40)\).

Programs conducted in four counties of Liberia \((41,42)\) as part of a project using CHWs to combat childhood communicable diseases reduced both overall mortality and malaria-specific morbidity and mortality. In one of the four counties, the availability of antimalarial drugs in the home increased after three years and all-cause (overall) childhood mortality was reduced by 28% in comparison to baseline \((41)\).

Programs based on CMDs have now been established in Burkina Faso, Eritrea, Ethiopia, Ghana, Nigeria and Uganda \((43)\). In Nigeria, a similar program increased the use of chloroquine for the treatment of children with fever from 36% to 48% \((45)\). These programs, which were based on unit-dose, prepackaged antimalarial medicines, have also
been associated with improved or high levels of adherence to the recommended treatment regimens (46-47).

### 3.2.2 Role(s) of Commercial Medicine Sellers:

There is increasing interest in the role of the private sector in HMM because over-the-counter (OTC) medicines\(^1\) are often used for home treatment, although OTCs may be of poor quality or used inappropriately. Short workshops and the distribution of behavior communication change (BCC) materials through existing medicine suppliers have improved knowledge and practices among trained retailers as measured by surveys of treatment-seeking behavior at household level and retail outlets (48-50).

In Kilifi, Kenya, a workshop-based program improved selling practices among retailers. Accurate information was provided to patients in 86% of consultations and the use of OTC malaria medicines for treatment of fever in children increased fourfold (49). The estimated cost for this program was $18 per outlet per annum. In Bungoma, Kenya, posters on the correct use of medicines distributed through existing supply channels (wholesalers and mobile vendors) reached 25% of the outlets in the district (50,51).

Retail outlet-based social marketing programs for prepackaged malaria medicines are being implemented in a number of countries (Cambodia, Madagascar, Myanmar and Nigeria) and often involve distribution systems in both the public and private sectors, although their impact has not been evaluated.

### 3.2.3 Broad Communication Strategies:

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\(^1\) Over-the-counter medicines refer to medicines available by ordinary retail purchase with no need for a prescription or license
An effective communication strategy is the cornerstone of appropriate HMM (33). This strategy must be multifocal and should target individuals, households and communities as well as health-care facilities, policy-makers and resource providers. It must be designed to improve understanding of the behaviors and practices of individuals as well as the underlying reasons for their adoption, as a basis for reinforcing positive behaviors and modifying or reducing behaviors that are less beneficial.

**Example 1:** In Nigeria, a communication strategy for behavioral change was initiated in both the public and private sectors (45,48). Messages about malaria case management, intermittent preventive treatment during pregnancy (IPTp), insecticide-treated nets and long-lasting insecticidal nets (ITNs, LLINs) were promoted using volunteers, social marketing of unit-doses, prepackaged antimalarial medicines and the training of patent medicine dealers. The channels used included interpersonal communication, traditional communication channels such as “town criers,” local festivals and social marketing through medicine packaging, radio spots and the distribution of booklets to patent medicine dealers. This strategy increased knowledge about the role and benefits of ITNs and LLINs in malaria prevention and increased awareness of the danger signs for malaria and the importance of early treatment with antimalarial drugs. The key successes of this program were: 1] an increased demand for health services, 2] increased access to medicines for the treatment of malaria and 3] community ownership and participation in the program.

**Example 2:** In Ghana, the He Ha Ho (Healthier Happier Home) campaign developed in 2000 by the Ministry of Health in collaboration with the Center for
Communication Programs of Johns Hopkins University\(^2\) \((52-55)\) combined a strong communication strategy with the training of medicine sellers in the appropriate use of chloroquine for treatment of malaria. This campaign made use of mass media (a long-standing radio series and television spots) and print media (leaflets, booklets, posters and reminder cards) and included the training of medicine sellers, medicine sales persons, students and women’s groups. This multi-faceted strategy created a high profile for the program nationally. The radio series and its theme song became popular and increased the appropriate use of chloroquine for the treatment of children with fever. The most important factors in the successful implementation of this program were: 1] implementation of the different components of the communication strategy at the same time and 2] the repetition of key messages \((55)\).

**Example 3:** In Ethiopia, a malaria control program taught mothers how to treat malaria at home. A major reduction in under-five mortality was achieved in holoendemic malarious areas by using local mother coordinators to teach mothers how to give antimalarial drugs to children with uncomplicated malaria who were less than 5 years of age \((28)\).

### 3.2.4 Prepackaged Tablet Formulations of Medicines:

Tablet formulations of antimalarial medicines have been shown to be better than syrups in terms of compliance (91% versus 42%) despite small increases in cost for the packaging \((46)\). Pre-packaging of tablet medicines has been shown to improve adherence to treatment by up to 20% with multiple-dose regimens \((47)\). Pre-packaging of full

\(^2\) For further details, see: http://www.hcpartnership.org/Publications/Fact_sheets/ChildSurvival.pdf (accessed 04 February 2010).
treatment courses stratified by age or weight increases appropriate drug use and improves both compliance and ease of use at the community level. Prepackaging has increasing relevance in countries now introducing artemisinin-based combination therapies (ACTs) and other antimalarial combinations because those medicines are not yet available in co-formulated or co-packaged formats. These results suggest that careful design of prepackaged antimalarial treatments (PPTs) facilitates appropriate treatment.

Example 1: Study of caregivers’ adherence to instructions for pre-packaged antimalarial medications in Uganda (HOMAPAK) has shown that most caregivers provide prompt and adequate antimalarial treatment according to the manufacturer’s guidelines. As a result, a large proportion of uncomplicated malaria episodes are likely to be treated successfully, reducing the risk of severe or complicated malaria (54).

Example 2: In Ghana, evaluation of artemether-lumefantrine for the HMM of uncomplicated malaria was shown to be feasible, acceptable and achieve high levels of compliance for children 6-59 months of age. However, for this intervention to be sustainable, the agents who diagnose malaria in children (perform RDTs) and provide HMM to their caregivers will need to be paid (55).

Example 3: In Sudan, HMM adapted to conditions in Sudan (56,57) improved access to ACTs from 25% to 65% and treatment-seeking behavior from 83% to 100%, based on assessments performed before- and after the implementation of HMM (56).

WHO recommends the inclusion of two inserts in prepackaged medicines, one for prescribers and one for consumers, thereby fulfilling both drug regulatory requirements and informing end-users at the same time (36).
3.3 Antimalarial Resistance

Antimalarial resistance has been defined as the “ability of a parasite to survive and/or multiply despite the administration and absorption of a drug given in doses equal to or higher than those usually recommended and within tolerance of the subject” (56,57). Another definition suggests that the drug in question must “gain access to the parasite or the infected red blood cell for the duration of the time necessary for its normal action” (58) Most researchers interpret these definitions as referring only to the persistence of parasites after treatment doses of an antimalarial rather than failure of chemoprophylaxis, although the failure of chemoprophylaxis is a useful early warning for drug resistance (59,60).

Antimalarial drug resistance is one of the greatest challenges to malaria control today. Drug resistance has been implicated in the spread of malaria to new areas and the re-emergence of malaria in areas where the disease had been controlled. Drug resistance has also played a significant role in the occurrence and severity of epidemics. In addition, population movements (e.g., Laotian and Cambodian refugees) have introduced resistant parasites to areas which were previously free of drug resistance.

3.3.1 Mechanisms of Antimalarial Resistance

In general, antimalarial resistance results from spontaneous point mutations that confer reduced susceptibility to a given drug or class of drugs. For some drugs (e.g., chloroquine), only a single point mutation is required to confer resistance (T76 vs. K76). In contrast, for other drugs (e.g., mefloquine), multiple mutations may be required. If these mutations do not reduce survival or otherwise interfere with parasite replication,
drug pressure then selects for (increases the numbers of) resistant parasites and against (reduces the number of) susceptible parasites. In addition, isolates from the blood of individual subjects may have multiple parasite genotypes which often have widely varying drug susceptibilities and resistances ranging from highly resistant to susceptible in the same subject (60). Similarly, the malaria parasites within a single geographic area often have a wide range of drug susceptibilities and resistances. Over time, antimalarial resistance may become established in the parasite population and can be very stable. However, it may or may not persist after drug pressure has been removed. The biochemical mechanisms responsible for antimalarial resistance have been well described for chloroquine and for antifolate drugs such as pyrimethamine, sulfadoxine and atovaquone (57).

### 3.3.2 Detection of Antimalarial Resistance

In general, four methods have been used to test for antimalarial drug resistance: 1] *in vivo* studies in humans, 2] *in vitro* studies using the parasite culture system in the laboratory, 3] animal models such as mice with *P. berghei* and non-human primates (e.g., *P. cynomolgi* in the rhesus as a model of human *P. vivax* infection) and 4] molecular characterization based on strategies such as the Polymerase Chain Reaction (PCR) with allotype-specific primers and probes plus DNA sequencing. In addition, less rigorous approaches have also been helpful, such as case reports, case series or passive surveillance. Although there has been much discussion about the relative merits of one test over another (with the implication that one type of test should be used preferentially), careful consideration usually reveals that multiple methods yield complementary rather
than conflicting results. For example, the identification of specific point mutations using
PCR or sequencing becomes clinically or epidemiologically significant only when it is
linked to (associated with) drug resistances that produce treatment failure in patients and
populations. However, establishing cause and effect relationships is difficult in field
settings. Especially in sub-Saharan Africa, where presumptive diagnosis and empirical
treatment are common, the diagnosis of treatment failure is often also presumptive
(persistence or reappearance of clinical symptoms in a patient who was treated recently).

3.3.3 Artemisinin Resistance:

Because *Plasmodium falciparum* has become resistant to chloroquine (CQ) in
most malaria-endemic countries, WHO now recommends ACTs as the first-line treatment
for uncomplicated *P. falciparum* malaria. In addition, ACTs are now available free of
charge at many health facilities and the malaria case definition has been changed at most
clinics and health centers to require laboratory confirmation (by RDT or microscopy)
before treatment. As a result, ACTs are now used widely across sub-Saharan Africa. In
addition, artemisinin monotherapy is unfortunately available over the counter at many
local pharmacies. Please note that the selective pressure from inappropriate use of
artemisinin monotherapy creates a risk of artemisinin resistance, which – if it became
widespread - would have a devastating effect on malaria control across the entire globe.
The recent development of greatest interest is that a number of studies have found *P.
falciparum* from western Cambodia are less susceptible to artemisinins than isolates from
northwestern Thailand. In addition, other studies have reported that artemisinin resistance
has not yet spread across Thailand and that *P. falciparum* parasites in Bangladesh are
predominantly artemisinin-susceptible (61). This resistance is characterized by slow parasite clearance in vivo without corresponding increases in IC$_{50}$s on conventional in vitro susceptibility testing (62).

3.3.4 Preventing/Delaying the Emergence of Antimalarial Resistance.

The future of antimalarial drug resistance and efforts to combat it are related to a number of assumptions:

- First, antimalarial drugs will continue to be necessary in the future,
- Second, as long as drugs are used, there will be a risk of resistance developing to those drugs,
- Third, the development of new drugs typically takes longer than the development of resistance and
- Fourth, affordability is an essential consideration for antimalarial drugs used to control malaria, especially in sub-Saharan Africa.
Chapter IV: Study Design and Methodology

4.1 Overview of Study Design and Methodology

The purpose of this study was to examine the effectiveness of the home-based management of malaria (HMM) using ACTs and RDTs in rural Senegal. To address this question, a cross-sectional retrospective study was performed in 20 intervention and 20 control villages (listed in a table in the Appendix) to define the effectiveness of HMM based on the:

1] Diagnosis and treatment of uncomplicated malaria at the village level by Community Health Workers (CHWs) and the
2] Referral of uncomplicated and complicated or severe malaria cases to health posts and health centers for treatment.

4.1.1 Logical Framework for Research Questions (Table 2 and text below)

The objectives of this research were to:

Objective 1: determine whether HMM improves malaria outcomes, as defined by the time required for a mother or other caregiver to recognize that her sick child has a fever and to seek care and treatment for her child.
a) **Time to seek care and treatment for a child with fever.** Is the time required to seek care and treatment for a child with fever shorter in the intervention villages (with HMM) than in the control villages (without HMM)? This question was addressed by performing household surveys of mothers and other caregivers in both intervention and control villages to compare the times required for mothers/caregivers to seek care and treatment for a child with fever in both groups of villages. The hypothesis underlying this objective is that the time from when mothers/caregivers recognize their sick child has a fever until the time they seek care and treatment for that child will be shorter (< 24 hours) for mothers and caregivers in the intervention villages than the control villages (≥ 24 hours).

**Objective 2:** Determine whether HMM decreases the frequency of uncomplicated or severe malaria cases or the malaria death rate among children < 5 years of age.

a) **Reducing referrals of uncomplicated malaria cases.** Does HMM reduce the number of uncomplicated malaria cases referred to health centers or health posts for care? This question was addressed by examining data from health posts and health centers.

b) **Reducing cases of severe malaria.** Does HMM reduce the frequency of severe malaria among children < 5 years of age? This objective was addressed by performing surveys at health facilities (health posts, health centers) to compare the number of severe malaria cases in children < 5 years of age referred from intervention vs. control villages. In the Senegalese health system, severe malaria cases are typically referred to health posts or health centers for treatment, although they may be treated at the village level by a CMD or CHW if the family prefers to remain close to home.
c) *Reducing Malaria Mortality.* Are there fewer malaria deaths among children < 5 years of age in intervention than control villages? This question was addressed by performing household surveys based on verbal autopsies to estimate and compare the numbers of malaria deaths among children < 5 years of age from intervention vs. control villages.
Table 2: Logical Framework for Research Questions

<table>
<thead>
<tr>
<th>Purpose:</th>
<th>Examine the effectiveness of the home-based management of malaria (HMM) using ACTs and RDTs in rural Senegal.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothesis 1:</strong></td>
<td>If HMM is effective, the time from when a mother or other caregiver recognizes her sick child has a fever until the time she seeks care and treatment for her child will be shorter for mothers/caregivers from intervention than control villages.</td>
</tr>
<tr>
<td><strong>Hypothesis 2:</strong></td>
<td>If HMM is effective, fewer cases of uncomplicated malaria will be referred to health posts and health centres for treatment from intervention than control villages.</td>
</tr>
<tr>
<td><strong>Hypothesis 3:</strong></td>
<td>If HMM is effective, fewer cases of severe (complicated) malaria will be referred to health centres and health posts for treatment from intervention than control villages.</td>
</tr>
<tr>
<td><strong>Hypothesis 4:</strong></td>
<td>If HMM is effective, the death rate for malaria will be lower in intervention than control villages.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Items</th>
<th>INDICATORS</th>
<th>VERIFICATION</th>
<th>HYPOTHESES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal:</strong> Reduce severe disease and death from malaria among children under 5 in target villages.</td>
<td>1. Percent (%) reduction in severe malaria cases among children under five (in intervention vs. control villages) 2. Percent reduction of malaria mortality among children under five (in intervention vs. control villages)</td>
<td>Health survey Verbal autopsy (past six months)</td>
<td>ACTs remain effective for the treatment of uncomplicated and complicated malaria</td>
</tr>
</tbody>
</table>

**Research Questions and Outputs**

| Output 1: Improved malaria outcomes with the implementation of HMM in rural Senegal | 1.1 Number of fever cases detected by caregivers/mothers within (24/48 hours) in intervention villages, 1.2 Number of fever cases detected by caregivers/mothers within (24/48 hours) in control villages, 1.3 Number of patients with fever seen by CMDs within 24/48 hours of the onset of fever, 1.2 Percent of children under five seen within 24/48 hours of the onset of fever or other symptoms, 1.3 Number of patients with fever tested with RDTs by CMDs | Household survey CMD survey and documentary review | HMM decreases time for mothers and other caregivers to recognize fever and bring sick children for diagnosis and treatment. HMM increases testing of febrile children with |
| Output 2: Decreased numbers of severe malaria cases with implementation of HMM | 2.1. Number of uncomplicated malaria cases from intervention villages seen at health posts, |
| | 2.2. Number of uncomplicated malaria cases from control villages seen at health posts, |
| | 2.3. Percent of children with severe malaria during the last six months |
| | 2.4. Percent of children under five with fever who were referred to a health facility for treatment with ACTs within 24 or 48 hours after the onset of fever, |
| | 2.5. Percentage of children under five with severe malaria who recovered after treatment with quinine, |
| | 2.6. Percent of inpatient children under five who died from severe malaria. | 2.5. Percentage of children under five with severe malaria who recovered after treatment with quinine, |
| | 2.6. Percent of inpatient children under five who died from severe malaria. | Document review and verbal autopsy | RDTs and treatment of children with malaria with ACTs. |
4.1.2 Underlying Hypothesis

- The **hypothesis underlying** the first and second objectives is that malaria morbidity and mortality among children < 5 years of age should decrease in the intervention villages if the mothers and other caregivers in those villages recognize fever in their children more rapidly and bring sick febrile children for care and treatment more rapidly than mothers and caregivers in the control (non-intervention) villages.

4.2 Organization of this Study of HMM

This study of HMM in Senegal has two parts:

1. Population-based household surveys of mothers and other caregivers to compare fever detection times, referral times and numbers of malaria deaths among children < 5 years of age in intervention vs. control villages and
2. Health facility-based surveys of health posts, Health Centers, CMDs and CHWs to compare referral times and numbers of uncomplicated malaria cases, severe malaria cases and malaria deaths among children < 5 years of age from intervention vs. control villages.

4.2.1 Study Population

The study population (subjects) examined were children < 5 years of age in 20 intervention villages and 20 control villages within three health districts in Senegal: Mékhé, Dioffior and Ranérou (see the map of Senegal below). The morbidity rate is defined in Senegal as the percent of sick, febrile children less than 5 years of age examined at Outpatient Clinics who had malaria (a positive RDT). The mortality rate
is defined in Senegal as the percent of deaths in children less than 5 years of age who had malaria (positive RDT or a positive blood smear).

Figure 9: Malaria Morbidity in Senegal. Source NMCP report 2014 (4)

Mékhé is in the Thiès region of Senegal close to (70 km east of) Dakar, the capital of Senegal. Dioffior is in the Fatick region of Senegal 120 km east-southeast of Dakar and Ranérou is in the Matam region of Senegal 800 km east of Dakar. The intervention villages are in under-served areas without health facilities (no health huts) and are at least 10 km from the nearest health post. Community health workers (CHWs) are selected by the community. They live in the communities they serve, are available 24 hours a day and 7 days a week and work without salary. During the implementation of the project, CHWs were trained (and later supervised) by the staff of the health posts and health centers. The control villages are in the same districts as
the intervention villages, are in under-served areas and are at least 5 km from the nearest health post. The population in each village (both intervention and control villages) is approximately 500 inhabitants.

4.2.2 Geographic and Economic Overview of Senegal

The population of Senegal was estimated at 14,073,401 in 2014. Most of the population (55%) lives in rural areas with stable malaria transmission and 19% are children < 5 years of age who have an annual mortality of ~72 per 1000 per year (63). For comparison, the annual mortality of children < 5 years of age in the U.S. is 7 per 1000 per year) (64).

The Gross Domestic Product (GDP) of Senegal is $14.79 billion per year ($1,600 per person) in comparison to $16.77 trillion per year for the U.S. ($47,000–48,000 per person) (65). Annual per capita health expenditures are $96 per person per year in Senegal in comparison to $8,895 per person per year in the U.S. (66).

4.2.3 Malaria Morbidity and Mortality in Senegal

From 2008 to 2014, malaria morbidity and mortality in Senegal decreased (morbidity from 5.7% to 3.4% of outpatient visits and mortality from 7.2% to 3.6% of inpatient deaths) according to the National Malaria Control Programme. The Home based Management of Malaria (HMM) is one of the major strategies used to control malaria in Senegal during that time. The data in Figure 10 suggest that the implementation of HMM in Senegal shows contributed to the massive decrease in malaria morbidity and mortality observed between 2005-2006 and 2009-2015.
Although the 2014 report of the National Malaria Control Programme shows positive trends for other indicators (Table 3), malaria deaths and morbidity began to decrease only recently (between 2007 and 2009, Figure 10, below).

### Figure 10: Malaria Morbidity and Mortality in Senegal (NMCP)

![Graph showing malaria morbidity and mortality](image)

### Table 3: *P. falciparum* Malaria Indicators in Senegal, 2013-2014

<table>
<thead>
<tr>
<th>Key Indicators</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of febrile cases for which RDTs were performed</td>
<td>93.7%</td>
<td>94.5%</td>
</tr>
<tr>
<td>Cases of uncomplicated malaria (cases/year)</td>
<td>366,687</td>
<td>265,624</td>
</tr>
<tr>
<td>Incidence of <em>uncomplicated</em> malaria in the population (cases/1000/year)</td>
<td>27.0</td>
<td>18.9</td>
</tr>
<tr>
<td>Cases of uncomplicated malaria per year in children &lt; 5 years</td>
<td>62,633</td>
<td>42,807</td>
</tr>
<tr>
<td>Cases of complicated or severe malaria (per year) in the population</td>
<td>20,801</td>
<td>12,636</td>
</tr>
<tr>
<td>Complicated or severe malaria cases per year in children &lt; 5 years</td>
<td>3,833</td>
<td>2,922</td>
</tr>
<tr>
<td>Total malaria deaths per year in the population</td>
<td>815</td>
<td>500</td>
</tr>
<tr>
<td>Malaria deaths per year among children &lt; 5 years of age</td>
<td>313</td>
<td>175</td>
</tr>
<tr>
<td>Percent of malaria deaths in children &lt; 5 years of age</td>
<td>38.4%</td>
<td>35.0%</td>
</tr>
<tr>
<td>Case Fatality Rate for Severe Malaria in children &lt; 5 years of age</td>
<td>8.2%</td>
<td>6.0%</td>
</tr>
</tbody>
</table>

### 4.3 Sampling Plan and Study Procedures

The sample sizes proposed to test the study hypotheses were estimated using two different methods, which both yielded similar results (Methods 1 and 2, below).
Method 1:

- **Information used to estimate Sample Size** for this survey:
  
  o 20 intervention and 20 control villages (average population = 500) based on the Demographic and Health Survey in 2005 (67),
  
  o Total Populations: 10,000 for the 20 intervention villages and 10,000 for the 20 control villages, for a total of 20,000,
  
  o Children < 5 years of age (CU5): 17%-20% of the 10,000 overall population for both intervention and control villages (67),
  
  o Number of children < 5 years of age in each group (Intervention villages and Control villages): 1,700 to 2,000 in each group,
  
  o Estimated baseline mortality in children < 5 years of age: 121 per 1000, over 5 years, or 2.4% per year (67),
  
  o Incidence of severe malaria: 2.5% per year (68).

- **Estimates of Significance based on projected (expected) 50% decreases in malaria mortality and morbidity with HMM**:
  
  o Mortality < 5 years from 2.4% (24 per 1000) to 1.2% (12 per 1000) based on MOH data (67) \( p=0.000016 \),
  
  o Morbidity, reduction in the frequency of severe malaria from 2.5% per year among children < 5 years of age to 1.25% (from 25 to 12-13 cases of severe malaria per 1,000 children < 5 years of age), \( p=0.0036 \). (The hypothesis is that mortality will decrease by \( \geq 50\% \)).

**Method 2**:

- Sample size calculations and significance level estimates for \( \geq 50\% \) reductions in morbidity and mortality with HMM:
or

\[ n = \frac{\left(\sqrt{pq_{1}} + \sqrt{pq_{2}}\right)(Z_{1} - Z_{1} - Z_{1})^2}{(p_1 - p_2)^2} \]

- \( p_1 \) = incidence severe malaria case per year = 2.5%
- \( q_1 \) = complement to \( p_1 \) = 1 - \( p_1 \) = 97.5%
- \( p_2 \) = mortality rate for CU5 per year = 2.4%
- \( q_2 \) = complement to \( p_2 \) = 1 - \( p_2 \) = 97.6%
- \( Z_{1-\alpha/2} \) = (See Z table)
- \( Z_{1-\beta} \) = (See Z table)

a. The survey strategy used to select the participating households was a systematic survey from a random starting point. After selecting the first household randomly from a list of all households, subsequent households were selected by adding the same number (number of households divided by the sample size) to the initial household number. In each household, one child under five years of age was selected randomly if care and treatment had been sought for more than one child from CMDs, CHWs, health posts or health centers. The mother or caregiver for that child was then interviewed using the household questionnaire.

b. A health facility data review: during this study health facility data reviews were performed at the health centers and health posts in
Mékhé, Dioffior and Ranérou. All confirmed malaria cases (uncomplicated and severe) and malaria death cases from intervention and control villages were collected from 2008 to 2014.

c. **Verbal autopsies** were performed by interviewing the mothers or caregivers of children who had died within the previous three months in both intervention and control villages. The purpose of the verbal autopsies was to estimate the numbers of malaria deaths in children less than 5 years of age.

### 4.3.1 Survey Instruments (Questionnaires):

Three questionnaires were used to examine the effectiveness of HMM:

- A household questionnaire,
- A health facility questionnaire and
- A verbal autopsy questionnaire.

Each of the questionnaires was translated and pre-tested before it was used to perform interviews (see Appendix).

### 4.3.2 Validation and Reliability of the Survey Instruments:

In this study, WHO/WAHO (West African Health Organization) questionnaires were used after they had been adapted for use in this study. Their validity and reliability have been taken into account.

The *validity* of the instrument was based on “*whether one can draw meaningful and useful inferences from scores on the instruments*” (69).

*Reliability* is “*the extent to which a measure produces the same results when used repeatedly to measure the same thing*” (69). It refers to whether scores for the
items on a test instrument are internally consistent and whether test administration and scoring were consistent.

- Setting criteria to select the researchers (i.e., should be health professionals),
- Researchers training on the content of the instruments and the procedures of administration and
- Pretesting the instruments in others same area to be sure on their validity and reliability.

4.4 Ethical Issues

The ethical aspects of this study were reviewed and approved before the study began. The prospectus for this research was submitted to the Ethical Committee of Ministry of Health (MOH, see Appendix) and to the Tulane University School of Graduate Studies. In addition, the National Malaria Control Programme (NMCP) participated both before and during the study. During the field survey, researchers were supervised. At the conclusion of this study, its findings (conclusions) were reviewed with both the MOH and the NMCP.

4.5 Outcome Variables

4.5.1 Definitions of Malarial Syndromes and Terms:

Early detection of fever: refers to the ability of mothers or other caregivers to detect fever or a “hot body” within 24 to 48 hours after the onset of symptoms.

Uncomplicated malaria (36): symptomatic malaria with laboratory confirmation (based on microscopy or RDTs) in the absence of vital organ dysfunction. The most common manifestations of uncomplicated malaria are fever,
chills, rigors, headaches and body pain. Other manifestations associated with uncomplicated malaria include malaise, nausea, vomiting and joint pain.

**Severe or complicated malaria (36):** symptomatic malaria with vital organ dysfunction in subjects with positive thick smears or rapid diagnostic tests. Criteria for vital organ dysfunction include: coma, convulsions, severe prostration, hypoglycemia (blood glucose < 2.2 mM), severe anemia (Hb < 5 g/dL), hemoglobinuria, hyper-parasitaemia (> 200,000 asexual parasites/μL), renal failure, pulmonary edema and right heart failure.

**Malaria mortality:** Deaths in patients with laboratory-confirmed diagnoses of severe or complicated malaria.

### 4.6 Expected Findings

The expected (hypothesized) findings in children < 5 years of age are:

- The time from diagnosis (the detection of fever) to arrival at a health facility for care and treatment will be shorter for children from intervention villages than control villages,
- Fewer cases of uncomplicated malaria will be referred to health facilities (health posts or health centers) for treatment from intervention villages than control villages,
- Fewer cases of severe malaria will be referred for treatment from intervention than control villages and
- There should be fewer malaria deaths among children less than five years of age in intervention than control villages.

### 4.7 Potential Policy Implications:
If these studies demonstrate that HMM is effective, their policy implications are that:

- The use of HMM in Senegal should be increased (scaled up) so it will be available in all communities with malaria in Senegal,
Chapter V: Data Analysis

5.1 Software used to perform Data Analysis

Data analysis was performed using the SPSS software package, version 19.0 (SPSS Inc.). The choice of this software package was based on its flexibility and ease of use. In addition, the statistical commands needed for this research were available in the SPSS software package. For example, SPSS regression offered missing data analysis and four options for the treatment of missing variables. In addition, the procedure for regression analysis offered forward, backward and stepwise selection of variables, with several user-modifiable statistical criteria for variable selection. Extensive analysis of residuals was also available.
Table 4: Statistical Analysis Plan

<table>
<thead>
<tr>
<th><strong>Primary Endpoints</strong></th>
<th><strong>Expected Differences (Hypotheses)</strong></th>
<th><strong>Statistical Testing Plan</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time from recognition of fever until mother/caregiver brings her child to CHW or health post for treatment</td>
<td>More times ≤ 24 hours for mothers/caregivers from intervention than control villages</td>
<td>Non-parametric comparison with Chi Square or Fisher’s Exact</td>
</tr>
<tr>
<td>Frequency of referral for treatment of uncomplicated malaria in children less than 5 years</td>
<td>More referrals for uncomplicated malaria from control than intervention villages</td>
<td>Non-parametric comparison with Chi Square or Fisher’s Exact</td>
</tr>
<tr>
<td>Frequency of referral for the treatment of complicated malaria in children less than 5 years</td>
<td>More referrals for complicated malaria from control than intervention villages</td>
<td>Non-parametric comparison with Chi Square or Fisher’s Exact</td>
</tr>
<tr>
<td>Frequency of death from complicated or severe malaria in children less than 5 years</td>
<td>More deaths due to complicated/severe malaria from control than intervention villages</td>
<td>Non-parametric comparison with Chi Square or Fisher’s Exact</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Secondary Endpoints</strong></th>
<th><strong>Expected Differences (Hypotheses)</strong></th>
<th><strong>Statistical Testing Plan</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of febrile children less than 5 years of age tested for malaria using an RDT within 24 hours</td>
<td>More sick children tested using RDTs within 24 hours from intervention than control villages</td>
<td>Non-parametric comparison using Chi Square or Fisher’s Exact</td>
</tr>
<tr>
<td>Fraction of sick children with positive RDTs treated using ACTs within 24 hours of fever/symptoms</td>
<td>More children with malaria treated within 24 hours from intervention than control villages</td>
<td>Non-parametric comparison with Chi Square or Fisher’s Exact Test.</td>
</tr>
<tr>
<td>Fraction of children with severe malaria who recovered after treatment with quinine</td>
<td>More frequent recovery for children from intervention than control villages</td>
<td>Non-parametric comparison with Chi Square or Fisher’s Exact Test.</td>
</tr>
</tbody>
</table>
Chapter VI: Study Results

6.1 Household Surveys

6.1.1 Interview Data from the Intervention and Control Villages

Interviews were performed in 455 households in intervention villages and 101 households in control villages. There were two reasons for the smaller numbers of household interviews in control villages. First, because HMM was being expanded rapidly by the National Malaria Control Programme, the number of villages without HMM that could serve as controls was decreasing. Second, because the interviews in control villages were in December 2014, they inadvertently competed with the need of local farmers to sell their crops in the market. As noted below, the percent of mothers and other caregivers who were married (97% and 99%) and the percent with occupations outside the home (41% and 60%) were similar in intervention and control villages. Although formal education was more common in the intervention villages (30% vs 14%), that difference was not significant and may have resulted from insufficient numbers of respondents in control villages (Table 5, below).

Table 5: Characteristics of Caregivers in Intervention vs. Control Villages

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Intervention Villages (n=455)</th>
<th>Control Villages (n=101)</th>
<th>Statistical Test(s)</th>
<th>p-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary School</td>
<td>72</td>
<td>1</td>
<td>Fisher’s</td>
<td>0.001</td>
</tr>
<tr>
<td>Secondary School</td>
<td>26</td>
<td>1</td>
<td>Fisher’s</td>
<td>0.04</td>
</tr>
<tr>
<td>Koranic school</td>
<td>37</td>
<td>12</td>
<td>Chi Square</td>
<td>0.22</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small farmer</td>
<td>128</td>
<td>39</td>
<td>Chi Square</td>
<td>0.03</td>
</tr>
<tr>
<td>Breeding livestock</td>
<td>18</td>
<td>2</td>
<td>Fisher’s</td>
<td>0.55</td>
</tr>
<tr>
<td>Small Traders</td>
<td>24</td>
<td>14</td>
<td>Chi Square</td>
<td>0.001</td>
</tr>
<tr>
<td>Salaried Employee</td>
<td>17</td>
<td>5</td>
<td>Chi Square</td>
<td>0.57</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>442</td>
<td>100</td>
<td>Fisher’s</td>
<td>0.48</td>
</tr>
<tr>
<td>Single</td>
<td>7</td>
<td>0</td>
<td>Fisher’s</td>
<td>0.36</td>
</tr>
<tr>
<td>Widowed</td>
<td>5</td>
<td>1</td>
<td>Fisher’s</td>
<td>1.00</td>
</tr>
<tr>
<td>Divorced</td>
<td>1</td>
<td>0</td>
<td>Fisher’s</td>
<td>1.00</td>
</tr>
</tbody>
</table>
6.1.2 Knowledge about Malaria Control Activities

The mothers and caregivers interviewed in the intervention villages were well-informed about the malaria control activities being performed in their communities (447/455=98%). As noted in the copy of the Questionnaire provided in the Appendix, this interview focused on whether the respondents were aware of malaria control activities in their village such as the provision of bed nets for children under 5, free treatment with ACTs for children with malaria diagnosed by RDTs and IPTp for pregnant women. In contrast, fewer mothers and caregivers in the control villages (24/101=24%) were well-informed about the malaria control activities being performed in their communities ($X^2=354.0$, $p<0.001$) (Table 6, below).

Table 6: Awareness of Malaria Control Activities in the Community

<table>
<thead>
<tr>
<th>Items</th>
<th>Intervention Villages</th>
<th>Control Villages</th>
<th>Statistical Test, $p$-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware of Malaria Control Activities</td>
<td>447</td>
<td>24</td>
<td>Fisher’s Exact &lt; 0.001</td>
</tr>
<tr>
<td>Not Aware of Malaria Control Activities</td>
<td>8</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>455</td>
<td>101</td>
<td></td>
</tr>
</tbody>
</table>

Fisher's Exact Test, $p<0.001$,

As noted below in Figure 11, there were also differences between intervention and control villages in numbers of mothers and caregivers informed about HMM (369/455 vs. 1/101, $X^2=238.3$, $p=0.001$), village-based antimalarial treatment by CHWs (118/455 vs. 8/101, $X^2=15.30$, $p<0.001$) and Intermittent Preventive Treatment in pregnancy (IPTp) (50/455 vs. 1/101, $X^2=9.919$, $p=0.0016$). In contrast, there were no differences between intervention and control villages in terms of mothers’ understanding of insecticide treated bed nets which were not part of HMM (LLINs, 432/455 vs. 93/101, $X^2=1.289$, $p=0.2562$) (Figure 11).
6.1.3 Knowledge about Persons participating in Malaria Control:

In both intervention and control villages, health workers and CHWs were the persons recognized by 85% of interviewees in intervention villages for malaria control, followed by health workers. In contrast, traditional healers were not recognized as persons participating in Malaria control activities (Table 7).

Table 7: Persons recognized as participating in Malaria Control Activities

<table>
<thead>
<tr>
<th>Malaria Control Personnel, Members of the Community</th>
<th>Intervention Villages (n=455)</th>
<th>Control Villages (n=101)</th>
<th>Chi Square</th>
<th>Fisher’s Exact</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health workers</td>
<td>229 (50%)</td>
<td>76 (75%)</td>
<td>$X^2 = 20.72$</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Health workers and CHWs</td>
<td>385 (85%)</td>
<td>25 (25%)</td>
<td>$X^2 = 152.96$</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Health workers and CHWs</td>
<td>41 (9%)</td>
<td>0 (0%)</td>
<td>Fisher’s Exact</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Community leaders</td>
<td>37 (8%)</td>
<td>0 (0%)</td>
<td>Fisher’s Exact</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Youth/women’s associations</td>
<td>43 (9%)</td>
<td>0 (0%)</td>
<td>Fisher’s Exact</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Traditional healers</td>
<td>10 (2%)</td>
<td>4 (4%)</td>
<td>Fisher’s Exact</td>
<td>0.290</td>
<td></td>
</tr>
</tbody>
</table>

6.1.4 Sites where Mothers/Caregivers sought Care and Treatment first
The majority of mothers and other caregivers interviewed (>99% and 93% for intervention and control villages, respectively) sought care and treatment for a sick febrile child (Figure 11). The difference between the intervention and control villages was where the mothers and caregivers first sought care and treatment for their child. Most mothers/caregivers from intervention villages (91%) went first to CHWs or CHWs at Health Centers. In contrast, 90% of mothers/caregivers from control villages went to health centers ($p<0.05$). This difference (414/455 vs. 1/101, $p=0.0012$) is consistent with the emphasis on care provided by CHWs in intervention villages (based on HMM) and the absence of that message in control villages. For villages in remote areas with limited access to health centers, this behavior may delay care and increase the risk of complications for febrile sick children (Figure 12).

**Figure 12:** Sites Chosen first to find Care/Treatment for a Sick Child

6.1.5 **Ages of Febrile Sick Children**

In both intervention and control villages, children less than five years of age may have fever at any time. However, there were no differences between intervention
and control villages in the ages of the sick children whose parents/caregivers were interviewed (Fisher’s Exact, \( p=0.51 \) for children < 1 month; \( X^2=0.4878, \text{df}=2, p = 0.783 \) for older children, Table 8).

Table 8: Ages of Sick Children whose Caregivers were Interviewed

<table>
<thead>
<tr>
<th></th>
<th>Intervention Villages (n=427)</th>
<th>Control Villages (n=85)</th>
<th>Statistical Test</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-29 days</td>
<td>3 (0.7%)</td>
<td>1 (1.3%)</td>
<td>Fisher’s Exact</td>
<td>0.51</td>
</tr>
<tr>
<td>1-11 months</td>
<td>85 (19.9%)</td>
<td>19 (22.3%)</td>
<td>( X^2=0.262 )</td>
<td>0.60</td>
</tr>
<tr>
<td>≥ 12 months</td>
<td>339 (79.4%)</td>
<td>65 (76.4%)</td>
<td>( X^2=0.363 )</td>
<td>0.54</td>
</tr>
<tr>
<td>Totals</td>
<td>427</td>
<td>85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.1.6 Time from a Child’s Illness to Survey Interviews with Mothers:

The times between a child’s illness and the survey interviews with their mothers or caregivers were similar for children from both intervention and control villages (Table 9). Therefore, there should have been no bias in terms of maternal/caregiver recall between the groups during the interviews.

Table 9: Time from a Child’s Illness to Survey Interviews

<table>
<thead>
<tr>
<th></th>
<th>Intervention Villages N=421</th>
<th>Control Villages N=84</th>
<th>ChiSquare</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 6 days</td>
<td>29 (6.9%)</td>
<td>6 (7.1%)</td>
<td>( X^2=0.07 )</td>
<td>0.93 (NS)</td>
</tr>
<tr>
<td>1≥ time ≤ 4 weeks</td>
<td>107 (25.4%)</td>
<td>23 (27.4%)</td>
<td>( X^2=0.14 )</td>
<td>0.70 (NS)</td>
</tr>
<tr>
<td>&gt;1 months</td>
<td>285 (67.7%)</td>
<td>55 (65.5%)</td>
<td>( X^2=0.16 )</td>
<td>0.69 (NS)</td>
</tr>
<tr>
<td>Totals</td>
<td>421</td>
<td>84</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.1.7 Time from Onset of Fever until a Child is brought for Treatment:

Most mothers and caregivers from the intervention villages (229/386=59%) sought care and treatment for a sick child within 24 hours after the onset of fever. In
contrast, only a minority of the mothers and caregivers from the control villages (16/67=24%) sought care and treatment for a sick child within 24 hours after the onset of fever ($X^2 = 28.88; p< 0.001; OR=4.65, 95% CI: 2.55 to 8.44$) (Figure 13). Based on these data, there was an expectation that shorter times observed in HMM villages would produce better outcomes for children from intervention vs. control villages.

**Figure 13:**  Time from the Onset of Fever to Seeking Care for a Sick Child

![Graph showing time from onset of fever to seeking care for a sick child in intervention and control villages.]

### 6.1.8 Signs and Symptoms reported by Mothers and Caregivers

Fever was the most common sign reported in both intervention and control villages when children were sick, followed by cough and diarrhea. These results indicate fever was the most common sign reported by mothers and caregivers and suggests that suspected malaria cases (febrile children) should be studied using RDTs or microscopy to confirm or refute that treatable diagnosis.
6.1.9 Places where Febrile Sick Children received Treatment:

Children who were febrile and sick in intervention villages received treatment in their own village more often than children in control villages (381/413=92% vs. 69/85=81%; $X^2 = 9.92; \ p = 0.002, \ OR=2.76; \ 95\% \ CI: \ 1.44-5.30$) (Table 10, below).

The importance of this result is that it is expected that the earlier and closer to the child’s home that treatment is started, the more likely complications such as severe malaria and death will be avoided, especially in remote areas where it is more difficult to access the health care system.

Table 10: Treatment of Sick Children within or outside their Villages*

<table>
<thead>
<tr>
<th>Treatment in Home Village</th>
<th>Intervention Villages (n=413)</th>
<th>Control Villages (n= 85)</th>
<th>Chi Square</th>
<th>p-Value</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>381 (92.2%)</td>
<td>69 (81.2%)</td>
<td>9.92</td>
<td>0.001</td>
<td>2.76</td>
<td>(1.44-5.30)</td>
</tr>
<tr>
<td>No</td>
<td>32 (7.8%)</td>
<td>16 (16.8%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>413</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* - 15 and 1 non-responders in the intervention and control villages, respectively.
In remote areas, febrile sick children from intervention villages were treated more often by CHWs. In contrast, febrile sick children from control villages were treated more frequently at health facilities such as health posts or Health Centers ($p<0.001$ for both comparisons, Table 11 below). This situation should be a problem because due to lack of accessibility and transportation in this context. Therefore, it is better to make treatment care close to their home.

**Table 11:** Treatment of Sick Children by CHWs or Health Centre Staff

<table>
<thead>
<tr>
<th></th>
<th>Intervention Villages (n=381)</th>
<th>Control Villages (n=69)</th>
<th>Chi Square</th>
<th>$p$-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOH Health Posts, Health Centres</td>
<td>179 (47%)</td>
<td>63 (91%)</td>
<td>46.17</td>
<td>0.001</td>
</tr>
<tr>
<td>CHWs</td>
<td>180 (47%)</td>
<td>0 (0%)</td>
<td>Fisher’s Exact</td>
<td>0.001</td>
</tr>
<tr>
<td>Traditional Healers</td>
<td>0 (0%)</td>
<td>3 (4%)</td>
<td>Fisher’s Exact</td>
<td>0.003</td>
</tr>
<tr>
<td>Others</td>
<td>22 (6%)</td>
<td>3 (4%)</td>
<td>Fisher’s Exact</td>
<td>NS</td>
</tr>
<tr>
<td>Totals</td>
<td>381 (100%)</td>
<td>69 (99%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 15 (below) shows caregivers in control villages brought their sick children to public health facilities more frequently. This a serious problem in remote areas with limited access to health care (lack of transportation, $\geq$ 5 km from villages).

**Figure 15:** Places where Sick Febrile Children were Treated
6.1.10 Evaluation of Febrile Sick Children by CHWs:

Because this chapter is about assessing the practices of CHW, it discusses only the intervention villages. When sick febrile children from intervention villages were brought to CHWs for care and treatment, the CHWs performed a rapid diagnostic test (RDT) in 91% of cases (148/162). When the CHWs did not perform finger sticks, the reasons given were: the finger stick was not necessary (n=10) or the RDT was not available (n=4).

6.1.11 Treatment of Sick Febrile Children based on the RDT Results:

Most febrile sick children brought to the CHWs had positive RDTs (90/148=61%) and were treated for malaria using ACTs (Figures 16-17). Among the 90 children with positive RDTs, 71% (n=64) were treated and cured using ACTs. In contrast, the 26 children with positive RDTs who were not cured by ACTs were examined for diarrhea and pneumonia and referred to the nearest health facility (health post or health center) for care (Figure 16). Conversely, sick febrile children with negative RDTs (58/148=39%) were referred to the nearest health post for examination and treatment by medical officers.

Figure 16: RDT Results for Sick Children from Intervention Villages (n=148)
Figure 17: ACT Treatment of Febrile Children with Positive RDTs (n=90)

NB: Ministry of Health guidelines are to refer children who still have fever 24 or 48 hours after treatment with ACTs.

6.1.12 Mothers/Caregivers receiving feedback from CHWs

After performing RDTs, CHWs provided feedback (information on diagnosis and treatment) to the mother or caregiver in 61% of cases (108/176) which is a recommendation regarding the HMM guidelines (Figure 18, below).

Figure 18: Feedback to Caregivers about RDT Results from CHWs
Most (167/176=95%) of the mothers and caregivers interviewed were satisfied with the work of the CHWs (Figure 19).

**Figure 19:** Fraction of Caregivers satisfied with the Work of CHWs

Most mothers and caregivers (98% of 221) thought HMM by CHWs should continue and should be available in their community (Figure 20).

**Figure 20:** Mothers/Caregivers who thought HMM should Continue

**6.2 Health Facility Surveys:**

The health facility surveys were based on reviews of registry data from 2008 to 2014.
6.2.1 Referral of Uncomplicated Malaria Cases from Intervention Villages to Health Posts for Treatment:

a. Referral of Uncomplicated Malaria Cases to the Dioffior Health Post:

From 2008 to 2014, 918 cases of uncomplicated malaria in children less than 5 years of age were referred to the Dioffior Health Post from its catchment area. During this time, the incidence of uncomplicated malaria (cases per 1000 persons per year) was lower in intervention than control villages (Figure 21).

Figure 21: Uncomplicated Malaria Referrals to the Dioffior Health Post (2008-14)

b. Referral of Uncomplicated Malaria Cases to the Mékhé Health Post:

From 2008 to 2014, 195 cases of uncomplicated malaria were referred for treatment to the Mékhé Health Post. Although the incidence of uncomplicated malaria was lower in intervention than control villages, those differences were not significant in part because a number of records were not available after a strike.
c. **Referral of Uncomplicated Malaria Cases to the Ranérou Health Post:**

From 2008 to 2014, 661 cases of uncomplicated malaria in children less than 5 years old were referred to the Ranérou Health Post from the catchment area. The incidence of uncomplicated malaria (cases per 1000 persons per year) was lower in intervention than control villages.
6.2.2 Referral of Complicated Malaria Cases from Intervention Villages to Health Centers for Treatment:

a. Referrals of Complicated Malaria Cases to the Dioffior Health Center:

From 2008-2014, no (zero) complicated malaria cases were referred from intervention villages and only 1 from a control village to the Dioffior Health Post. Although no conclusions can be drawn from these data, the low numbers of complicated malaria cases are a major improvement from previous years.

b. Referrals of Complicated Malaria Cases to the Mékhé Health Center:

From 2008 to 2014, no cases of complicated malaria were referred from intervention or control villages to the Mékhé Health Center (As noted, this is in part because a number of records were no longer available [were missing] after a strike.)

c. Referrals of Complicated Malaria Cases to the Ranérou Health Center:

From 2008 to 2014, a number of complicated (severe) malaria cases were referred to the Ranérou Health Centre. Based on these data, the incidence of severe malaria (per 1000 per year) was lower in intervention than control villages.

Figure 24: Complicated Malaria Referrals to the Ranérou Health Centre (2008-14)
6.2.3 Malaria Deaths in Children less than 5 years of age at Health Centers:

a. Malaria Deaths in Children < 5 years (Dioffior Health Post/Centre):

Review of records from 2008 to 2014 at the Dioffior Health Post revealed no malaria deaths among children less than 5 years of age. In addition, no records of malaria deaths were found in either intervention villages or control villages within the catchment area of the Dioffior Health Post.

b. Malaria Deaths in Children < 5 years (Mékhé Health Post/Center):

Review of records from 2008 to 2014 at the Mékhé Health Post revealed no malaria deaths among children less than 5 years of age. In addition, no records of malaria deaths were found in either intervention villages or control villages within the catchment area of the Mékhé Health Centre.

c. Malaria Deaths in Children < 5 years (Ranérou Health Post/Center):

In contrast to the Dioffior and Mékhé Health Centers, review of records from 2008 to 2014 at the Ranérou Health Center revealed 5 malaria deaths among children less than 5 years of age. (Figure 24).

Figure 25: Malaria Deaths in Ranérou Villages (2008-2014)
6.3  **Verbal Autopsies for Children who died in the past Three Months:**

Verbal autopsies performed at the community level are recommended by WHO particularly when limited or no data are available from health services. The purpose of verbal autopsies is to identify deaths attributable to malaria at the community level.

**a. Malaria Deaths in Children < 5 referred to the Dioffior Health Center:**

No malaria deaths in children < 5 years of age were found at the community level in either intervention or control villages referring to the Dioffior Health Center during the three months before this survey began.

**b. Malaria Deaths among Children < 5 referred to Mékhé Health Center:**

No malaria deaths in children < 5 years of age were found at the community level in either intervention or control villages referring to the Mékhé Health Center during the three months before this survey began.

**c. Malaria Deaths in Children < 5 referred to Ranérou Health Center:**

No malaria deaths in children under 5 were found at the community level in either the intervention or control villages referring to the Ranérou Health Center during the three months before this survey. However, we identified 1 death in the intervention villages and 8 in the control villages among newborns (0-20 days of age). Although the risk of death was less for newborns from intervention than control villages (Fisher’s Exact: \( p = 0.026 \), OR: 0.095, 95% CI: 0.01-0.82; Figure 26), it is not clear whether those deaths were related to malaria.
Among the symptoms observed before newborns died, failure to feed was the most frequent (n=5), followed by fever (n=3) and lethargy (n=3). However, as noted above, there was no laboratory evidence these deaths were related to malaria.
Chapter VII: Discussion

Key Findings, Study Limitations, Policy Implications

7.1. Study Limitations

The limitations of these studies include:

7.1.1 Fewer Household Interviews in the Control Villages:

The smaller number of household interviews performed with mothers and caregivers in control vs. intervention villages (101 vs. 455) poses a risk of confounding by the smaller number of interviews used to obtain data from mothers and caregivers in the control villages. This problem resulted in large measure from a decision by the Ministry of Health to make HMM available in as many villages with endemic malaria transmission as soon as possible. This concern has been addressed by comparing data for intervention and control villages across regions and health centers to identify common trends and patterns whenever possible.

7.1.2 Incomplete Documentation (incomplete data) at the Mékhé site:

For example, the prolonged strike at Mékhé meant that substantial amounts of data were missing from those records for 2012 and 2013. As a result, the Mékhé data do not have sufficient power to demonstrate an effect of HMM on the frequency of uncomplicated malaria. In contrast, because there were no strikes in Dioffior or Ranérou, the results from those health posts were more complete and demonstrated that HMM reduced the frequency of uncomplicated malaria in intervention villages in comparison to control villages at the other two study sites (Dioffior and Ranérou).
7.1.3 **Potential Sources of Bias:**

Although this study was not presented to residents of the control villages (because they had not received HMM), it was presented to (reviewed with) the chiefs, elders and men’s and women’s councils in the intervention villages because they received HMM as part of this study. Residents of the intervention villages were inevitably more aware of this study and its goals than residents of the control villages (Figures 11-12). As a result, their responses to questions about whether HMM and the CHWs were helpful and should be continued (Figures 19-20 in Chapter IV, above) may have been biased favorably. In contrast, there is no reason why decisions by CHWs in control villages on the referral of symptomatic malaria cases should have been affected by studies occurring in intervention villages at the same time.

7.2 **Factors that affect the Success or Failure of HMM**

In Senegal, HMM is now being implemented in villages ≥ 5 km from the nearest health facility because it is particularly difficult to access health facilities from those villages during the rainy season. In this study the intervention and the control villages had similar demographic and socio-economic characteristics.

7.2.1. **The Role(s) of Communication Strategies.**

An effective communication strategy has been shown to be the cornerstone of HMM. This strategy must be multifocal and should target individuals, households and communities, as well as health-care facilities, policy-makers and resource providers. It must be designed to improve understanding of the behaviors and practices adopted
by individuals as well as the underlying reasons for their adoption, as a basis for reinforcing positive behaviors and modifying those that are less beneficial (35,45).

Example 1: In Nigeria, a communication strategy for behavioral change was initiated in both the public and private sectors. Messages on malaria case management, intermittent preventive treatment during pregnancy (IPTp) and insecticide-treated nets (ITNs, LLINs) were promoted using volunteers, social marketing of unit-dose, prepackaged antimalarial medicines and the training of patent medicine dealers. The channels used included interpersonal communication, traditional communication channels such as “town criers” and local festivals and social marketing through medicine packaging, radio spots and distribution of booklets to patent medicine dealers. This strategy increased knowledge about the role and benefits of ITNs in malaria prevention, awareness of the danger signs of malaria and the importance of early treatment for febrile children. The key to the success of this program was the shift from supply to demand creation for health services with increased access to medicines and community ownership (35).

Example 2: In Ghana, the He Ha Ho (Healthier Happier Home) campaign developed in 2000 by the Ministry of Health in collaboration with the Center for Communication Programs of the Johns Hopkins University 3 linked a strong communication strategy to the training of medicine sellers in the appropriate use of chloroquine for treatment of malaria. That campaign made use of mass media (a long-standing radio series and television spots), print media (leaflets, booklets, posters and reminder cards) and included the training of medicine sellers, medicine sales persons, students and women’s groups. These methods were effective in creating a high profile for the national malaria program; the radio series and theme song became very

3 For further details, see: http://www.hcpartnership.org/Publications/Fact_sheets/ChildSurvival.pdf (accessed 04 February 2010).
popular, resulting in an increase in the appropriate use of chloroquine for the treatment of children with fever. Two key factors in the success of the program were the implementation of different components of the communication strategy at the same time and the repetition of key messages (45).

7.2.2  **Symptoms and Signs reported by Mothers and other Caregivers:**

During this study, the three most common signs (fever, cough and diarrhea) observed in children with malaria were similar in both intervention and control villages. In fact, the similar signs and symptoms observed in both groups of villages reinforce the integrated community case management (iCCM) strategy promoted by WHO for rural areas. This is because the goal of iCCM is to provide effective case management for young children suffering from malaria, pneumonia and diarrhea in hard to reach areas, especially among vulnerable populations who may otherwise be neglected. Recent experience suggests this can be cost effective if well-utilized and that iCCM may be a key public health strategy to increase the quality of treatment for children in malaria-endemic countries of sub-Saharan Africa (29).

7.2.3  **Acceptance of HMM by Study Participants:**

HMM was well-received by the mothers and other caregivers interviewed: 95% of those interviewed were satisfied with the work of the CHWs; 96% would consult the CHWs for another illness. They recognized that the treatment by CHWs brought something positive to their households and families.

**Example 1:** In Ghana, the evaluation of HMM using artemether + lumefantrine for children 6-59 months old demonstrated that it was feasible and that it
achieved high levels of compliance in Dangme. However, if this intervention is to be sustainable, the agents will need to be paid (55).

Example 2: In Sudan, the use of HMM adapted to local conditions improved the accessibility of ACTs from 25% to 65% and treatment-seeking behavior from 83% to 100% (77).

7.3 Summary (Overview) of Hypothesis-based Studies in this Project:

7.3.1 Time for Mothers to Seek Care for Children with Fever

• Specific Aim 1:

Does HMM reduce the time from when a mother recognizes her child is sick or has a fever to the time when she brings her child for care and treatment?

• Key Results:

This hypothesis was confirmed. Mothers/caregivers in intervention villages sought care within 24 hours from the onset of fever more frequently than mothers/caregivers from control villages ($X^2 = 28.88; p< 0.001; OR=4.65$ and 95%CI: 2.55 to 8.44).

• Significance in relation to the underlying hypothesis:

Shorter times from the onset of fever to the beginning of treatment are essential for the effective treatment of uncomplicated malaria and for the prevention of severe malaria.

• Relationship to other studies in the literature:

Most deaths from malaria among children less than 5 years of age occur within 48 hours after the onset of symptoms (70,71). For example, in Rwanda, a study of HMM performed in two malaria-endemic districts showed that the
time from the onset of fever to treatment was reduced and that there was less malaria morbidity in HMM districts than control districts (73).

### 7.3.2 Referral of Children with Uncomplicated Malaria to Health Posts

- **Specific Aim 2:**
  Does HMM reduce the number of children with uncomplicated malaria referred to health posts for treatment/care?

- **Key Results:**
  
  *This hypothesis was also confirmed.* Fewer uncomplicated malaria cases were referred from intervention than control villages to the Dioffior and Ranérou Health Posts ($p < 0.001$, OR$_1$: 0.200, 95% CI: 0.13-0.30 and OR$_2$: 0.04, 95% CI: 0.03-0.05). In contrast, these differences were smaller (18 vs. 31) and did not reach significance at the Mékhé Health Post because a number of patient records had been lost after a strike.

- **Significance in relation to the underlying hypothesis:**
  When HMM is effective at the community level, it should decrease the need to refer children with uncomplicated malaria for additional care and treatment at health posts and other health centers. This was the case for both the Dioffior and Ranérou Health Centers.

- **Relationship to other studies in the literature:**
  An interventional study in a rural health district of Burkina Faso showed that HMM reduced the numbers of referrals to health posts and improved the performance of peripheral health care facilities (72,73). Similarly, a study in Tigray, Ethiopia showed that HMM using artemether + lumefantrine
decreased the number of referrals from intervention villages to health centers and health posts (74).

7.3.3 Referral of Children with Complicated Malaria to Health Centers

- **Specific Aim 3:**
  Does HMM using ACTs reduce the frequency of referrals for **complicated** malaria to health centers?

- **Key Result:**
  *This hypothesis was also confirmed.* Fewer cases of complicated malaria were referred from intervention than control villages to the Ranérou Health Center (26 vs. 121, \( X^2=70.05, \ p < 0.001, \) OR: 0.179, 95% CI: 0.01-0.27). Please note that this calculation (comparison) could not be performed for either the Dioffior or Méhké Health Centers because neither of those communities reported or referred cases of complicated malaria.

- **Significance in relation to the underlying hypothesis:**
  When HMM is effective at the community level, it should reduce the number of referrals for children with complicated malaria to health centers for additional treatment or care. This was the case for the Ranérou Health Center.

- **Relationship to other studies in the literature:**
  In Burkina Faso, an HMM program using CHWs produced a 50% reduction in the incidence of severe malaria (27); In Senegal, an assessment of HMM performed by comparing data from 2008-2009 showed that the incidence of malaria-related hospitalizations decreased in both intervention and comparison regions. That study found no differences
in the frequency of complicated malaria between HMM (intervention) districts and control districts (75).

7.3.4 Frequency of Malaria Deaths in Intervention vs. Control Villages:

- **Specific Aim 4:**
  Does HMM reduce malaria deaths among children less than 5 years of age?

- **Key Results:**
  
  *This hypothesis could not be tested because the numbers of malaria deaths reported were so few.* Based on Ranérou Health Center registry data, 1 malaria death was found in children under 5 from intervention villages vs. 4 from control villages (Fisher’s Exact Test, \( p=0.373 \)). No malaria deaths were identified in the Dioffior or Mékhé Health Center registry data.

- **Significance in relation to the underlying hypothesis:**
  When HMM is effective, it should reduce the number of malaria deaths among children less than 5 years of age. In these data, there were too few malaria deaths to test this hypothesis.

- **Other studies in the literature:**
  
  A community-based randomized controlled trial using CHWs in Tigray, Ethiopia, reported a 40% reduction in overall under-five childhood mortality in intervention areas vs. control areas (28).
  
  A systematic review of HMM showed that only the study in Ethiopia found a reduction in the under-5 mortality rate (41%, 95% CI 29 – 51%) (76).
  
  In Senegal, comparison of data for 2008-2009 found that in-hospital malaria deaths decreased by 62.5% (95% CI 43.8-81.2) in intervention regions. In
contrast, decreases in control regions were smaller and did not reach statistical significance (75).

7.4 Research Findings, Policy Implications and Recommendations:

7.4.1 Summary of Research Findings (Study Results):

Among children < 5 years of age, this study found that:

- Fever was detected earlier by mothers/caregivers in intervention villages than mothers/caregivers in control villages;
- Fewer uncomplicated cases of malaria were referred for treatment from intervention than control villages to other health facilities (health posts or health centers),
- The time from diagnosis to treatment (from the detection of fever to the child’s arrival at a health facility that provided diagnosis and treatment) was shorter for children from intervention villages than children from control villages,
- Fewer complicated malaria cases were referred for treatment from intervention than control villages,
- There were fewer malaria deaths among children under five years of age in the intervention than the control villages.

7.4.2 Policy Implications and Recommendations:

- HMM should be scaled up at the national level and provided for all communities with endemic malaria and
- Additional studies should be performed to assess the impact of HMM where complicated malaria cases are most common.
7.4.3 Concluding Comments:

For all these reasons (based on the results of these studies), we recommend the implementation of HMM in countries such as Senegal and its neighbors, where the epidemiology of malaria and its transmission are similar. In addition, based on the success of HMM demonstrated in this study, we recommend similar studies of strategies such as iCCM which has the potential to distinguish among illnesses which often have presentations similar to malaria (e.g., fever without localizing signs) but require different treatments (e.g., bacterial pneumonia, tuberculosis, viral hemorrhagic fevers, bacterial and viral meningitis).
Chapter VIII: Recommendations and Conclusions

8.1. Recommendations

- To strengthen the National Malaria Control Programme (particularly HMM), the NMCP should

  o Continue surveillance for uncomplicated and complicated malaria,

  o Improve the quality of the epidemiologic data (on-site verification),

  o Supervise periodically the Health Posts/Centres and CHWs in relation to case management guidelines,

  o Reinforce the Malaria BCC activities (Community awareness) and

  o Perform further studies to assess the impact of HMM in areas where complicated malaria cases are concentrated.

8.2. Conclusions

The Home-based Management of Malaria (HMM) is a cornerstone of malaria control in sub-Saharan Africa (SSA) and is recommended by WHO to provide prompt antimalarial treatment for children in under-served areas. Although HMM had been shown to reduce malaria morbidity and mortality with chloroquine, it had not been examined previously in the era of artemisinin-based combination therapies (ACTs).

The objectives of this study were to determine whether HMM reduced: 1] the time between when a mother or guardian realized her child was ill and the time when the child was brought for treatment and 2] malaria morbidity in children less than 5 years
of age. The methodology used was a cross-sectional retrospective study (2008-2014) to compare intervention villages which had received HMM to control villages which had not received HMM in order to examine the effectiveness of HMM.

The Key Results have shown that more mothers and caregivers were informed about the malaria control activities being performed in their community (98% vs. 24%) in intervention than control villages ($p < 0.001$). Consistent with that result, mothers and caregivers in intervention villages sought care for their sick children earlier than mothers in control villages ($p < 0.001$) and were more likely to obtain treatment from community health workers (CHWs) in their home villages. In contrast, more children were referred for malaria treatment to health posts and health centers from control than intervention villages ($p < 0.001$). Likewise, more children with complicated malaria were referred for treatment from control villages ($p < 0.001$), although this conclusion was limited by the small numbers of complicated (severe) malaria cases.

The results reported here indicate that HMM shortens the time mothers wait before taking their children to receive treatment. Because more children with uncomplicated or complicated malaria are referred for treatment from control than intervention villages, these results indicate that the availability of HMM treatment in the child’s home village reduces morbidity. Additional studies with larger numbers of subjects will be necessary to determine whether HMM also reduces mortality.
APPENDIX

1. Household survey questionnaire
2. Health survey questionnaire
3. Verbal autopsy questionnaire
### QUESTIONNAIRE DU MENAGE
#### HOUSEHOLD QUESTIONNAIRE

<table>
<thead>
<tr>
<th>Numéro questionnaire:</th>
<th>Questionnaire Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numéro ménage:</td>
<td>Household Number:</td>
</tr>
</tbody>
</table>

**Langue entretien:** Code langue: _______

*Interview Language:*

**Interprète Oui:** _____  **Nom enquêteur:** ____________________________

*Interpreter: Yes:________  Name of Interviewer: ____________________________*

**Début entretien:** Heure: _____  **Fin entretien:** Heure: _____

*Interview began: Hours:  ____ Minutes: ____  Finished: ____ Hours: ____ Minutes: ____*

**Nom Superviseur:** ____________________________

*Name of Supervisor: ____________________________*

---

**Information à l'intention de la personne enquêtée**

Bonjour/Bonsoir Monsieur/Madame. Je m'appelle ____________________________.

*(nom de l’enquêteur)*

Je fais ce travail pour le compte du Ministère de la Santé et de l’Action Sociale. Ce travail se situe dans le cadre de l’implication des communautés dans la prise en charge du paludisme à domicile.Votre communauté est parmi celles qui ont été choisies au hasard pour ce travail. Votre ménage est aussi parmi ceux qui ont été choisis au hasard dans cette communauté. Je veux m’entretenir avec la mère d’enfant de moins de cinq ans ou bien la gardienne d’enfant de moins de cinq ans. La mère d’enfant de moins de cinq ans ou bien la gardienne d’enfant de moins de cinq ans peuvent sur n’importe quelle question, se faire assister par n’importe quel membre du ménage. Mais elle est l’interlocutrice principale. Mais vous n’êtes pas obligé d’accepter cet entretien ou vous pouvez à tout moment au cours de l’entretien décider de ne pas continuer si cela n’a aucun intérêt pour vous. Je voudrais un entretien avec vous sur des sujets relatifs à la santé, à aux dernières expériences de recours aux soins pour faire face à des problèmes de santé survenus dans votre menage. Les informations que vous donnerez nous aiderons dans la suite de ce travail et dans la mise en œuvre de la lutte contre les maladies dans votre communauté et particulièrement dans la lutte contre le paludisme. Nous allons nous entretenir à peu près pour une demi-heure. Les informations venant de vous resteront confidentielles et votre nom n’apparaîtra pas dans le compte rendu qui va être fait au Ministère de la santé. Si vous voulez avoir des informations complémentaires sur ce travail vous pouvez contacter Dr Ibrahima Seck de l’Institut de Santé et Développement de l’UCAD aux contacts suivants :

Tél-Port : 77 634 13 31 ou Tél-Bur : 33 824 98 78 ;
email : iseck1@tulane.edu ..............................................................

Puisse-je m’entretenir avec vous? Oui [  ]  Non [  ] ➔ Remerciez le répondant et quittez.

---

**Information for the respondent (the person being interviewed)**

Hello Sir, Hello Madam, My name is: ____________________________.

*(Name of Investigator)*

I am here on behalf of a study being performed by the Ministry of Health and Social Action. This study is about community involvement in the home-based management of malaria. Your
community is among those selected randomly for this study. Your household is also one of the households selected randomly from the community. For this study, I would like to talk with the mothers and guardians of children less than five years of age. During the interview, the mothers and guardians should be the principal respondents, although they may be assisted by other household members on any of the questions. Please understand that you are not required to participate in this interview and that you can withdraw from this study at any time during the interview if you decide to do so. I would like to interview you about topics related to health, including the recent experiences you have had seeking care for health problems in your household. The information you provide will help us in the fight against disease in your community, especially in the fight against malaria. To complete this interview, we will need to talk for about 30 minutes. The information you provide will remain confidential and your name will not appear in the report about this study to the Ministry of Health. If you would like more information about this study, please contact:

Dr Ibrahima Seck, Institute of Health and Development of the University Cheikh Anta Diop (UCAD) at one of the phone numbers or the E-Mail address below:
Tél-Port (Cell): 77 634 13 31 ou Tél-Bur (Office): 33 824 98 78;
email: iseck1@tulane.edu

May I speak with you? Oui [ ]
Non [ ] Remerciez le répondant et quittez.
<table>
<thead>
<tr>
<th>Information géographique</th>
<th>Geographic Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGION (REGION)</td>
<td>____</td>
</tr>
<tr>
<td>DISTRICT (DISTRICT)</td>
<td>____</td>
</tr>
<tr>
<td>COMMUNAUTE/VILLAGE (COMMUNITY/VILLAGE)</td>
<td>____</td>
</tr>
<tr>
<td>Code pour région [       ]</td>
<td>Code pour district [     ]</td>
</tr>
<tr>
<td>Code pour communauté/village [ ]</td>
<td></td>
</tr>
</tbody>
</table>

| Distance du centre de santé du district: | 1= Proche, Close [ ] |
| Distance to the center of the health district: | 2= Éloigné, Far away [ ] |
| Si loin, quelle est la distance en km? | If it is far away, what is the distance in km? |

| Distance du Poste de santé: | 1= Proche, Close [ ] |
| Distance to the nearest Health Post: | 2= Éloigné, Far away [ ] |
| Si loin, quelle est la distance en km? | If it is far away, what is the distance in km? |

| Distance du DSDOM: | 0= Dans la même communauté, in the same community [ ] |
| Distance to a Community Health Worker: | 1= Proche, Close [ ] |
| 2= Éloigné, Far away [ ] |
| Si loin, quelle est la distance en km? | If the CHW is far away, what is the distance in km? |
# Partie 1: Information Socio-démographique
Tout d’abord je voudrais avoir des informations sur vous-même et sur votre ménage.

<table>
<thead>
<tr>
<th>Q. #</th>
<th>QUESTION</th>
<th>CODES</th>
<th>ALLER A Q.</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Notez le sexe, <em>Indicate gender</em></td>
<td>Féminin………………………………1</td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Quel est votre âge? <em>What is your age?</em></td>
<td>Mettre en années revolues………. Enter the number of completed years</td>
<td></td>
</tr>
</tbody>
</table>
| 103  | Avez-vous été scolarisé? *Have you been to school?* | Oui (Yes)…………………………01  
Non (No) ……………………02 | 105 |
| 104  | Quel est le plus haut niveau de scolarité atteint? *What was your highest level of education?* | Enseignement primaire…………………………01  
Sécondaire ……………………………02  
Supérieur…………………………03  
Cours du soir ……………………………04  
Ecole coranique…I….05  
Autre ……………………………………97  
(A spécifier, If other, specify) |  |
| 105  | Avez vous une profession? *Do you have a profession?* | Oui (Yes)…………………………1  
Non (No) ……………………2 | 107 |
| 106  | Laquelle? *Which one? What is your profession?* | Agriculture (Farmer) …………….01  
Pêche (Fishing) ……………02  
Elevage (breeding livestock)………03  
Commerce (trade) ………………04  
Salaré (salaried)………………….05  
Artisan (craftsman)………………06  
Affaires (business)………………07  
Autre (other) ………………………97  
(A spécifier, If other, specify) |  |
| 107  | Situation matrimoniale *Marital status* | Célibataire (single)…………………1  
Mariée (married)…………………2  
Veuve (widowed)………………….3  
Divorcée (divorced)……………..4  
Instance de divorce (waiting divorce) ……5 |  |
| 108  | Depuis combien de temps vous habitez dans cette communauté ou village? *How long have you lived in this community or village?* | Mette le nombre d’années revolues___________ Enter the number of completed years. |  |
Partie 2:
INFORMATIONS ET CONNAISSANCES SUR LA PRISE EN CHARGE A DOMICILE DU PALUDISME

INFORMATION AND KNOWLEDGE ABOUT HOME-BASED MANAGEMENT OF MALARIA

Je voudrais maintenant vous poser quelques questions sur la lutte contre le paludisme dans votre communauté. I would like to ask you some questions about the control of malaria in your community.

<table>
<thead>
<tr>
<th>Q. #</th>
<th>QUESTION</th>
<th>CODES</th>
<th>GO TO Q.</th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>La lutte contre le paludisme est elle menée dans votre communauté?</td>
<td>Oui (Yes)...................................................................................01</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Is the fight against malaria active in your community?</em></td>
<td>Non (No).....................................................................................02</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Ne sait pas (do not know)</em></td>
<td>.........................................................................................98</td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>Par qui elle est menée?</td>
<td>Par les agents de santé..................................................................01</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>How is the fight against malaria active?</em></td>
<td>by government health workers,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*What malaria control activities are being performed in your community?</td>
<td>by traditional healers</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>[Possibilité de réponses multiples] Multiple possible responses</em></td>
<td>Par les membres des communautés ...........................................02</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>by members of the community</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Les leaders communautaires..................................................05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>by community leaders</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Les associations et groupements.............................................06</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(by community associations)</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Les agents de santé communautaire et les relais</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>by government and community health workers</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.........................................................................................07</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Par tous ceux-ci *(by all these).............................................08</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Autre *(other)...........................................................................97</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(A préciser, If other, specify)</em></td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>Quelles sont les activités menées dans le cadre de la lutte contre le paludisme?</td>
<td>Utilisation des moustiquaires imprégnées..................................01</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>What control measures are being provided in the fight against malaria</em></td>
<td>Traitement préventif intermittent.............................................02</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>(for malaria control)</em></td>
<td>Prise en charge par les agents de santé.....................................03</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prise en charge par les relais et agents de santé communautaire ......04</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prise en charge par les dispensateurs de soins à domicile................05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prise en charge par les tradithérapeutes....................................06</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulvérisation intradomiciliaire.............................................07</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(A préciser, If other, please specify)</em></td>
<td></td>
</tr>
<tr>
<td>Q. #</td>
<td>QUESTION</td>
<td>CODES</td>
<td>GO TO Q.</td>
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<tr>
<td>------</td>
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<td>-------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| 204  | Quelles sont les activités menées dans le cadre de la prise en charge à domicile?  
What activities are being performed to support the home-based management of malaria?  
Information from community members  
ACT treatment by CHWs  
Utilization of RDTs by CHWs  
Referral of severe malaria by CHWs  
Treatment of malaria by Health workers  
Malaria treatment by traditional healers  
Home visits by CHWs  
Other | Information des membres de communauté.01  
Traitement avec les ACTs par les DSDOM..02  
Utilisations des TDRs par les DSDOM........03  
Reference aux formations sanitaires des cas graves par les DSDOM..........................04  
Prise en charge par les agents de santé.....05  
Prise en charge par les tradithérapeutes...06  
Visites à domicile par les DSDOM..........07  
Autre ............................................97  
(A préciser, If other specify) | |
| 205  | Avez-vous été particulièrement impliquées dans une ou plusieurs de ces activités?  
Have you participated in one or more of these activities? | Oui (Yes) .....................................01  
Non (No) ......................................02 | |
| 206  | Laquelle ou lesquelles?  
Which ones, i.e., which activities? | Information des membres de communauté.01  
Traitement avec les ACTs par les DSDOM..02  
Utilisations des TDRs par les DSDOM........03  
Reference aux formations sanitaires des cas graves par les DSDOM..........................04  
Prise en charge par les agents de santé.....05  
Prise en charge par les tradithérapeutes...06  
Visites à domicile par les DSDOM..........07  
Autre ............................................97  
(A préciser) | |
| 207  | Quelles sont les autres personnes impliquées dans la prise en charge à domicile?  
Which other people are involved in the home-based management of malaria?  
Health workers  
Traditional healers  
Members of the community  
Community associations  
Health workers and CHWs  
All of the above  
Other | Par les agents de santé.........................01  
Par les tradithérapeutes.......................02  
Par les membres des communautés ..........03  
Agents de santé et membres des communautés ........................................04  
Les leaders communautaires.................05  
Les associations et groupements.............06  
Les agents de santé communautaire et les relais ..............................................07  
Par tous ceux-ci..................................08  
Autre ............................................97  
(A préciser, If other, specify) | |
| 208  | Dans quelles activités elles sont particulièrement impliquées?  
What activities are involved?  
Information from community members  
ACT treatment by CHWs  
Referral of severe malaria to health centers  
Malaria treatment by health workers  
Malaria treatment by traditional healers  
Home visits by CHWs  
Other (please specify) | Information des membres de communauté.01  
Traitement avec les ACTs par les DSDOM.........................02  
Utilisations des TDRs par les DSDOM........03  
Reference aux formations sanitaires des cas graves par les DSDOM..........................04  
Prise en charge par les agents de santé.....05  
Prise en charge par les tradithérapeutes...06  
Visites à domicile par les DSDOM..........07  
Autre ............................................97  
(A préciser) | |
<table>
<thead>
<tr>
<th>Q. #</th>
<th>QUESTION</th>
<th>CODES</th>
</tr>
</thead>
</table>
| 209  | Existe-il des lieux où les membres de votre ménage vont pour se traiter en cas de paludisme? Are there places where members of your household go to receive treatment for malaria? | *Oui (Yes)…………………………………01*  
  *Non (No)…………………………………02* |
| 210  | Où vont-ils? Where do they go for treatment?  
  *Health center and government hospital*  
  *Health center and private hospital*  
  *Home of CHW*  
  *Home of traditional healer*  
  *Both health center and home of CHW*  
  *Both conventional and traditional medicine*  
  Other (please specify) | *Centre de santé et hôpitaux de l’Etat………01*  
  *Centre de santé et hôpitaux privés ………02*  
  *Chez un DSDOM…………………………03*  
  *Chez un tradithérapeute…………………………04*  
  *A la fois au centre de santé et chez le DSDOM…………………………05*  
  *A la fois par la médecine conventionnelle et traditionnelle ………06*  
  *Autre …………………………………………97*  
  *(A spécifier)* |
| 211  | Si non que font-ils? If they do not go for treatment, what do they do?  
  *Home treatment*  
  *Do nothing*  
  Other (please specify) | Se traitent à domicile…………………………01  
  Ne font rien……………………………………..02  
  Autre *(a spécifier)* |

**Partie 3: EXPERIENCE ET PERCEPTION DE LA PECADOM**

Je voudrais vous poser des questions sur votre expérience de la prise en charge à domicile du paludisme ici.

<table>
<thead>
<tr>
<th>Q. #</th>
<th>QUESTION</th>
<th>CODES</th>
</tr>
</thead>
</table>
| 301  | La dernière fois que votre enfant de moins de cinq ans est tombé malade où a-t-il été traité en premier lieu?  
  *The last time that your child less than five years of age fell ill, where was he treated?* | Centre de santé et hôpitaux de l’Etat ………01  
  *Health center at government hospital*  
  Centre de santé et hôpitaux privés……………………02  
  *Health center at private hospital*  
  Home of CHW  
  Chez un DSDOM…………………………03  
  *Home of traditional healer*  
  A la fois au centre de santé et chez le DSDOM……05  
  *Both health center and home of CHW*  
  A la fois par la médecine conventionnelle et traditionnelle ………06  
  *(traditional and conventional medicine)*  
  *Autre …………………………………………97*  
  *(A spécifier, If other, specify)* |
| 302  | Il avait à peu près quel âge?  
  *At that time, how old was the child?* | Age en jour *(in years)*  
  Age en mois *(in months)*  
  Age en année *(in years)* |
| 303  | Il y a de cela combien de temps?  
  *How long was the child sick?* | Nombre de jours *(days)*  
  Nombre de semaines *(weeks)*  
  Nombre de mois *(months)* |
<table>
<thead>
<tr>
<th>Q. #</th>
<th>QUESTION</th>
<th>CODES</th>
</tr>
</thead>
<tbody>
<tr>
<td>304</td>
<td>Vous y êtes allés combien de temps après le début de la fièvre ou « corps chaud »? How long from the start of the fever (&quot;hot body&quot;) to treatment?</td>
<td>&lt; 24 heures (&lt; 24 hours)..............................01 24 à 48 heures (24-48 hrs).........................02 49 à 72 heures (49-72 hrs)......................03 &gt; 72 heures (&gt;72 hrs)...............................04</td>
</tr>
<tr>
<td>305</td>
<td>De quoi souffrait-il? What was the cause of the child’s illness?</td>
<td>Paludisme (malaria) ..................................01 Autres (other causes) ...............................02 Ne sait pas (do not know) .......................97</td>
</tr>
<tr>
<td>306</td>
<td>Le malade a-t-il reçu des médicaments? Was the child treated with antimalarial drugs?</td>
<td>Oui (Yes)..............................................01 Non (No)..............................................02</td>
</tr>
<tr>
<td>307</td>
<td>Si oui où? If yes (if the child was treated with antimalarial drugs), where was the child treated?</td>
<td>Centre de santé et hôpitaux de l’Etat..........01 Health center and government hospital Centre de santé et hôpitaux privés ............02 Health center and private hospital Chez un DSDOM......................................03 Home of CHW Chez un tradithérapeute..........................04 Home of traditional healer A la fois au centre de santé et chez le DSDOM ....05 Both at health center and home of CHW A la fois par la médecine conventionnelle et traditionnelle .........................06 Both conventional and traditional medicine Ils ont été donnés .....................................07 They were given ?? Autre ..............................................97 (A specifier, if other, please specify)</td>
</tr>
<tr>
<td>308</td>
<td>Si le malade a été amené chez le DSDOM, votre enfant malade a-t-il été piqué avant le traitement? If the patient was taken to the community health worker (CHW), was there a finger stick before the treatment?</td>
<td>Oui (Yes)..............................................01 Non (No)..............................................02</td>
</tr>
<tr>
<td>309</td>
<td>Si l’enfant malade a été amené chez le DSDOM n’a pas été piqué, le DSDOM a-t-il dit que: If the community health worker did not do a finger stick, the community health worker (CHW) said:</td>
<td>Ce n’était pas nécessaire..........................01 (the finger stick was not necessary) Il n’avait pas le matériel pour cela..................02 (the supplied needed were not available) Autre .....................................................97 (other) (A specifier, please specify)</td>
</tr>
<tr>
<td>310</td>
<td>Après examen, Le DSDOM vous a-t-il dit que votre enfant malade avait le paludisme? After the examination, did the CHW say the child had malaria?</td>
<td>Oui (Yes)..............................................01 Non (No)..............................................02</td>
</tr>
<tr>
<td>Q. #</td>
<td>QUESTION</td>
<td>CODES</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>-------</td>
</tr>
</tbody>
</table>
| 311  | Le DSDOM a-t-il donné ensuite à votre enfant malade un traitement avec un ACT? *Did the CHW treat your child with an ACT?* | Oui (Yes)……………………………………………..01  
                  Non (No)……………………………………………02 |  |
| 312  | Si non, Le DSDOM a-t-il recommandé que votre enfant soit transféré à une formation sanitaire? *If the child was not treated, did the CHW recommend transfer to a health center?* | Oui (Yes)……………………………………………..01  
                  Non (No)……………………………………………02 |  |
| 313  | Si Oui, Avez-vous à utiliser les médicaments donnés par le DSDOM? *If Yes, did you use the medicine provided by the CHW?* | Oui (Yes)……………………………………………..01  
                  Non (No)……………………………………………02 | 315 |
| 314  | Le malade a-t-il été guéri après la prise du médicament (ACT)? *Was the child cured after taking the drug (ACT)?* | Oui (Yes)……………………………………………..01  
                  Non (No)……………………………………………02 |  |
| 315  | Si non où est-ce que vous l'avez amené ensuite? *If the child was not cured, where did you next take the child?* | Centre de santé et hôpitaux de l'Etat ......................01  
                  Health center and government hospital  
                  Centre de santé et hôpitaux privés .....................02  
                  Health center and private hospital  
                  Chez un DSDOM...........................................03  
                  Home of CHW  
                  Chez un tradithérapeute ..................................04  
                  Home of traditional healer  
                  A la fois au centre de santé et chez le DSDOM ..............05  
                  Both health center and home of CHW  
                  A la fois par la médecine conventionnelle et traditionnelle .................................................06  
                  Both conventional and traditional medicine  
                  Autre ..........................................................97  
                  (A specifier, If other please specify) |  |
| 316  | Etes-vous satisfait du travail du DSDOM? *Were you satisfied with the work of the CHW?* | Oui (Yes)……………………………………………..01  
                  Non (No)……………………………………………02 |  |
| 317  | Si non pourquoi? *If not, why were you not satisfied ?* | Il était absent.................................................01  
                  He was not there (was absent)  
                  Il ne s’est pas bien occupé de moi ou du malade...02  
                  He was not interested in my child’s illness  
                  Il n’avait pas de médicaments........................................03  
                  There were no medications (drugs)  
                  Il ne m’a pas piqué............................................04  
                  He did not do a finger stick  
                  Je n’ai pas pu payer les médicaments ..................... 05  
                  I could not pay for the drugs  
                  Autre ..........................................................97  
                  (A spécifier, If other, please specify) |  |
<table>
<thead>
<tr>
<th>Q. #</th>
<th>QUESTION</th>
<th>CODES</th>
<th>GO TO Q.</th>
</tr>
</thead>
<tbody>
<tr>
<td>318</td>
<td>Etes-vous prêt à consulter le DSDOM une autrefois en cas de maladie?</td>
<td>Oui (Yes) .......................................................................................01</td>
<td>318</td>
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<tr>
<td></td>
<td>Would you consult the CHW for another illness?</td>
<td>Non (No) .........................................................................................02</td>
<td></td>
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<td>319</td>
<td>Si non pourquoi? If not, why not?</td>
<td>Il était absent .............................................................................01</td>
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<td>He was not there (was absent)</td>
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<td>Il ne s’est pas bien occupé de moi ou du malade .........................02</td>
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<td>Il n’avait pas de médicaments .................................................03</td>
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<td>There were no medications (drugs)</td>
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<td>Il ne m’a pas piqué ......................................................................04</td>
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<td>He did not do a finger stick</td>
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<td>Je n’ai pas pu payer les médicaments .......................................05</td>
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<td>I could not pay for the drugs</td>
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<td>Autre ............................................................................................97</td>
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<td>(A spécifier, If other, please specify)</td>
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<tr>
<td>320</td>
<td>Est-ce que le traitement par les DSDOM a apporté quelque chose à votre ménage? Does treatment by a CHW bring something positive to your household?</td>
<td>Oui (Yes) .......................................................................................01</td>
<td>320</td>
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<td></td>
<td></td>
<td>Non (No) .......................................................................................02</td>
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<tr>
<td>321</td>
<td>Si non pourquoi? If not, why not?</td>
<td>Cela n’a rien changé .......................................................................01</td>
<td>321</td>
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<td></td>
<td></td>
<td>This has not changed</td>
<td></td>
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<td>Perte de temps car il renvoie au centre de santé ..........................02</td>
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<td>Waste of time because it refers to the Health Center</td>
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<td>On dépense plus ............................................................................03</td>
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<td>It is more expensive</td>
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<td>Le DSDOM qui vient de notre ménage consacre trop de temps à ce travail ..........................................................................................04</td>
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<td>The CHW who comes to our house takes too long with his work</td>
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<td>Autre ............................................................................................97</td>
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<td>(A spécifier, If other, please specify)</td>
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<td>322</td>
<td>Voulez-vous que le traitement par des DSDOM continue dans votre communauté? Should home-based management of malaria by CHWs continue in your community?</td>
<td>Oui (Yes) .......................................................................................01</td>
<td>322</td>
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<td></td>
<td></td>
<td>Non (No) .......................................................................................02</td>
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<td>323</td>
<td>Si non pourquoi? If not, why not?</td>
<td>Cela n’a rien changé ........................................................................01</td>
<td>323</td>
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<td>This has not changed</td>
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<td>Perte de temps car il renvoie au centre de santé ..........................02</td>
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<td>On dépense plus ............................................................................03</td>
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<td>Autre ............................................................................................97</td>
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**REMERCIER LE REPONDANT AVANT DE PRENDRE CONGE DE LUI**
### EVALUATION DE LA PRISE EN CHARGE DU PALUDISME A DOMICILE

**EVALUATION OF THE HOME-BASED MANAGEMENT OF MALARIA**

**ENTRETIEN AVEC LES INFIRMIERS CHEF DE POSTE**

**INTERVIEW WITH THE HEAD NURSE OF THE HEALTH POST**

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<th>Région</th>
<th>District</th>
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</table>

| Poste de santé de (Health Post) | .......................................................... |
| Date de l'entretien (Date of Interview) | .......................................................... |
| Nom de l'interlocuteur (Name of Contact) | .......................................................... |
| Homme ou Femme (Man or Woman) | .......................................................... |
| Nom de l'enquêteur (Name of Interviewer) | .......................................................... |
| Temps début entretien (Time interview began) | .......................................................... |
| Temps fin de l'entretien (Time interview finished) | .......................................................... |

**Information à l'intention d'interlocuteur**

Bonjour/Bonjour Monsieur/Madame le/la………. Nous voudrons échanger avec vous sur la documentation relative à la PECADOM pour compléter les informations que vous avez déjà données.

……………………………………………………………………………………

Pourriez-vous mettre à notre dispositions tous les documents relatifs à la mise en œuvre de la PECADOM Oui [ ] Non [ ]

---

**Information à l'intention d'interlocuteur**

Hello Sir, Hello Madame le/la………. We would like to share with you the documentation for Home-based Management of Malaria (HMM) to supplement the information you have already provided.

……………………………………………………………………………………

Could you provide us copies of the documents you have about the implementation of Home-based Management of Malaria (PECADOM)? Oui [ ] Non [ ]
1. **Quels sont Les outils de travail?** *(What are the tools that work?)*
   - Supports de rapports *(Media reports)*
   - Rapports venant des DSDOM *(Reports from the CHW)*
   - Rapports transmis au niveau district *(Reports sent to the district level)*
   - Autres supports disponibles *(Other materials available)*

2. **Examen de registre de consultation du poste de santé**
   **Examen des registres de Septembre à Décembre 2012.**
   - Nombre de consultations *(Number of consultations (patient visits))*
   - Nombre de cas confirmés de paludisme simple chez enfants de moins de cinq ans *(Number of confirmed cases of uncomplicated malaria in children less than five years of age)*
   - Nombre de cas de paludisme grave chez les enfants de moins de cinq ans reçus au Poste de santé. *(Number of cases of severe malaria in children less than five years received at the health post.)*
   - Nombre de cas de cas de paludisme grave chez les enfants de moins de cinq ans référés. *(Number of cases of severe malaria referred among children less than five years of age.)*
   - Nombre de cas de paludisme grave chez les enfants de moins de cinq ans référés par les DSDOM *(Number of severe malaria cases in children less than five years referred by CHWs)*
   - Nombre de décès chez les enfants de moins de cinq ans *(Number of deaths among children less than 5 years of age)*
   - Nombre de décès liés au paludisme chez les enfants de moins de cinq ans. *(Number of malaria deaths among children less than 5 years of age.)*

**NB:**
- Pour chaque cas de paludisme grave reçu ou référé, préciser le village d’origine, *(Specify the original (home) village for each severe malaria case received or referred elsewhere),*
- Pour cas de décès d’enfant de moins de cinq ans, préciser le village d’origine, *(Specify the original (Home) village for death of a child less than 5 years of age.)*

**REMERCIER LE REPONDANT AVANT DE PRENDRE CONGE DE LUI**
RESEAU-IN DEPTH

Questionnaire standard d’autopsie verbale

Ce travail fait partie des activités du projet INDEPTH-MTIMBA
This work is part of the project activities of INDEPTH-MTIMBA

Instructions à l’interviewer: Présentez-vous et expliquez l’objectif de votre visite. Demander à parler à la mère de l’enfant ou à un autre adulte ayant pris soins du défunt pendant la maladie qui a conduit à son décès. Si cela n’est pas possible, informez-vous sur la période pendant laquelle la mère ou la personne ayant pris soins du malade sera de retour à la maison et repassez dans le ménage pour l’interview.

Instructions to the interviewer: Introduce yourself and explain the purpose of your visit. Ask to speak with the child's mother or another adult who took care of the child during the illness that led to their death. If this is not possible, learn when the mother or other adult who took care of the child will return to the house and return to the household at that time for an interview.

Adapté à partir du questionnaire standard d’autopsie verbale pour nourrissons et enfants (WHO/CDS/CSR/ISR/99.4) et des questionnaires existants dans les sites INDEPTH.
This questionnaire was adapted from a standard verbal autopsy for infants and children (WHO/CDS/CSR/ISR/99.4) and questionnaires at the INDEPTH study sites.
PARTIE 1: MORTALITÉ NEONATALE
(enfants de 0-27 jours d’âge)

SECTION 1: INFORMATIONS GENERALES SUR LE DEFUNT
(General Information on the Deceased)

1.1 Nom et prénom de l’enfant (Surname and first name) …………………………………………………… ID: PERMID

1.2 Nom du village (Name of village)…………………………………………………………… ID: VILLGID

1.3 Numéro de concession /ménage (Number of household) …………………………………………………… ID: COMPID

1.4 Date de naissance:…(jj/mm/aa) (Date of birth: dd/mm/yy) …………………………………………………… ID: DOB

1.4.1 Où l’enfant est-il né?. (Where was the child born?)
1. Hôpital (hospital)
2. Autre formation sanitaire (other health facility)
3. Sur la route de l’hôpital ou d’une autre formation sanitaire (on the way to the hospital or other health facility)
4. Domicile (at home) …………………………………………
5. Autre (préciser, If other, specify): …………………………………………

1.4.2 L’accouchement a t-il été assisté par (The delivery was assisted by)
1. Un agent de santé (Health worker)
2. Accoucheuse villageoise formée (Trained [certified] village midwife)
3. Accoucheuse villageoise sans formation (Untrained [traditional] village midwife)
4. Membres de la famille (Members of the family)
5. Autre (If other, specify) …………………………………………

1.5 Sexe de l’enfant: (Gender of the child) ………………………………………………………………………… ID: SEXD

1.6 Date du décès: (jj/mm/aa) (Date of death (dd/mm/yr)) ………………………………………………………………………… ID: DOD

1.7 Age au moment du décès (Age at the time of death, in days) …………………………………………………… ID: DAYS

1.8 Où l’enfant est-il décédé? (Where did the child die?)
1. Hôpital (hospital)
2. Autre formation sanitaire (other health facility)
3. Sur la route de l’hôpital ou d’une autre formation sanitaire
4. Domicile
5. Autre (préciser) (If other, specify)

1.8.1 Dans le cas où le décès a eu lieu dans une structure sanitaire, enregistrez son nom et son adresse:

For cases in which the death occurred in a health facility, provide the child’s name and address:

_______________________________________________________________________________________
_______________________________________________________________________________________
SECTION 2. INFORMATIONS DE BASE SUR L’INTERVIEW

BASIC INFORMATION ABOUT THE INTERVIEW

2.1. Langue d’interview (Language of the interview): ………………………………………

2.2 Code de l’interviewer (numéro d’identification): FSCODE

2.3 Date de l’interview: (jj/mm/aa) (Date of Interview dd/mm/yr) DINT

| Date de la première tentative d’entretien (Date of the first attempt to interview) |
| Date de la deuxième tentative d’entretien (Date of the second attempt to interview) |
| Date de la troisième tentative d’entretien (Date of the third attempt to interview) |
| Date de vérification des fiches par le superviseur (Date of verification of records by supervisor) |
| Date de saisie à l’ordinateur (Date of data entry on the computer) |

SECTION 3: INFORMATIONS SUR LE RÉPONDANT

INFORMATION ABOUT THE RESPONDENT

3.1 Nom et prénom (s) du principal répondant: …………………………………………………..

3.2 Quelle est la relation entre le principal répondant et l’enfant décédé? (Encercler le chiffre correspondant)

1. Mère (mother)  
2. Père (father)  
3. Grandmère (grandmother)  
4. Grand-père (grandfather)  
5. Tante (aunt)  
6. Oncle (uncle)  
7. Autre (préciser, If other specify):

3.3 Quel est l’âge du répondant? How old is the respondent?

3.4 Quel est le nombre d’années d’instruction (éducation formelle) du répondant?
How many years of education (formal education) of the respondent?

3.5 Quel est le niveau d’instruction le plus élevé atteint par le répondant:

1. Primaire (primary school)  
2. Secondaire (secondary school)  
3. Tertiaire (≥ universitaire; university or higher)  
4. Aucune (none)

3.6.1 : Parmi les personnes présentes au moment de l’interview, lesquelles ont assisté l’enfant pendant la maladie qui a entraîné son décès (répondre par oui ou non)?  
Among those present at the time of the interview, which family members attended the child during the illness that ended in their death (yes or no)?
3.6.2 D’autres personnes seraient-elles présentes au moment de l’interview? 
(Were there other individuals present during the time of the interview?)

3.6.3 Comment se porte actuellement la mère du bébé? 
(How is the baby’s mother now?)

3.6.4 Comment se porte actuellement le père du bébé? 
(How is the baby’s father now?)

3.6.5 L’un des parents du bébé a-t-il ou a-t-il eu le VIH/SIDA? 
(Does (or did) one of the baby’s parents have AIDS?)

3.6.6 L’enfant avait-il le VIH/SIDA? 
(Did the child have AIDS?)

3.6.7 Un membre de la famille a-t-il été diagnostiqué tuberculeux? 
(Was a member of the family diagnosed with tuberculosis?)

3.6.7.1 Si oui, cette personne vit-elle ou a-t-elle vécu dans la même maison que le bébé? 
(If yes, did [or does] this person live in the same house with the child who died?)
SECTION 4: QUESTION OUVERTE SUR L'HISTOIRE DE LA MALADIE

4.1 Pouvez-vous me parler de la maladie qui a conduit au décès du bébé?

Instructions à l'interviewer – Laissez le répondant vous parler de la maladie du défunt selon ses propres mots. Ne susciter aucune réponse, sauf pour demander s’il y a quelque chose d’autre après que le répondant ait fini de raconter. Continuer à poser cette question jusqu’à ce que le répondant dise qu’il n’y a plus rien d’autre. En enregistrant l’histoire de la maladie, veuillez souligner tout terme inhabituel.
Prenez le temps de noter tous les signes qui ont été spontanément mentionnés par le répondant lors de la narration de l’histoire de la maladie. Utiliser le tableau ci-dessous comme guide.

<table>
<thead>
<tr>
<th>4.2 Signes</th>
<th>Combien de temps après le début de la maladie, les signes ont-ils commencé</th>
<th>Durée des signes (en jours)</th>
<th>Sévérité: 1. bénin ou modéré 2. grave</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1</td>
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<td>4.2.9</td>
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<td>4.2.10</td>
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4.3 A quel moment le problème/la maladie a commencé ?

- 1. Immédiatement après la naissance
- Après une période de bonne santé

4.4 Quelle a été la durée de la maladie qui a immédiatement précédé le décès du bébé (en jours)

4.5 Le bébé a-t-il reçu des soins ailleurs qu’à la maison pendant la maladie?

- 1. Oui
- 2. Non

Si la réponse est 2 ou 999, allez à la section 5

4.5.1 Combien de jours après le début de la maladie, les soins ont-ils été recherchés?

4.5.2 Où (chez qui) est-ce que les soins ont été administrés (encercler toutes les réponses)

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<tr>
<td>2. Leader religieux</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>3. Hôpital public (CHN, CHR, CMA, CM)</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>5. Agent de santé communautaire</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
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</tbody>
</table>
8. Vendeur de médicament (marché, boutique) 
   1. Oui  2. Non  999. NSP  

9. Parents ou amis 
   1. Oui  2. Non  999. NSP  

10. Autre (préciser) 
   ................................................................. 
   1. Oui  2. Non  999. NSP  

Après que le répondant ait fini poser la question: Avez-vous recherché les soins autre part?

4.5.3 Où avez-vous recherché les soins en premier lieu?  
(Marquez un chiffre correspondant aux réponses ci-dessus (1-10))

<table>
<thead>
<tr>
<th>Réponse</th>
<th>888. NA</th>
<th>999.NSP</th>
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4.5.4 Où avez-vous recherché les soins en deuxième lieu?  
(Marquez un chiffre correspondant aux réponses ci-dessus (1-10))

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<tr>
<th>Réponse</th>
<th>888. NA</th>
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4.5.5 Où avez-vous recherché les soins en troisième lieu?  
(Marquez un chiffre correspondant aux réponses ci-dessus (1-10))

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<tr>
<th>Réponse</th>
<th>888. NA</th>
<th>999.NSP</th>
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SECTION 5: ACCIDENTS ET BLESSURES

5.1 Le bébé est-il décédé suite à un accident ou une blessure? 
   1. Oui  2. Non  999.NSP  

5.1.1 Si oui, de quel type d’accident ou de blessure s’agit-il? Laissez le répondant répondre spontanément.

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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.1.2 Si la réponse est 6, préciser de quel animal s’agit-il?  

5.1.3 Le bébé est-il décédé sur le lieu de l’accident (blessure)?  
   1. Oui  2. Non  999.NSP  

5.1.4 Combien de temps après l’accident ou la blessure le bébé a-t-il survécu?  
   1. Décédé sur le champ  2. <24 heures  3. >=24 heures  999.NSP  

5.1.5 A t-il reçu des soins médicaux avant le décès?  
   1. Oui  2. Non  999.NSP  

Si l’enfant est décédé suite à un accident/blessure aller à la section 7.0 arrêtez l’interview à ce niveau.
**SECTION 6: AUTRES MALADIES NEONATALES**

6.1 L’enfant était-il issu d’un accouchement unique ou multiple (jumeaux, triplet etc.) ?

<table>
<thead>
<tr>
<th>1. Unique</th>
<th>2. Multiple</th>
</tr>
</thead>
</table>

6.2 Où l’enfant est-il né?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Domicile</td>
<td>5. Autre (préciser)</td>
<td>..........................................................</td>
</tr>
</tbody>
</table>

6.3 Qui est-ce qui a assisté la mère lors de l’accouchement ?

<table>
<thead>
<tr>
<th>1. Médecin</th>
<th>2. Sage femme / accoucheuse auxiliaire etc.</th>
<th>3. Accoucheuse villageoise</th>
</tr>
</thead>
</table>

6.4 La mère du bébé avait-elle des complications pendant les 12 dernières semaines (3 mois) de la grossesse ?

<table>
<thead>
<tr>
<th>1.Oui</th>
<th>2.Non</th>
<th>999.NSP</th>
</tr>
</thead>
</table>

6.4.1 Si oui, quel(s) type(s) de complication(s) a-t-elle eu pendant les derniers moments de la grossesse ou de l’accouchement? *(Encercler toutes les réponses mentionnées)*

<table>
<thead>
<tr>
<th>La mère a eu des convulsions</th>
<th>1. Oui</th>
<th>2. Non</th>
<th>999. NSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saignement abondant avant ou pendant l’accouchement</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>Rupture de la poche des eaux un jour ou plus avant le début des contractions</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>Accouchement difficile/travail prolongé (&gt;=12 heures)</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>Accouchement après intervention chirurgicale (préciser) ..........................................................</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>Enfant sorti les pieds en avant (présentation de siège)</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>Mère malade durant la période de grossesse ou de l’accouchement</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
<tr>
<td>Autre (préciser) ................................................................................</td>
<td>1. Oui</td>
<td>2. Non</td>
<td>999. NSP</td>
</tr>
</tbody>
</table>

*Après que le répondant ait fini, demander s’il y avait autre chose? ..........................................................*  

6.5 Combien de mois la grossesse a-t-elle duré ?

<table>
<thead>
<tr>
<th>999.NSP</th>
</tr>
</thead>
</table>

6.6 La mère de l’enfant avait-elle été vaccinée contre le tétanos depuis qu’elle a atteint l’âge de procréation (avant cette grossesse)?

<table>
<thead>
<tr>
<th>1.Oui</th>
<th>2.Non</th>
<th>999.NSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVACA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Si oui, combien de doses a-t-elle reçu?

<table>
<thead>
<tr>
<th>999.NSP</th>
</tr>
</thead>
</table>

6.7 La mère de l’enfant a-t-elle été vaccinée contre le tétanos pendant la grossesse?

<table>
<thead>
<tr>
<th>1.Oui</th>
<th>2.Non</th>
<th>999.NSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVACP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NBDOA**
Si oui combien de doses?

6.8 A la naissance, le bébé présentait-il une malformation importante pouvant entraîner la mort ?
(expliquer la malformation en insistant sur la différence entre malformation létale et non létale)

6.8.1 Si oui décrire brièvement:...........................................................................................................

6.9 A la naissance, le bébé était-il : (lire tous les choix)
1. Très petit 2. Plus petit que la normale 3. normal 4. plus grand que la normale

6.10 Y avait-il des contusions ou de signes de blessure sur le corps de l’enfant après la naissance?

6.11 Le bébé avait-il des difficultés respiratoires aussitôt après sa naissance ? (Note: Ne pas inclure le gasp ou les très courtes respirations)

6.12 Le bébé avait-il des difficultés respiratoires après une période de bonne santé ? (Ne pas inclure le gasp ou les très courtes respirations)

6.13 Le bébé avait-il des difficultés à téter aussitôt après la naissance?
6.13.1 Si oui, Pendant combien de temps le bébé a-t-il eu des difficultés à téter

6.14 Le bébé avait-il des difficultés à téter après une période de bonne santé?
6.14.1 Si oui, pendant combien de temps le bébé a-t-il eu des difficultés à téter ?

6.15 Le bébé a-t-il crié à la naissance?
Si non ou NSP , aller à la question 6.16

6.16 Le bébé a-t-il eu des difficultés à crier après une période de bonne santé ?

6.17 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu des spasmes ou des convulsions

6.18 Pendant la maladie qui a entraîné le décès, le bébé est-il devenu aréactif ou inconscient?

6.19 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu la fontanelle bombée?

6.20 Pendant la maladie qui a entraîné le décès, avait-il les yeux ou la peau jaune?

6.21 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu des rougeurs ou un écoulement autour de la base du cordon ombilical ?

6.22 Pendant la maladie qui a entraîné le décès, y avait-il des zones sur le corps du bébé où la peau était rouge, chaude ou desquamée?
99

6.23 Pendant la maladie qui a entraîné le décès, avait-il des éruptions cutanées avec des vésicules purulentes?  
1.Oui  2.Non  999.NSP  SRAS

6.24 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu la fièvre?  
1.Oui  2.Non  999.NSP  FEV

6.24.1 Si oui, combien de jours la fièvre a-t-elle duré?  
999.NSP  DFEV

6.25 Pendant la maladie qui a entraîné le décès, le corps du bébé était-il froid au toucher?  
1.Oui  2.Non  999.NSP  COLD

6.26 Pendant la maladie qui a entraîné le décès, le bébé a-t-il saigné à quelque endroit que ce soit ?  
1.Oui  2.Non  999.NSP  BLEE

6.26.1 Si oui demander où exactement ?……………………………………………….

6.27 Pendant la maladie qui a entraîné le décès, le bébé a-t-il vomi ou eu des tuméfactions à l’abdomen ?  
1.Oui  2.Non  999.NSP  VOMI

6.28 Pendant la maladie qui a entraîné le décès, le bébé a-t-il fait la diarrhée (selles plus fréquentes et plus liquides que d’habitude)?  
Si non ou NSP aller à la question 6.29

6.28.1 Si oui demander: pendant combien de jours les selles ont-elles été fréquentes ou liquides ?  
999.NSP  STOOD

6.28.2 : Au moment où les selles étaient plus fréquentes, combien de selles le bébé faisait-il par jour?  
999.NSP  STOON

6.28.3 Y avait-il du sang dans les selles du bébé ?  
1.Oui  2.Non  999.NSP  BLOOS

6.28.4 Pendant la diarrhée, le bébé a-t-il été réhydraté oralement (sels de réhydratation orale, eau de riz sucrée/salée, solutions salées/sucrées  
1.Oui  2.Non  999.NSP  DRINK

6.29 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu des difficultés respiratoires?  
1.Oui  2.Non  999.NSP  DIFBR

6.29.1 Si oui: pendant combien de jours il a-t-il présenté des difficultés respiratoires?  
999.NSP  DIFBRD

6.30 Pendant la maladie qui a entraîné le décès, la respiration du bébé était-elle rapide (tachypnée)?  
1.Oui  2.Non  999.NSP  FASBR

Si non ou NSP, aller à la section 6.31)

6.30.1 Si oui demander: combien de jours la respiration rapide a-t-elle duré?  
999.NSP  FASBRD

6.30.2 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu un balancement thoraco-abdominal ?  
1.Oui  2.Non  999.NSP  INDRC

6.31 Pendant la maladie qui a entraîné le décès, le bébé a-t-il eu la toux?  
1.Oui  2.Non  999.NSP  COUG
6.31.1 Si oui demander : combien de jours la toux a duré?

6.32 Pendant la maladie qui a entraîné le décès, a-t-il eu des pauses respiratoires (courtes périodes d’arrêt et de reprise de la respiration)?

7.0: TRAITEMENT ET DOSSIER DU DEFUNT

7.1 Traitement

<table>
<thead>
<tr>
<th>Source</th>
<th>Résumé des détails</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificat de décès</td>
<td>Cause du décès:</td>
</tr>
<tr>
<td>Autorisation d’inhumer</td>
<td>Cause du décès:</td>
</tr>
<tr>
<td>Résultats d’autopsie</td>
<td>Cause du décès:</td>
</tr>
<tr>
<td>Carnet SMI</td>
<td></td>
</tr>
<tr>
<td>Prescriptions médicales</td>
<td></td>
</tr>
<tr>
<td>Carnet de soins</td>
<td></td>
</tr>
<tr>
<td>Certificat de constatation de décès</td>
<td>Diagnostic:</td>
</tr>
<tr>
<td>Autres documents médicaux</td>
<td></td>
</tr>
<tr>
<td>Résultats de laboratoire</td>
<td></td>
</tr>
<tr>
<td>Aucun document disponible</td>
<td></td>
</tr>
</tbody>
</table>

REMERCIEZ LE REPONDANT POUR SA COOPERATION

8. Commentaires et observations de l’interviewer.

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

Certifié correct le: ___________________ Par: ___________________

CCB
References (Bibliography)


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BIOGRAPHY

Ibrahima SECK, is a Medical Doctor, Public health specialist, Director of studies at the Institute of Health and Development, Senior Lecturer at the Medicine Preventive and Public health service, Faculty of Medicine, Pharmacy and Odontology, at the University Cheikh Anta Diop, Dakar Senegal.

He has more than twelve years working on the public health area. He was the head medical of the Matam district (Senegal), National Control Tuberculosis Program Manager. Since 2001, he is based at the Public health service and Preventive Medicine, University Cheikh Anta Diop. He provided several consultancies in Malaria with WHO, RBM, Malaria no More, USAID, World Bank, UNICEF, etc. His key areas are:

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- Community health assessment;
- Global Fund against Malaria, Tuberculosis and AIDS proposal development.