The household burden of uncomplicated malaria treatment in sub-Saharan Africa

A review

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09-12-2012

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Bachelor thesis Economics and Business Economics

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December 2012

Cover picture:

Photo of a man carrying his daughter, who is being treated for malaria by International Medical Corps doctors, at Akobo County Hospital in South Sudan.[Brookings, 2012]

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Abstract

In 2003 Chima et *al.* published a review on the economic impact of malaria to sub-Saharan African households. Since then several initiatives such as the Roll Back Malaria program and the Affordable Medicines Facility malaria have been initiated. In addition many new studies have been conducted in this field. Now the question has arisen whether these initiatives have led to a decrease in the burden of uncomplicated malaria treatment to sub-Saharan African households. To address this question, this thesis reviews available scientific literature from 2003 to September 2012, related to the household burden of uncomplicated malaria treatment in sub-Saharan Africa, and draws conclusions on future policy making and future research initiatives.

Although many differences exist between areas and countries the results of this thesis suggest that the economic household burden of malaria treatment to sub-Saharan African countries is (still) extensive. For many people in sub-Saharan Africa the costs for the treatment of one case of malaria are such a high percentage of monthly income/expenditure that it leads to (household) catastrophe. Also few countries in sub-Saharan Africa have healthcare insurance or subsidies for malaria treatment available, leading to extra catastrophe. Lastly, not in every healthcare facility appropriate treatment for malaria is available, resulting in many ill people receiving incorrect or less effective treatment.

These issues may be resolved by implementing several different policies. One may be making more public healthcare facilities available to the public. Another, more easily implementable solution, may be allowing at least part of the retail sector to sell anti malarial drugs, and in particular the newest first line treatments. In several sub-Saharan African countries drug shops already have permission to sell these treatments and sometimes buy them at a subsidized price. In terms of future research, this may be directed at the differences in household burden of uncomplicated malaria treatment between rural and urban areas or directed at the differences in household burden of uncomplicated malaria treatment in different socio-economic groups. Lastly, in order to continue long term subsidies and discounts for malaria treatment in sub-Saharan African countries more research needs to be conducted into sustainable subsidy schemes.

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1. Introduction

Malaria is a mosquito borne infectious disease which, if not treated properly can be life threatening. In 2010 it was responsible for an estimated 655 000 deaths worldwide, of which over 90% occurred in sub-Saharan Africa [1] [World Health Organization, 2011] Figure 1 shows a map of all sub-Saharan African countries.

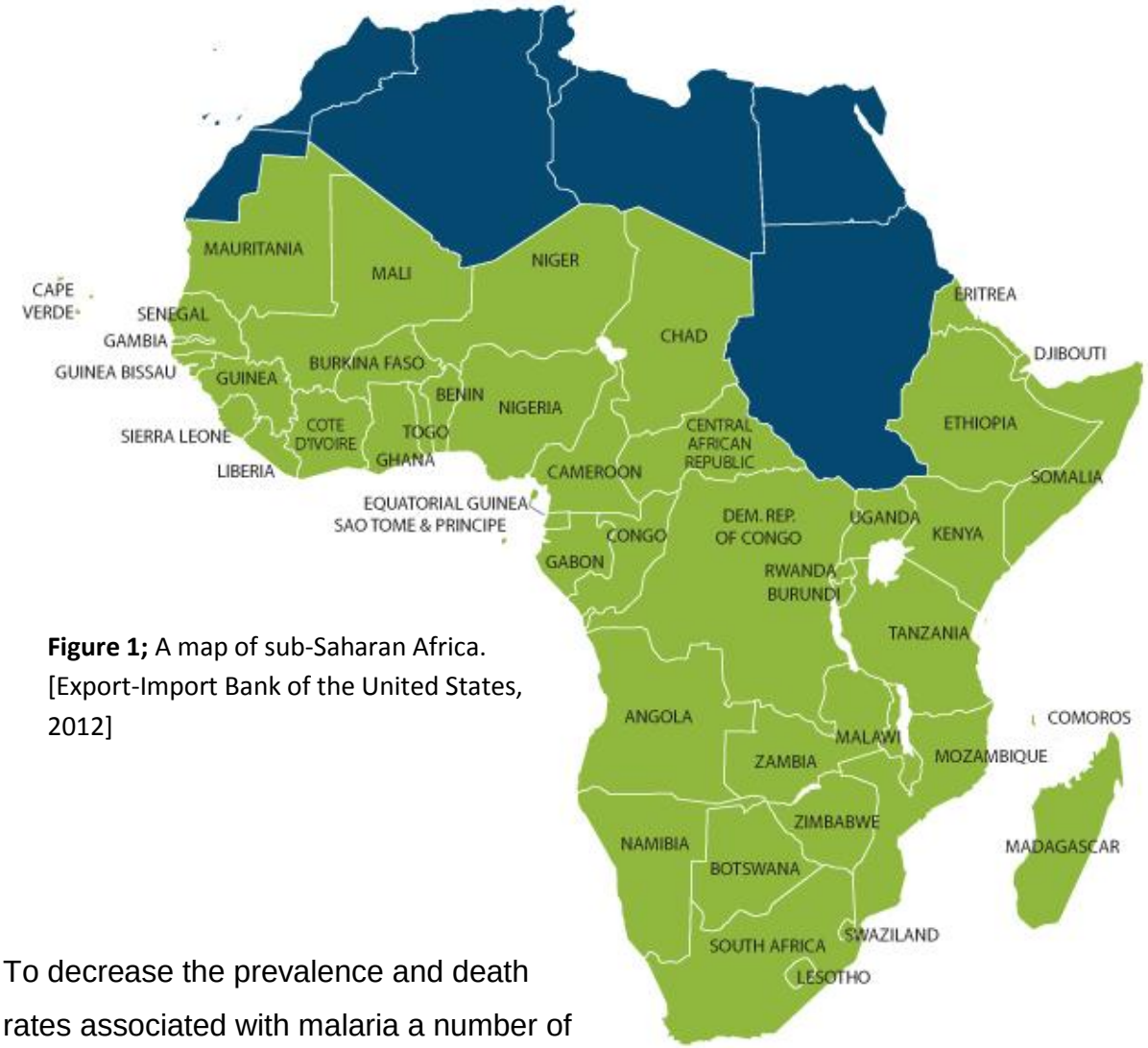

Figure 1; A map of sub-Saharan Africa. [Export-Import Bank of the United States, 2012]

To decrease the prevalence and death rates associated with malaria a number of initiatives have been started in the last decade. All of these initiatives (Roll Back Malaria program [Roll Back Malaria, 2012], Millennium Development Goals [World Health Organization, 2012(a)] and Affordable Medicines Facility malaria [The Global Fund, 2012]) aim at decreasing the malaria burden for both households and countries as a whole. These initiatives aim to provide better access to malaria prevention and treatment (i.a. new first line treatment), and have led to an enormous

[1] In fact in the WHO African region which consists of sub-Saharan Africa plus Algeria and Western Sahara minus Djibouti and Somalia.[World Health Organization, 2012(c)]

increase in information available on these subjects. Implementation of new first line treatments has led to an increase in costs associated with malaria treatment seeking. In 2005 the first World Malaria Report was published, followed by annual reports from 2008 onwards. These reports summarize the current status of malaria in the world, as well as the extent to which malaria is a burden for different countries (meso level) and the world as a whole (macro level). However they do not describe the burden of malaria treatment on a micro level, the extent to which the (increase of) treatment (costs) of malaria is a burden to households (the amount households need to pay in time, money or assets) for many people. This gap was partially filled in 2003 by a review article of Chima et *al*. In this review the authors concluded that although many uncertainties exist surrounding the burden of malaria treatment to households, "this should not be considered a constraint on immediate action to improve control" … and the household burden of malaria treatment "is without doubt enormous in sub-Saharan Africa, and the suffering caused to individuals and their families is undeniably huge".[Chima et *al.*, 2003]. Furthermore, in that review both the direct and indirect costs incurred by households due to malaria were described. The authors described costs both for prevention and treatment of malaria and coping mechanisms. Despite elaborate information on all these subjects they did not look at the treatment costs as percentage of income or as percentage of household expenditures and therefore could not determine to what extent the household burden in sub-Saharan Africa is catastrophic. Since then many new studies have been conducted and in many (sub-Saharan African) countries new (more expensive) first line treatments have been implemented, which may have affected the household burden over the past years.[Morel et al., 2005; Mutabingwa, 2005; Malaria consortium, 2012] This thesis also focuses on the household burden of uncomplicated malaria treatment. Besides just looking at the costs incurred by households it looks at the costs as percentage of household expenditure. It therefore is an update on the state of affairs since 2003, and to some extent an expansion of the review of Chima et *al*.

The household burden, as measured in this thesis consists of direct and indirect costs. Direct costs are medicine costs, fees charged by healthcare professionals, travel costs and any costs incurred during a patients stay at a distant healthcare facility (food etc.). Indirect costs are the costs of productive labor time lost due to

either being ill with malaria or taking care of someone with malaria. This thesis also describes costs as percentage of household expenditure, coping mechanisms, places where treatment was sought and future research/policy implications. This thesis differs from current available literature in that it gives an overview of the household burden of malaria treatment, as opposed to the burden of the disease as a whole. Coping mechanisms have been described before (Chima et *al.*, 2003, Leive and Xu, 2008], however this thesis reviews mechanisms described specifically for malaria treatment and in more recent literature. Overall, a review of this sort is relevant for future decision making and policies on how to ensure high rates of (appropriate) treatment seeking in the case of malaria, as well as for evaluating past initiatives to fight the disease.

2. Research objectives

This thesis aims at giving an overview of the household burden of malaria treatment in sub-Saharan Africa (SSA). For this an overview of malaria as a disease is given, with information on what the disease is, what types of treatment exist and what the prevalence of malaria is in different areas of sub-Saharan Africa. Then an overview is given on the relevance of this thesis in the field of malaria treatment, followed by an explanation of the research methods used, as well as inclusion/exclusion criteria and calculation methods used.

The main question this thesis aims to answer is:
What is the household burden of uncomplicated malaria treatment to sub-Saharan African households?

For this the following sub questions are asked and answered:

1. Where do people in sub-Saharan Africa seek treatment for uncomplicated malaria and why?
2. What percentage of malaria infected people in sub-Saharan Africa is treated with an anti-malarial medicine and does it differ per treatment sector?
3. What types of uncomplicated malaria treatment subsidies exist in sub-Saharan Africa?
4. What are treatment costs for uncomplicated malaria in sub-Saharan Africa, including direct-, indirect- and total costs, as well as differences in costs for seasonality?
5. Are the costs for uncomplicated malaria treatment catastrophic to sub-Saharan African households?
6. What types of coping mechanisms do sub-Saharan African households have for dealing with treatment costs of uncomplicated malaria?

The thesis ends with a discussion on limiting factors and finally a combined discussion and conclusion with implications for future policy making and research.

3. Background information

This chapter discusses some background information on malaria. It starts with information on the disease itself; cause, symptoms, types of treatment (including resistance) and information on prevalence of malaria. The following subchapter describes current initiatives to fight malaria.

3.1 Malaria, the disease

There are five species of Plasmodium which cause malaria. However, the vast majority of (uncomplicated) malaria infections are caused by Plasmodium falciparum (P. falciparum). [World Health Organization, 2012(b); Types of Malaria, 2012] Some of the most common first signs of malaria are flu like symptoms. In many malaria endemic areas diagnostic tests for malaria are not available or too expensive, therefore cases of flu are often mistakenly diagnosed as malaria.[Bartoloni and Zammarchi, 2012] Possible treatments for malaria are chloroquine, amodiaquine, quinine (mostly used for complicated malaria), artemisinins (there are multiple types), chlorproguanil-dapsone and sulfadoxine/pyrimethamine (SP; in most countries up to the introduction of Artemisinin-combination therapy the first line treatment for uncomplicated malaria). However, resistance to all of these drugs has been reported.[Winstanley et *al.*, 2004] Therefore the World Health Organization (WHO) has recommended the use of Artemisinin-combination therapy (ACTs) as first line treatment for uncomplicated malaria (since 2006).[World Health Organization, 2006] ACTs consist of artemisinin in combination with other anti-malarial drugs (like lumefantrine, mefloquine, amodiaquine, sulfadoxine/pyrimethamine).[Malaria consortium, 2012] Because of the combination of two different types of anti-malarial drugs (AMs), resistance can be overcome. Parasites that have become resistant to one of the two anti-malarial drugs are more likely to be susceptible to the other.[Yeung et *al*, 2004] ACTs need to be taken 2 to 3 times a day for 3 days.[Bartoloni A. and Zammarchi L., 2012; MedTV, 2012] Because malaria symptoms tend to fade after 24 to 48 hours of treatment many patients (especially in sub-Saharan Africa) do not finish their treatment, leaving them with medication to use when the malaria infection returns or a new infection occurs.[SciDev Net, 2005] This may cause malaria parasites to become resistant to ACTs. The reason for this is that if not all parasites are killed (which is likely when treatment is halted within 24 to 48

hours of initiation), they may attain resistance against the combination of drugs. Most ACTs do not need to be taken with food. [Bartoloni A. and Zammarchi L., 2012] This is an important aspect because many patients in sub-Saharan Africa do not have enough money/resources to consume three meals a day. This therefore is not a constricting factor for malaria treatment, as it is with HIV/AIDS.[Panosaids, 2012]
When ill with malaria, many patients receive some form of antipyretic to reduce fever symptoms.[Winstanley et *al.*, 2004] This thesis does not focus on the costs of these additive medicines; however they are important for effective treatment of malaria.

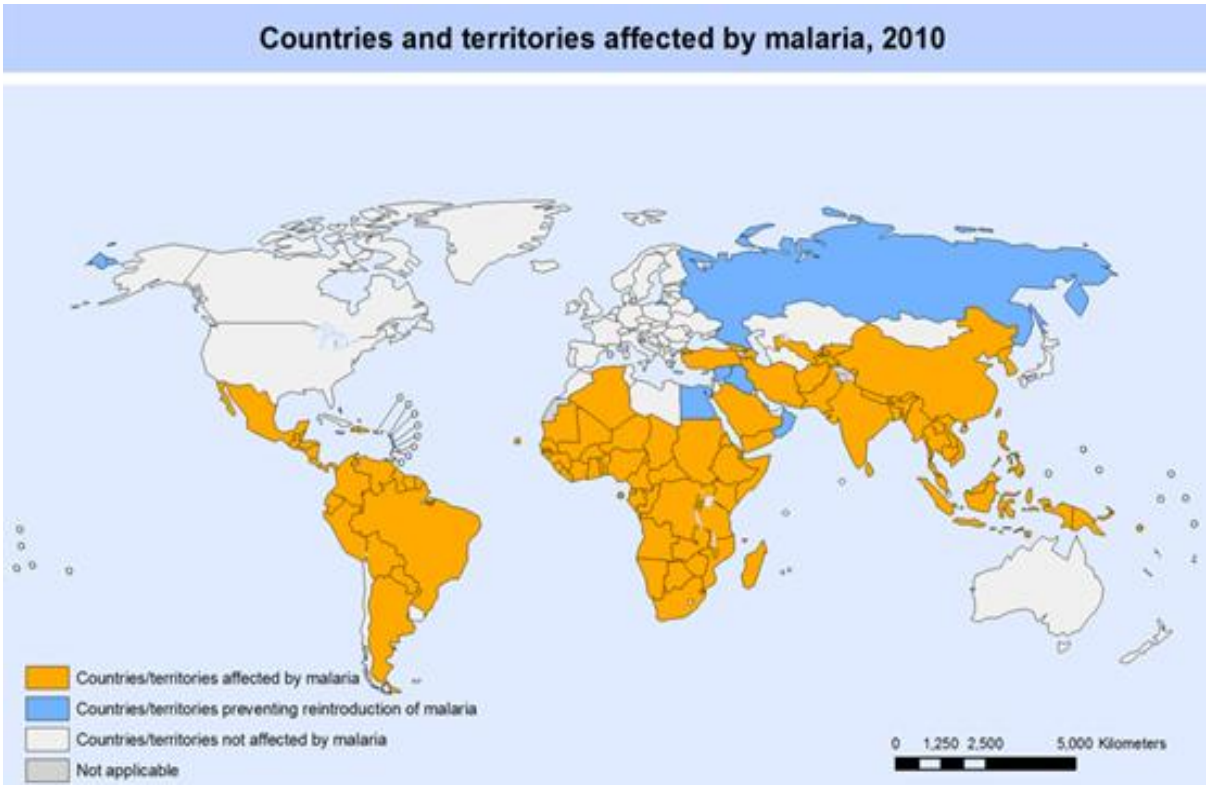

Figure 2; A map giving an overview of countries affected by malaria in 2010.[WHO Global Health Observatory Map Gallery, 2012(a)]

Finally the prevalence of malaria differs greatly with location of residence. Some countries in SSA have much higher prevalence of malaria than others (figure 2 and 3). Next to that, in rural areas the prevalence of malaria is about 3.5 times as high as in peri-urban areas and 23.5 times as high as in urban areas.[The World Bank, 2012(a)] Also the poorer population is at greater risk of being infected with malaria owing to worse housing conditions, closer proximity to water sources and lower

capacity (education and recourses) for the use of preventive measures.[Nkuo-Akenji et *al.,* 2006]

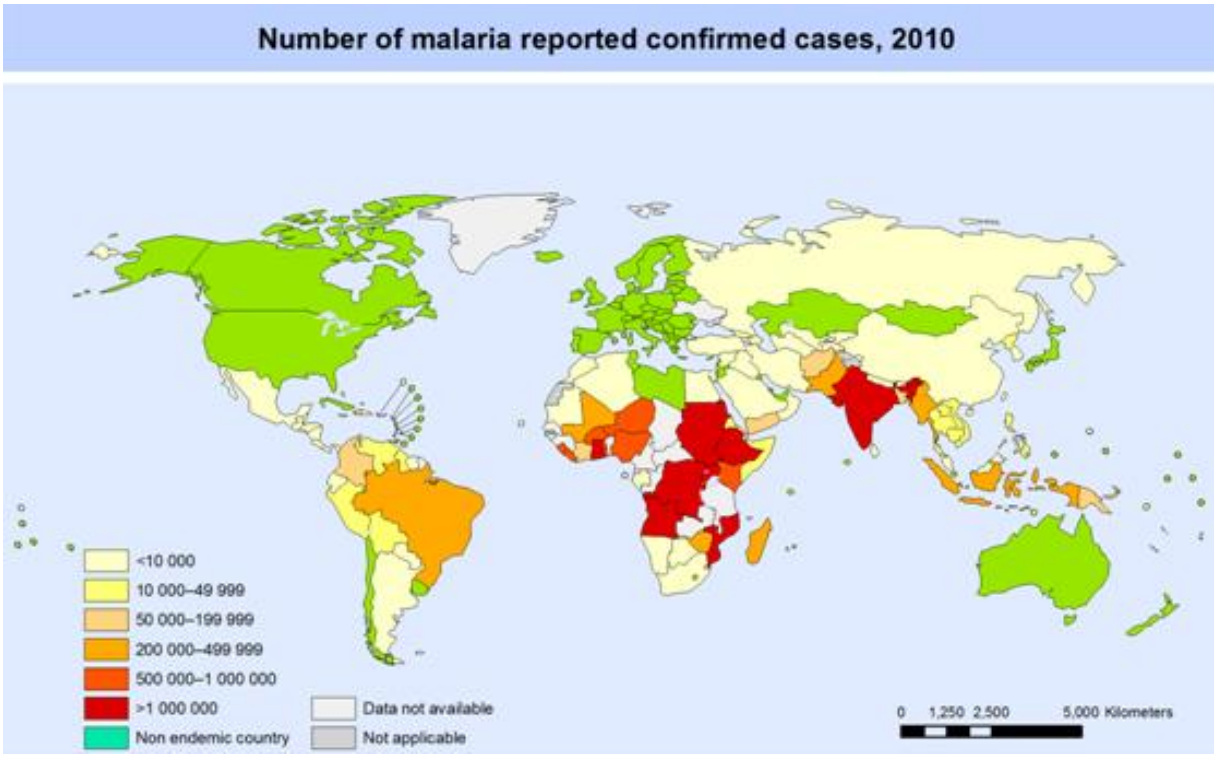

Figure 3; A map showing an overview of the number of malaria reported confirmed cases in 2010.[WHO Global Health Observatory Map Gallery, 2012(b)]

3.2 Current initiatives to fight malaria

In the last 15 years many initiatives have been started in the fight against malaria. In 1998 the Roll Back Malaria (RBM) partnership was one of the first. It started as a partnership between the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), the World Bank and the World Health Organization. Its goal was (and still is) to "reduce the human suffering and economic losses due to one of the world`s most costly diseases (malaria)."[Press Release WHO 1998, 2012] In 2000 the Millennium Development Goals were set. One of these goals (6c) was to "have halted by 2015 and begun to reverse the incidence of malaria and other major diseases."[World Health Organization, 2012(a)]

In April 2009 the Affordable Medicines Facility-malaria (AMFm) was launched. This initiative of the RBM, World Bank and the Bill & Melinda Gates Foundation began pursuing its goals of expanding access to the most effective treatment for malaria, ACTs, in July 2010.[The Global Fund, 2012] So far these initiatives have caused the

incidence of malaria worldwide to decrease with 17% between 2000 and 2010. Also, malaria specific mortality was reduced by 33% in sub-Saharan Africa[2] in this time period.[World Health Organization, 2011] Overall, these initiatives are responsible for better and more accessible malaria prevention and treatment, as well as an enormous increase in information available on malaria prevention and treatment. As stated before, every year a new World Malaria Report is published by the WHO. However there is no current overview or review that addresses the household burden of malaria for sub-Saharan Africa.

In most SSA countries the majority of the population is not covered by healthcare insurance or subsidies for malaria treatment. Types of subsidies and insurances for malaria treatment range from none in Nigeria [Vogel, 1990; Onwujekwe et *al*., 2010(a)]; Onwujekwe et *al*., 2010(b)] to free ACT distribution in government facilities to patients of all ages and more than 11% of the population being insured in Kenya [Vogel, 1990; Kangwana et *al*., 2011],

In some countries (like Tanzania) the government has started new initiatives to raise the quality of the retail sector and at the same time to make it more affordable. In these countries normal drug shops have the opportunity to, with a small effort, become accredited drug dispensing outlets (ADDO's). ADDO's, unlike normal drug shops in the retail sector, have permission to sell anti-malarial drugs and even the newest first line treatments. Next to this, they can often buy the newest first line treatment for a subsidized price.[Alba et *al.,* 2010]

[2] In fact in the WHO African region which consists of sub-Saharan Africa plus Algeria and Western Sahara minus Djibouti and Somalia.[World Health Organization, 2012(c)]

4. Methods

For this thesis a search of all available scientific literature was conducted from 2003 onwards. 2003 was used as a base year because in 2003 Chima *et al.* published a review that discussed some of the same issues that are also discussed in this review.[Chima et *al.*, 2003]

4.1 Inclusion criteria and search queries

A first search was conducted in Pubmed. Search queries were used with the following restrictions; that articles had to be in either English or Dutch and published between 01-01-2003 and 09-22-2012. All articles included in this thesis had to have information on the direct costs of uncomplicated malaria treatment in SSA. Table 1 shows the search queries that were used.

Table 1: Search queries in Pubmed

AND/AND*	OR/OR**	NOT***	Number of hits
sub-saharan africa malaria	payment* cost* financing	Affordability impoverishment catastrophic coping out-of pocket economic burden user fee* co payment* copayment* household expenditure*	463
sub-saharan africa malaria	out-of pocket economic burden user fee* co payment* copayment* household expenditure*		153
sub-saharan africa malaria	affordability impoverishment catastrophic coping	out-of pocket economic burden user fee* co payment* copayment* household expenditure*	22

***** Search queries were entered as "A" AND "B" AND "C"; ******Search queries were Entered as AND("A" OR "B" OR "C"); *******Search queries were entered as NOT ("A" OR "B" OR "C").

The search resulted in 638 hits in total, of which 0 were double and 621 were excluded based on the title[3] or lack of information on direct treatment costs as stated in the abstract and/or the entire article. This resulted in 19 articles that were usable. Snowballing was then conducted to search for more articles. This resulted in 0 articles that were used.

Finally, a search was conducted in Google Scholar to ensure that all relevant articles were found. Google Scholar was used because it is a very non specific search engine. If any relevant articles could be found using this search engine it would mean that not all available scientific articles were included. For this, the following search queries were used (table 2):

Table 2: Search queries in Google Scholar

In title	In title (OR/OR)˚	In article	Number of hits
Malaria	Payment payments cost costs financing	sub saharan Africa	107
Malaria	economic burden copayment copayments	sub saharan Africa	8
Malaria	user fee user fees co payment co payments	sub saharan Africa	3
Malaria	Affordability impoverishment coping catastrophic	sub saharan Africa	3
Malaria	household expenditure household expenditures out-of pocket	sub saharan Africa	2

˚ Search queries were entered as "A" OR "B" OR "C"

[3] If the title clearly stated that the content of the article was about costs for malaria prevention (bed nets, mosquito sprays, etc.), malaria prevention and treatment only for pregnant women, costs for inpatient care (hospitalization) or about an area outside of sub-Saharan Africa the article was excluded.

This search resulted in 123 hits, of which all were excluded based on the title[4], lack of information on direct treatment costs as stated in the abstract and/or the entire article or because they were already included using the Pubmed query.

In total 19 articles were used for this literature review. Table A, B and C in the appendix show background information on the used articles.

4.2 Calculation methods

All prices mentioned in this review were recalculated to United States (US) dollars 2011. To achieve this all prices were first changed into US dollars using historical exchange rates.[Historical rates, 2012] For studies where a year of study was mentioned this year was used for the exchange rate. For studies were no year of study was mentioned the year of publication was used for the exchange rate. Next the US dollar was recalculated to US dollar 2011 using an inflation calculator.[Dollar Times, 2012] The expenditure per capita was calculated using the household final consumption expenditure as % of GDP and the GDP per capita in current US dollar as given by the World Bank [The World Bank, 2012(b); The World Bank, 2012(c)] and where not available as given by Nation Master.[Nation Master, 2012]

4.3 Calculation example

Somi et *al.* conducted a study in Tanzania in 2004. They found mean total direct costs of Tsh 643. The direct treatment costs were recalculated to US dollars 2011 as follows:

- This price was recalculated into US dollars using the mean historical exchange rate for 2004 of 1 US dollar which equaled 1087.094722 Tsh.[Historical rates, 2012] → 643 TSH /1087.094722 exchange rate ≈ 0.5915 US dollars 2004.
- US dollars 2004 were then recalculated to US dollars 2011 using an inflation calculator [Dollar Times, 2012], this resulted in 0.70 US dollars 2011 (both by filling in the inflation calculator, as well as by using the annual inflation as

[4] If the title clearly stated that the content of the article was about costs for malaria prevention (bed nets, mosquito sprays, etc.), malaria prevention and treatment only for pregnant women, costs for inpatient care (hospitalization) or about an area outside of sub-Saharan Africa the article was excluded.

given by the inflation calculator of 2.51% → $1.0251^{7(\text{years})} \approx 1.19$ → 1.19 * 0.5915 US dollars 2004 ≈ 0.70 US dollars 2011) (see table E in the appendix)

The costs as percentage of total per capita expenditure in Tanzania in 2004 was calculated as follows:

- Household final consumption expenditure as percentage of GDP in Tanzania in 2004 was looked up at the World Bank.[The World Bank, 2012(b)] This was 67%.
- GDP per capita in Tanzania in 2004 (expressed in current US dollars) was looked up at the World Bank.[The World Bank, 2012(c)] This was 349 current (approximately 2011) US dollars.
- The monthly per capita final consumption expenditure was then calculated by multiplying GDP per capita with percentage of household final consumption expenditure and dividing this by twelve (for the months) → 349 US dollars 2011 * 0.67% = 233.83 US dollars 2011 → 233.83 / 12 ≈19.49 US dollars 2011.
- Finally the total direct costs were calculated as percentage of monthly expenditure. For this the direct costs were divided by monthly household final consumption expenditure → 0.70 US dollars 2011/ 19.49 US dollars 2011 ≈ 0.036 → 3.6% (see table I in the appendix)

4.4 Exclusion criteria

Costs for malaria prevention, like bed nets and mosquito sprays, as well as costs for malaria prevention/treatment for pregnant women and costs for inpatient care (hospitalization) were not reviewed. Also the household burden in terms of suffering and grief due to malaria were not considered. Finally, this review does not compare the treatment costs for different income quantiles or for people living in urban versus rural areas.

5. Treatment seeking behavior and anti-malarial drug distribution

This chapter describes in which sector people seek treatment, why they decide to use that sector and what the consequences are for the type of treatment they receive. These questions are relevant for answering the main question of *what the household burden of uncomplicated malaria treatment to sub-Saharan African households is*, because financial issues may be responsible for decisions on healthcare facilities visited. Also the type of treatment received may be connected to the type of facility used.

5.1 Where is treatment sought?

Table D in the appendix shows the different sectors where people seek treatment. The sectors mentioned are the public sector (consisting of government facilities and nonprofit organizations, including government clinics, government dispensaries and community health workers (CHW's)), the private sector (consisting of all for profit private facilities and including private clinics), the retail sector (consisting of drug shops, pharmacies, ADDO's and general stores) and the home/other sector (consisting of people who seek treatment outside one of the first three sectors, including herbal medicine treatments and church visits).

Type of facility used differs greatly between study areas and countries. When looking at table D it can be observed that in most countries the public- and the retail sector are the most visited sectors, however there are some exceptions. The percentage of visits therefore ranges from 2% in Tanzania [Somi et *al.*, 2007] to 98.5% of visits in South-Africa (Mpumalanga) [Castillo-Riguelme et *al.*, 2008] for the public sector and 0% in South-Africa (KZN and Mpumalanga) [Castillo-Riguelme et *al.*, 2008] to 73.61% of visits in Kenya (Kwale) [Chuma et *al.*, 2010] for the retail sector. The home/other sector is also used a lot in some countries and rarely in others, ranging from 0% in Kenya [Chuma et *al.*, 2010] to 73.2% of the visits in Nigeria [Uzochukwu et *al.,* 2008]. When looking at these data it needs to be considered that in many studies use of the retail sector is considered as treatment at home and vice versa. Also in studies where the home/other sector is separated from the retail sector people often use old medicines that are left over in the home from previous illnesses. These medicines are generally previously bought in the retail sector. Therefore the

percentage of people buying medicines in the retail sector is most likely higher than what the data in table D show. These findings are in compliance with literature. In a review on care seeking behavior during childhood illness in sub-Saharan Africa Goodman *et al.* found that between 15 and 83% of care seekers used the retail sector, but it often ranged between 50 and 70%.[Goodman et *al.*, 2007] The same results were shown in studies from Burkina Faso [Mueller et *al.*, 2004], Kenya [Guyatt and Snow, 2004] and Sub-Saharan Africa as a whole [Thera et *al.*, 2000; Fawole and Onadeko, 2001; Nyamongo, 2002] where 69%, 50% and 80-90% respectively first sought care either via home treatment (including treatment with left over drugs previously bought in the retail sector) or the retail sector in general.

5.2 Why do people seek treatment in a certain sector?

There are several factors that influence provider choice. According to Asenso-Okyere *et al.* [Asenso-Okyere et *al.*, 1997]*,* Dzator *et al.* [Dzator and Asafu-Adjaye, 2004] and Morey *et al.* [Morey et *al.*, 2003] both direct and indirect costs are important factors influencing the decision of whether to seek treatment and where it should be sought. A second important factor for deciding to seek treatment and provider choice is the ability to pay.[Asenso-Okyere et *al.*, 1997; Kamat and Brown, 2002; Kofoed et *al.*, 2004; Worrall et *al.*, 2005] Many studies show preference for care seeking in the retail sector as compared to the public sector. Reasons for this preference are; retailers are more accessible, have longer and more flexible opening hours, provide quicker service, are willing to negotiate charges and offer credit, are perceived as being cheaper, have more reliable drug stocks (stock-outs have been reported frequently in publicly run facilities [Kangwana et *al.*, 2011]), and are perceived as relatively courteous and approachable.[Williams and Jones, 2004; Alba et al., 2010]

5.3 What percentage of people is treated with an anti-malarial drug?

Literature shows a big difference in anti-malarial medication given out in different sectors. Most AMs are distributed in the public sector and the least amount of distribution takes place in the home/other sector.[Amin et *al.*, 2003; Wiseman et *al.,* 2008; World Health Organization, 2009;] This subchapter discusses the amount of AM medication distributed in the different study areas and countries reviewed and whether these findings correspond with literature.

The sector with the highest percentage of AM treatment given is the public sector, ranging from 48% in Tanzania [Njau et *al.*, 2006] to 91% in Malawi [Mota et *al.,* 2009] of people receiving an AM whilst visiting this sector. In the private sector percentage of AM treatment given ranges from 14% to 71% of visits in Tanzania [Simba et *al.*, 2010; Njau et *al.*, 2006 respectively] and in the retail sector from 10% to 58% of visits in Tanzania [Njau et *al.*, 2006 respectively]. These results are in compliance with results from surveys conducted between 2007 and 2008 in 11 sub-Saharan African countries. These surveys found that even though there was a large increase in the number of AMs distributed through the public sector, children visiting the retail sector were treated with an AM a lot less often.[World Health Organization, 2009] Furthermore, it needs to be regarded that in the retail sector often a wrong dosage of AM treatment is given, either caused by lack of knowledge and/or lack of money to pay for a full treatment. This further diminishes the percentage of correct treatment distributed in this sector.[SciDev Net, 2005]

A second explanation for the lower percentage of people receiving an AM whilst visiting the retail sector is threefold. Firstly, in many countries the retail sector is not allowed to sell (new first line) AMs.[Kachur et *al.*, 2006; Alba et *al.,* 2010; Ewing et *al.,* 2011] Secondly many AMs, especially the newest first line ACTs, are very expensive and due to capital constraints shopkeepers may not be able to stock them. Finally, some of the newest AMs are provided with subsidy to government facilities but not to the retail sector. Also shops that can buy the newest AMs for a subsidized price often do not pass the subsidy to the consumer because they prefer to keep the profit for themselves. This means that AMs in the retail sector often are still very expensive.[D' Alessandro et *al.* 2005; Kangwana et al., 2011]

6. Subsidies

Existence of subsidies decreases the cost of treatment for malaria patients and therefore reduces the household burden of malaria. Thus, in order to give a complete overview of the household burden of uncomplicated malaria treatment to sub-Saharan African households it is important to discuss the healthcare insurance schemes and subsidies in place in the countries reviewed.

Only few of the articles reviewed in this thesis mention healthcare insurance schemes or government subsidies for malaria treatment. The studies that do mention it tend to do this in the introduction of the article only. Overall, according to the articles reviewed in Tanzania, Kenya, Gambia, Nigeria and Malawi the following subsidy schemes existed at the time of study:

Table 3; Existing subsidies in several countries

Country	Institution	Eligible	Provided services and drugs
Tanzania 2006 *(Njau et al.)*	Government facilities	Under 5's and pregnant women	ALu* provision (medication)**
Kenya 2011 *(Kangwana et al.)*	Government facilities	All	ALu* provision (medication)
Gambia 2003 *(Clarke et al.)*	Government facilities	Under 5's	Consultation, tests and medication
Nigeria 2010(a+b) *(Onwujekwe et al.)*	N.A.	N.A.	None
Malawi 2009+2011 *(Mota et al.; Ewing et al.)*	Public health facilities	All	Consultation, tests and medication

* First line ACT for this country; ** Subsidized ALu also available to ADDO's.

When looking at the data in this thesis it needs to be considered that, as shown in table 3, subsidy schemes exist for the public/government facilities in some countries. However it is also important to keep in mind that in these countries often unofficial fees are paid to health workers in government facilities, undoing (to some extend) the subsidies in place.[Alba et *al.,* 2010; Onwujekwe et *al.,* 2010(a); Kangwana et *al.*, 2011]

7. Treatment costs

In this chapter an overview of the direct, indirect and total costs of uncomplicated malaria treatment is given. The direct and indirect costs are also given as percentage of total treatment costs. At the end of this chapter seasonality of treatment costs is reviewed.

7.1 Direct costs

Direct costs for malaria treatment consist of medicine costs, fees charged by healthcare professionals, travel costs and any costs incurred during a patient's stay at a distant healthcare facility (food etc.). Table E and F in the appendix show the direct costs for uncomplicated malaria treatment per illness and as percentage of total treatment costs respectively (unless otherwise stated). The costs shown in the tables are costs made from the user perspective, thus they include all sources of care accessible to households and consist of only out-of-pocket expenditures. Most of the studies used are based on household expenditures on malaria treatment in either the wet or dry season. Therefore most of the data in table E do not reflect the actual economic burden of malaria throughout the year. Chapter 7.4 (Treatment costs and seasonality) shortly discusses two of the studies that do consider the difference between the wet and dry season and any implications that arise due to seasonality.

The direct expenditure per uncomplicated malaria case ranges from $0.21 (5.8% of total costs) in Malawi [Ewing et *al.,* 2011] to $8.18 (49.5% of total costs) in Nigeria (Udi) [Onwujekwe et *al.,* 2008] (table E and F).

Table G in the appendix shows the division of direct costs into medicine costs, fees charged by healthcare professionals, travel costs, and for some countries costs incurred during a patient's stay at a distant healthcare facility. As shown in table G, in most countries the direct costs consist mainly of medicine costs, with the exception of one study in Malawi [Ewing et *al.,* 2011], one study in the Gambia [Wiseman et *al*., 2008] and one study in South-Africa (both KZN and Mpumalanga) and Mozambique [Castillo-Riguelme et *al.*, 2008;]. In these countries the direct costs consist mainly of travel costs, which range from $0.18-0.91 (70.0-93.7% of direct costs) in Malawi,

$0.10 (36.4% of direct costs) in the Gambia, $2.28 (80.0% of direct costs) in KZN (South-Africa), $2.05 (79.0% of direct costs) in Mpumalanga (South-Africa) and $4.52 (55.0% of direct costs) in Mozambique. In general the medicine costs range from $0.02 (10.0% of direct costs) in Malawi [Ewing et *al.,* 2011] and $0.08 (3.0% of direct costs) in South-Africa (KZN) [Castillo-Riguelme et *al.*, 2008] to $5.41 (93.6% of direct costs) in Nigeria (Nachi) [Onwujekwe et *al.,* 2008].

In general travel costs range from $0.00 in Kenya [Larson et *al.,* 2006] to $4.52 (55.0% of direct costs) in Mozambique [Castillo-Riguelme et *al.*, 2008] and may depend on proximity to a health facility as shown for Malawi [Ewing et *al.,* 2011]. Fees charged by healthcare professionals, including costs for tests, range from $0.00 in several countries [*i.a.:* Mota et *al.,* 2009; Ewing et *al.,* 2011] to $1.67 (24.0% of indirect costs) in Nigeria [Onwujekwe et *al.,* 2010(a)]. Only in 2 studies (3 countries) costs incurred during a patient's stay at a distant healthcare facility are mentioned. In these countries the unspecified extra costs range from $0.07 (1.2% of direct costs) in Nigeria [Onwujekwe et *al.,* 2010(a)] to $0.50 (18.0% of the direct costs) in South-Africa (KZN) [Castillo-Riguelme et *al.*, 2008]. In table G these costs are included in travel costs.

Overall the medicine costs are responsible for 0.7-61.1% of total costs, travel costs for 0.2-11.4% of total costs and fees for 0-18.0% of total costs (table F). It is interesting to see that different costs as percentage of total costs vary widely across study areas and countries.

7.2 Indirect costs

Indirect costs for malaria treatment consist of productive labor time lost due to either being ill with malaria or taking care of someone with malaria (including travel time to the facility and waiting time at the facility). Table E and F also show the indirect costs for uncomplicated malaria treatment per illness and as percentage of total treatment costs respectively (unless otherwise stated). As with the direct costs, indirect costs include all sources of care accessible to households and in general they show the household burden due to malaria treatment over the period of one season.

The indirect costs per uncomplicated malaria case range from $3.33 in Malawi [Ewing et *al.,* 2011] to $18.18 in Nigeria (Inyi) [Onwujekwe et *al.,* 2008] and range

from 50.5% of total costs in Nigeria (Udi) ($3.76) [Onwujekwe et *al.,* 2008] to 92.7% of total costs in Malawi ($4.98) [Ewing et *al.,* 2011]. It is striking to see that indirect costs in all countries and areas reviewed make up more than half of the total costs.

Table H in the appendix shows the division of indirect costs into travel time, waiting time at a facility, caring time for a sick person and time spend being ill and incapable of working. In most studies the economic costs of not being able to work is based on "the wage rate method, which uses estimates of the time lost, multiplied by some value of a day's work."[Chima et *al*., 2003] With this method it needs to be considered that some people within a community are unemployed and therefore do not miss out on their daily wage when ill. An example of such an overestimation of indirect costs of uncomplicated malaria treatment is the study by Castillo-Riquelme et *al*.[Castillo-Riguelme et *al.*, 2008] In this study 34.0-35.0% of the inhabitants of the study area (KZN and Mpumalanga in South-Africa) are unemployed. This overestimation is mentioned by the authors, however they do not take it into account when calculating the economic cost of days lost due to illness. Also in some countries labor substitution occurs.[Deressa et *al.,* 2007; Castillo-Riguelme et *al.*, 2008] This means that if one individual falls ill and becomes incapable of working, somebody else takes over his/her activities for a certain period of time. This will also reduce the actual economic indirect burden of being ill with malaria (where known values for substitution are added to 'Sick time' in table H). Overestimation of the indirect household burden due to malaria is also true for people who (especially in the poorer socioeconomic groups of communities) decide to keep working whilst ill. These people are generally less productive than when they are not ill. Unfortunately this is very hard to measure and most of the articles reviewed here do not take this into account in their calculations.

In most countries the indirect costs consist mainly of time spend being ill, which ranges from 2.46 days in the Gambia [Clarke et *al.,* 2003] to 9.19 days in Nigeria (Udi) [Onwujekwe et *al.,* 2008]. However it needs to be considered that for most articles reviewed this is total time being ill and not only time lost from work due to illness. Time spend caring for an ill person is the second biggest part of indirect costs, it ranges from 1.1 days in South-Africa (Mpumalanga) [Castillo-Riguelme et *al.*, 2008] to 5.9 days in Kenya (Gucha) [Chuma et *al.*, 2010]. Travel time and waiting

time at a healthcare facility range from 0-12 hours in Kenya [Larson et *al.,* 2006] and 1 minute in Malawi [Ewing et *al.,* 2011] to 86 minutes in South-Africa (KZN) [Castillo-Riguelme et *al.*, 2008] respectively.

7.3 Total costs

Table E shows besides the direct and indirect also the total costs for uncomplicated malaria treatment per illness (unless otherwise stated). As with the direct and indirect costs, total costs include all sources of care accessible to household. In general it shows the household burden due to malaria treatment over the period of one season. Total costs consist mainly of indirect costs, which range from $3.76 (50.5% of total costs) in Nigeria (Udi) [Onwujekwe et *al.,* 2008] to $3.33 (94.2% of total costs) in Malawi [Ewing et *al.,* 2011]. Direct costs of malaria treatment range from $0.41 (5.8% of total costs) in Malawi [Ewing et *al.,* 2011] to $3.69 (49.5% of total costs) in Nigeria (Udi) [Onwujekwe et *al.,* 2008].

Costs, both in absolute terms as in percentage of household income/expenditure differ widely for low income households as compared to households with a higher income. For example, in Tanzania the direct costs, indirect costs and total costs of uncomplicated malaria treatment in the wet season are $0.62, $8.03 and $8.65 (0.6%, 7.3% and 7.9% of household expenditure) for the most poor respectively, as compared to $1.13, 4.95, $6.08 (0.2%, 0.8% and 1.0% of household expenditure) for the least poor respectively.[Somi et *al.*, 2007] However further analysis of differences in household costs per socioeconomic group are outside the scope of this thesis.

7.4 Treatment costs and seasonality

Somi *et al.* discuss the difference in economic burden between the dry and the wet season in Tanzania. They show that the direct, indirect and total costs in the dry season are almost 1.5 times as high as in the wet season.[Somi et *al.*, 2007] An explanation for this finding is twofold. Firstly, liquidity of households is higher in the dry season as compared to the wet season, due to rice planting and harvesting cycles.[Somi et *al.*, 2007] Liquidity causes higher household spending on both malaria [Chuma et *al.*, 2006] and health in general [Sauerborn et *al.*, 1996]. Secondly, in the wet season the opportunity costs of not working are higher than in the dry season. Therefore more households seek treatment in the dry season (91 %

in Tanzania) than in the wet season (70% in Tanzania) as shown by Somi et *al.* It is expected that this difference in direct costs between the dry and the wet season can be extrapolated to other countries. However Ewing *et al.* found that the direct treatment costs of uncomplicated malaria in Malawi are higher in the wet season than in the dry season.[Ewing et *al.,* 2011] These contradicting results may be explained by the fact that Ewing et *al.* only look at treatment costs in the formal sector and do not consider households that incur direct costs at a different provider. Somi et *al.* do consider this change in provider. They look at the change of treatment seeking in the population. The amount of people that seek treatment does not only reduce in the wet season it also changes from seeking treatment predominantly in the public sector to treatment seeking in the retail sector. Treatment in the retail sector is generally less expensive than in the public sector, both in terms of direct costs (due to lower travel costs) and indirect costs (less travel time needed).[Njau et *al.*, 2006; Somi et *al.*, 2007]

8. Catastrophic costs and Coping mechanisms

This chapter discusses to what extend payments for malaria treatment are catastrophic to sub-Saharan African households. It then discusses the way in which households cope with these payments.

8.1 Catastrophic costs

Catastrophic costs have been defined as the level of expenditure that threatens households' livelihoods.[Castillo-Riguelme et *al.*, 2008] However generally it is defined as expenditure of 10 to 20% of income [Prescott et *al.*, 1999; Ranson, 2002; Feder et al., 1987] or 40% of non-food expenditure [Xu et *al.*, 2003]. Some studies have suggested that for people living below the poverty line any expenditure on healthcare is catastrophic and the threshold may be less than 2% of income.[Ichoku, 2005] This subchapter discusses catastrophic costs in the articles reviewed.

Table I in the appendix shows the amount spent on treatment for uncomplicated malaria as a percentage of final monthly household expenditure (where information was available). The total treatment costs range from 6.9% of monthly household expenditure in Mozambique to 86.4% of monthly household expenditure in Ethiopia. The direct treatment costs range from 0.1% of monthly household expenditure in the Gambia to 53.5% of monthly household expenditure in Mozambique. And the indirect treatment costs range from 7.4% of monthly household expenditure in Kenya to 62.0% of monthly household expenditure in Ethiopia.

However the data in table I need to be considered with care because the data on monthly household expenditure are taken from a different source [The World Bank, 2012(b); The World Bank, 2012(c); Nation Master, 2012] than the data on household costs for malaria treatment (articles reviewed). Also the household expenditure per month is an average for the countries in a certain year. Most of the studies reviewed were conducted in rural areas (table A). Data from the World Bank show that in the countries reviewed in this thesis (except in South-Africa) the percentage of people living below the national poverty line ranges between 35 and 60% of the population. However data from the World Bank also show that the percentage of people living below the national poverty line is 10 to 35% higher for rural areas than for urban

areas.[The World Bank, 2012(a)] Therefore the amount spent on treatment for uncomplicated malaria as a percentage of final monthly household expenditure may in fact be higher than portrayed in table I. Finally, the definitions used for percentage of payment causing catastrophe are based on income and non-food expenditure rather than total expenditure and may therefore be too low and too high respectively.

When looking at the 10-20% boundary of expenditure as percentage of income (in this case of total expenditure)[Prescott et *al.*, 1999; Ranson, 2002; Feder et al., 1987] it can be concluded that for most countries expenditures for treatment of uncomplicated malaria are catastrophic. The exceptions are one study in Mozambique [Hume et *al.*, 2008], where the total malaria treatment expenditure is 6.9% of total monthly expenditure and two studies in Kenya [Chuma et *al.*, 2006; Larson et *al.*, 2006], which are just below the threshold at 9.3 and 9.6% of total monthly expenditure respectively.
Using the 40% of non-food expenditure threshold for catastrophic payments [Xu et *al.*, 2003], it may be concluded that only for Ethiopia (86.4% total treatment costs as percentage of monthly expenditure) [Deressa et *al.*, 2007], one study in Nigeria (52.4% total treatment costs as percentage of monthly expenditure)[Onwujekwe et *al.*, 2010a] and for several studies in one specific socioeconomic group or season [Somi et *al.*, 2007; Onwujekwe et *al.*, 2008; Castillo-Riquelme et *al.*, 2008] payments for malaria treatment are catastrophic.
Using Ichoku's definition of catastrophic expenditure for the very poor it can be concluded that for all countries reviewed here (except South-Africa since it does not fall into the category of the very poor) expenditures on uncomplicated malaria treatment are catastrophic (more than 2% expenditure of income, in this case of total expenditure).[Ichoku, 2005] However, one might suggest that 2% of income spend on malaria treatment is a very low threshold and may in fact not be catastrophic.

Finally, for people living below the poverty line every day lost from work may be catastrophic.[Russell, 2005 and Waelkens, 2005] For most countries reviewed in this thesis more than one day is lost due to illness (table H).

8.2 Coping mechanisms

Coping mechanisms are defined as strategies adopted by family members, friends and colleagues to minimize the effects of an illness on the welfare of all concerned. There is a difference in coping mechanisms for direct and indirect costs. For direct costs it is relevant to know how people manage to pay for their treatment. For indirect costs it is relevant to know whether the loss in welfare is due to not being able to work, or due to not being able to participate in other activities. Only three of the articles reviewed in this review mention strategies for coping with direct costs of malaria treatment.[Deressa et *al.*, 2007; Mota et *al.*, 2009; Onwujekwe et *al.*, 2010(b)] Two studies mention labor substitution as a means for coping with indirect costs.[Deressa et *al.,* 2007; Castillo-Riguelme et *al.*, 2008]

Deressa et *al.* show that in rural Ethiopia 36.1% of patients use interest-free loans to cover direct expenditures on treatment versus 26.8% of patients spending available cash or savings, and 17.1 and 13.3% of patients selling crops and livestock respectively.[Deressa et *al.,* 2007] In Malawi 5% (6.1% for treatment of a child) of patients seeking treatment in the informal sector and 18% (3.8% for treatment of a child) of patients seeking treatment in the formal sector need to borrow money in order to pay for treatment. In the informal and formal health sector 5% and 0% respectively sell assets in order to pay for treatment.[Mota et *al.,* 2009] In Nigeria between 84.6 and 87.0% of people pay for treatment with out of pocket money, between 7.2 and 11.5% of people pay for treatment with installments and the remainder of people are either reimbursed, pay in kind or have some form of health insurance. In most instances, between 90.8 and 92.5%, people pay for malaria treatment with their own money (whether this money consists of savings or whether it is obtained by selling assets is unknown). In the remainder of the cases people either borrow money, a relative pays, the community picks up the bill or some other payment method is used.[Onwujekwe et *al.,* 2010(b)]

In conclusion, people often pay for treatment with their own money (either savings or obtained by selling livestock/crops) or borrow money. Still, these coping mechanisms do not show whether some people decide not to seek or buy treatment due to the high costs.

9. Limitations

There are several limitations to this review and any study conducted on the household burden of malaria treatment. The first limitations discussed are limitations that are relevant to this review in specific:

9.1 Limitations of this review in specific

First there are some issues regarding calculation and presentation methods that need to be discussed. For articles where no year of study was given the year of publication was used for calculation of costs made. An inaccuracy in these costs can cause a change in outcome because many of the costs made are relatively small and an addition of $0.01 to $0.10 can have a major effect on total treatment costs.

Furthermore, the way in which costs of the different studies are portrayed is not uniform. Some studies show mean costs, other median or a range of costs. Some studies show costs per malaria case per individual, others per household and yet others show costs per month. Some studies show total treatment costs whereas others only show direct treatment costs, both direct and indirect treatment costs but in different units (like monetary value and time) or only part of the direct or indirect treatment costs. Some studies show treatment costs for children under a certain age, others show treatment costs only for adults or for both groups. Also some of the studies show treatment costs in all sectors found in that study area, whereas other studies only show treatment costs in certain sectors. Finally only average (where possible) costs for treatment per area are given even though these costs can vary greatly between different socioeconomic groups within a community.

All these factors influence the comparability of the articles that are reviewed in this thesis. Therefore some of the conclusions made in the next chapter are more tentative than one might expect.

9.2 Limitations of articles on the household burden of malaria treatment in general

The most important limitation to any article written on household burden of malaria treatment is the way in which indirect costs are measured. Indirect costs are generally measured in a time unit. It proves to be very hard to measure what amount

of time exactly somebody is incapable of working (4.4 days versus 4.6 days for example). A next problem is the fact that in many (lower socioeconomic) communities, family and friends take over part of the workload when a person falls ill (substitution).[Chima et *al.*, 2003; Deressa et *al.,* 2007; Castillo-Riguelme et *al.*, 2008] This causes the economic burden due to malaria illness to decrease. However it also needs to be considered that when people take over workload this might cause them to become overworked or to do less of a good job at their own work and it may thereby increase the economic burden again. Furthermore, it is difficult to put a monetary value on time lost due to illness or taking care of an ill person. The studies reviewed have different ways of defining opportunity costs of time lost. This difference may have a significant impact on estimations of the indirect costs. Also in most studies where illness of children or elderly was reviewed time lost due to illness was not taken into account, even though many children (and elderly) have important tasks within the household or on the farm.[Chima et *al.*, 2003]

Finally, in all studies reviewed no distinction between regular fever and malaria was made. This is caused by the fact that in most countries tests for malaria are too expensive and are not available to the entire population.[Goodman et *al.*, 2000; Bloland et *al.*, 2003] As a result people often decide to seek treatment for their illness without knowing whether they have malaria or a regular fever.

10. Discussion and Conclusion

Although many differences exist between areas and countries in conclusion it can be stated that the economic household burden of malaria treatment to sub-Saharan African countries is (still) extensive. This conclusion was also drawn by Chima et *al.* in 2003.[Chima et *al.*, 2003] It is substantiated by the facts that; for many people in SSA the costs for the treatment of one case of malaria are such a high percentage of monthly income/expenditure that they lead to (household) catastrophe; on top of this, few countries in SSA have healthcare insurance or subsidies for malaria treatment available [Vogel, 1990; Onwujekwe et *al*., 2010(a)]; Onwujekwe et *al*., 2010(b)], leading to extra catastrophe; and lastly, not in every healthcare facility appropriate treatment for malaria is available, resulting in many ill people receiving incorrect or less effective treatment.[SciDev Net, 2005]

The remainder of this chapter briefly summarizes the sub questions asked at the beginning of this thesis. Also a more extensive conclusion to the main question is given, followed by policy- and research implications.

10.1 Treatment seeking behavior and anti-malarial drug distribution

Treatment seeking behavior varies widely across different study areas and countries. Nevertheless this review shows that in many countries treatment is mostly sought in public facilities and the retail sector. Reasons for people to choose the retail sector over other sectors include accessibility, longer and more flexible opening hours, quicker service, willingness to negotiate charges, credit offering, perception of being cheaper, more courteous and approachable [Williams and Jones, 2004; Alba et *al.,* 2010], and more reliable drug stocks (as opposed to public/government facilities where stock-outs have been reported frequently [Kangwana et *al.*, 2011]).

Anti-malarial medication is generally distributed more often in the public sector than any of the other sectors. The sector with the least AM distribution is the home/other sector. Reasons for higher AM distribution in the public sector than any other sector are; the fact that often the public sector is the only sector allowed to sell AMs [Kachur et *al.*, 2006; Alba et *al.,* 2010; Ewing et *al.,* 2011] and; AMs are sold for a relatively

low price or given out for free in this sector, as a result of government subsidies. [D' Alessandro et *al.* 2005; Kangwana et al., 2011]

10.2 Subsidies

In some sub-Saharan African countries healthcare subsidies exist. Only in a few of the articles reviewed in this thesis subsidy schemes for the treatment of malaria are described. These schemes range from no subsidies whatsoever, to free first line AM treatment in public/government facilities and in some countries even subsidized first line AM treatment in part of the retail sector. Considering subsidies is important for calculating the household burden of malaria, however it also needs to be taken into account that in many public/government facilities unofficial fees have to be paid to health workers, undoing (to some extent) the subsidies in place.[Alba et *al.,* 2010; Onwujekwe et *al.,* 2010(a); Kangwana et *al.*, 2011]

10.3 Treatment costs

Treatment costs for uncomplicated malaria, both direct and indirect costs, vary widely across countries. For most countries total treatment costs consist mainly of indirect costs (like travel, waiting, caring and sick time). This finding is in compliance with results from Chima et *al.*, although they do not consider travel time in their valuation of indirect costs.[Chima et *al.*, 2003] The direct costs consist mainly of medicine costs for all countries, followed by travel costs and fees charged at the facility respectively. Treatment costs differ between the wet and dry season. In the dry season treatment costs are higher due to lower incidence of malaria and lower opportunity costs of treatment seeking as compared to the wet season. However these findings have not been found in all articles reviewed here. Also these findings cannot be compared to the review of Chima et *al.* since they do not discern between the different direct costs.

10.4 Catastrophe due to malaria

For many of the areas in this review expenditure on uncomplicated malaria treatment can be defined as catastrophic. But the exact number of areas where treatment costs can be defined as such is dependent on the definition used for catastrophic payments. It ranges from all but one area when Ichoku's definition of catastrophe (costs that are more than 2% of income) is used [Ichoku, 2005], to all but 3 areas

using a cut of point of 10-20% of expenditure as percentage of income (in this case of total expenditure))[Prescott et *al.*, 1999; Ranson, 2002; Feder et al., 1987] and only 2 areas having catastrophic costs using a cut of point of 40% of costs as percentage of non-food expenditure [Xu et *al.*, 2003].

Additionally, for most of the people every day lost from work (due to illness) may lead to extra catastrophic payments/income lost (extra catastrophe).[Russell, 2005 and Waelkens, 2005] Most people pay for treatment with their own money (either savings or obtained by selling livestock/crops) or borrowed money

Unfortunately catastrophe as a result of malaria cannot be calculated accurately. After considering the catastrophic impact of both direct and indirect costs it needs to be considered that many (very poor) people decide not to seek or buy any treatment owing to inability to pay.[Asenso-Okyere et *al.*, 1997; Kamat and Brown, 2002; Kofoed et *al.*, 2004; Worrall et *al.*, 2005] These people will thus not receive proper care.

10.5 What is the household burden of uncomplicated malaria treatment to sub-Saharan African households and how does this reflect on current initiatives to fight malaria?

Although there are many factors surrounding the economic impact of malaria treatment that are hard to measure and therefore remain uncertain, it can safely be concluded that; the household burden of uncomplicated malaria treatment in sub-Saharan Africa is (still) substantial for many areas and countries. This conclusion was also drawn by Chima et *al.* in 2003. The costs for uncomplicated malaria treatment in the present review (in as much as they can be compared) do not differ much from treatment costs as shown by Chima et *al.* in 2003. One might therefore wonder if the initiatives that have been started since their review was published are (or have been) successful.

Firstly, many of the initiatives that have been started aim at increasing the number of people using preventive measures and receiving (appropriate) treatment (and consequently decreasing the incidence and mortality of malaria). These initiatives thus aim at decreasing the number of times a person seeks treatment for malaria, yet

not necessarily at decreasing the costs for the treatment of one single case of malaria. One of the exceptions to this rule is the AMFm initiative, which not only aims at increasing the amount of appropriate treatment distributed, but also at decreasing the costs of every single case of malaria treated.[The Global Fund, 2012] Unfortunately at this moment it is hard to measure what effect this initiative, as well as many of the other initiatives, has on the costs of malaria treatment since it was started only three years ago. On top of this most of the articles reviewed in this thesis describe studies conducted between 2001 and 2005 and are therefore too old to reflect on most of the (more recent) initiatives.

With regard to achieving the Millennium Development Goals [World Health Organization, 2012(a)] it would be more relevant to look at incidence and death rates of malaria over the past decade than to look at costs and household burden of malaria treatment as done in this review.
Nonetheless, if we do briefly look at both incidence and malaria specific death rates a decline has been recorded between 2000 and 2010.[World Health Organization, 2011] Thus it is very likely that the birth of initiatives to fight malaria is (and has been) helpful in attaining the Millennium Development Goal of having "halted by 2015 and begun to reverse the incidence of malaria…"[World Health Organization, 2012(a)]

The following two sub chapters describe implications for future policy making as well as for future research in order to tackle the growing problem of household burden of malaria treatment to sub-Saharan African households.

10.6 Policy implications

Implications for future policy making may be taken from the data shown in this review. Most importantly it has been shown that many people seek treatment in the retail sector. This finding is import for the measurement of the household burden of uncomplicated malaria treatment because the use of different facilities may lead to different types of treatment that are prescribed. If incorrect treatment is given it may lead to prolonged and/or returning illness. This in turn leads to more economic hardship because more medication needs to be obtained and thereby increases the household burden due to treatment of uncomplicated malaria.

In terms of the retail sector, it often does not prescribe the correct medication (relatively low percentage of anti-malarial drug prescribing). Moreover when the correct medication is prescribed often a wrong dosage is given, either caused by lack of knowledge and/or lack of money to pay for a full treatment.[SciDev Net, 2005] A last factor influencing the correct treatment being distributed in the retail sector is the fact that often this sector is not allowed to sell the newest first line anti-malarial drug and is thus often not stocked with the best treatment or if they are, it is not subsidized by the government.[Kachur et *al.*, 2006; Alba et *al.,* 2010; Ewing et *al.,* 2011]

These issues may be resolved by implementing several different policies; One may be making more public healthcare facilities available to the public. This implies that healthcare facilities should be located closer to all rural areas, reducing indirect and direct costs. Also waiting time at facilities should be reduced to a minimum, further reducing the indirect costs.
Another, more feasible solution, may be allowing at least part of the retail sector to sell AMs and in particular the newest first line ACTs. In order to ensure proper treatment (selling proper dosages to the proper people) education of shopkeepers in the retail sector is necessary.[Williams and Jones, 2004] Secondly anti-malarial medication in the retail sector should then be subsidized, as in the public sector, since many people otherwise will not be able to afford medication.
Subsidizing the retail sector and allowing certain shops to sell AMs and in particular ACTs is not as strange as it may sound. In many countries drug shops have the possibility to become ADDO's and thereby gain permission to sell ACTs and sometimes buy them at a subsidized price.[Alba et *al.,* 2010] In countries where the AMFm is active these ADDO’s and some other shops in the retail sectors are eligible to buy subsidized ACTs via their program.[The Global Fund, 2012]

Also education on malaria prevention and treatment is very important. Education on treatment should be directed at teaching people where they can buy proper treatment, what this treatment consists of, what it should cost and why it is important to finish an entire treatment in order to avoid resistance. [Williams and Jones, 2004]

10.7 Research implications

Despite an extensive literature study this review does not show a comprehensive overview of the total household burden of uncomplicated malaria treatment in sub-Saharan Africa. This is due to the fact that there are many factors that influence expenditure on malaria treatment, as well as many factors that influence the average income or total expenditure of a household. Thus there are still many areas on which future research might focus.

This study mainly reviews studies conducted in rural areas (table A), because from 2003 onwards very few studies on the household burden of malaria treatment have been conducted (and published) in urban areas. Hence it is important for studies to be conducted on the difference in household burden of malaria treatment between rural, urban (and peri-urban) areas.

When it comes to different socio-economic populations and the household burden of malaria, many studies have been conducted but are not discussed here, because of the limitations to the scope of this thesis. It would be interesting to conduct a review towards the difference in socio-economic status, what it does to both the treatment seeking behavior for malaria as well as the household burden of malaria treatment. Other studies/reviews that could give more of an insight into the actual burden of malaria should be directed at researching the amount of people that seek treatment in different seasons (wet versus rainy season); and the number of people that buy and actually use the appropriate dosing of anti-malarial medication.

Finally, in order to sustain long term subsidies and/or discounts to sub-Saharan African countries for malaria treatment research needs to be conducted in sustainability of subsidies. As well as research into the possibilities to make AMs and in particular ACTs available and affordable to the entire population of sub-Saharan Africa.

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12. Appendix (tables)