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Dedication

To my family

And my friends

For their support
Acknowledgment

I express my deep sense of gratitude & heartfelt thanks to Dr. Osman Hamid AbduElhameed for his inspiring guidance.

I’m also grateful to the staff in Albageer Alwrane Heath Center.

I’m also grateful to my family and my friends.

Yassir Mokhtar Bilow Mohamad

Abstract

Malaria is a fatal disease transmitted to humans through mosquito bites, and spread in about 100 countries in the world and there about 40% of the world population are at risk of malaria. In pregnancy it is associated with many negative outcomes for the woman, foetus and neonate. Intermittent preventive treatment during pregnancy (IPTp) using sulfadoxine/pyrimethamine (SP), insecticide-treated mosquito nets (ITNs) and indoor residual spray (IRS), constitute the main strategies used to prevent malaria. It is consider as one of the most important health problem in Sudan if were not the most important of all, causing many deaths mother and children. The study aims to find out the prevalence of malaria among pregnant women in Albageer Alwrane Heath Center during the month of October 2015, it is descriptive analytic study done to all pregnant women attending to the health center at that period. Where the information was collected using questionnaire containing demographic information, socioeconomic data, number of parity, gestational age, use of preventable method and type, malaria in previous pregnancy, clinical presentation, the result of microscopic examination, type of medication. The result showed 31% were Primigravida, 14% were Secundigravida, 22% were Gravid three, 14% were Gravid four, 19% were Gravid five and more, 37 in 1st trimester, 42% in 2ed trimester, 21 in 3rd trimester. Prevalence of malaria among pregnant women was 67% by microscopic examination, 42% of the women use prevention methods and majority were nets 63%, prevalence among users of these methods were 54% while among non users were 76%. 12% think methods are expensive, 21% think they are not available, 40% think they are not important, 27% don't know. 84% attending with fever, 58% attending with headache. Study recommended health education about malaria for any pregnant women and raise the quality of health services and continuity of this kind of studies.
الملاريا عند النساء الحوامل في مركز صحي الباقير الوراني، محلية الكاملين، ولاية الجزيرة، السودان (2015)

ياسر مختار بيلو محمد

ملخص الدراسة

الملاريا من الأمراض التي تنتقل إلى البشر من خلال لدغات الباعوضة، وهي من الأمراض التي تم اكتشافها في أواخر القرن التاسع عشر الميلادي. وتنتشر في حوالي مائتي دولة من العالم، وتواجد حوالي 40% من سكان العالم معرضون لخطر الملاريا. في الحمل، لها بعض المضاعفات للأم الجنين والمولود. إن العلاج الوقائي لفترة الحمل والدعمات المشابهة والخشوف بالبيضات ذات الأثر الباقى تمثل الاستراتيجيات الأساسية للوقاية من الملاريا. وملاريا من أكبر المشكلات الصحية في السودان، بسبب عدد من وفيات الأمهات والأطفال لذلك كان لابد من دراسة مشكلة الملاريا في فترة الحمل كأحد مهام طبيب الأسرة. يتعرف على المشاكل الصحية وأيضاً طرق المعالجة و الوقاية منها. إن هذا البحث يهدف إلى دراسة معدل الاصابة بملاريا عند النساء الحوامل في مركز صحي الباقير الوراني خلال شهر أكتوبر 2015، وهو بحث وصفي تحليلي لكل النساء الحوامل التي حضرن المركز الصحي في هذه الفترة. تم من خلاله معرفة المعلومات الديموغرافية عنهن ومعلومات عن الحالة الاقتصادية وعدد مرات الحمل والعمر الحاصل. واستخدام الوسائل الوقائية من الملاريا وتنوعها والملاريا في حمل سابق وأعراضهن السريرية وفحص المجهر. أظهرت النتائج أن نسبة 31% كريات و 14% في الحمل الثاني و 22% في الحمل الثالث و 14% في الحمل الرابع و 19% في الحمل الخامس. لما فوق معدل الملاريا عند النساء في فترة الحمل كانت 67%، وذلك وجد أن نسبة 42% سكان وسائل وقارب وطبيبي وواضحية استعملن الدعم المختلفة. بينما معدل الإناث 67% إن نسبة 12% من النساء في وسائل الاتصال بالملاريا لا يستعمون الدعم. إن نسبة 54% بين النساء الاتصال بالملاريا لا يستعملن الدعم. إن نسبة 21% يعتقدن أنها غير متوفرة. و 40% يعتقدن أنها غير متوفرة. و 27% لا يعرفن ماهو السبب. و 84% منهن حضورن بشكوي الحمى و 58% منهن حضورن بشكوي صداع اوصت الدراسة بضرورة التثقيف الصحي لكل امرأة حامل ورفع جودة الخدمات الصحية واستمرار مثل هذا النوع من الدراسات.
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Chapter (1)

Introduction

Historical Background:

Malaria is one of the oldest diseases known to humans. It is believed that it may have infected humans for 50,000 years, and to have been a human pathogen through this entire period. Historian and archaeologist have found evidence of the disease existence in the Xian Dynasty Medieval Europe. The linguistic origin of the word “malaria” stems from Medieval Italian “Mala aria” meaning “bad air”, since it was believed to be caused by putrid marsh air.

The parasite of malaria was first viewed inside red blood cells by a French doctor working in the army stationed in Algeria in 1880, his name was Charles Laveran. Laveran was also the first to propose the notion of protozoa as the cause of disease. He later received the Nobel Prize for his discovery. In 1898, proof that malaria was transmitted by mosquitoes was finally established by Sir Ronald Ross, a physician in the British army in India. He was able to isolate the malaria parasite from the salivary gland of mosquitoes that bite malaria-infected birds and then transmit the parasite to healthy birds. Sir Ronald Ross won the Nobel Prize in 1902.

The process of control and prevention of malaria in the United States began in 1914, when the US Public Health Service (USPHS) petitioned the Congress for the fund of anti-malarial efforts. The funds granted to the states were used to establish malaria control activities all over the US and even military bases located in high-risk regions in the southern US to ensure continuous training of soldiers in the area.

Epidemiology: According to the latest WHO estimates, released in December 2015, there were 214 million cases of malaria in 2015 and 438,000 deaths.

Between 2000 and 2015, malaria incidence among populations at risk fell by 37% globally; during the same period, malaria mortality rates among populations at risk decreased by 60%. An estimated 6.2 million malaria deaths have been averted globally since 2001.

Sub-Saharan Africa continues to carry a disproportionately high share of the global malaria burden. In 2015, the region was home to 88% of malaria cases and 90% of malaria deaths.
Some 15 countries – mainly in sub-Saharan Africa – account for 80% of malaria cases and 78% deaths globally. Since 2000, the decline in malaria incidence in these 15 countries (32%) has lagged behind that of other countries globally (53%).

In areas with high transmission of malaria, children under 5 are particularly susceptible to infection, illness and death; more than two thirds (70%) of all malaria deaths occur in this age group. Between 2000 and 2015, the under-5 malaria death rate fell by 65% globally, translating into an estimated 5.9 million child lives saved between 2001 and 2015.

Developing countries are hardest hit especially sub-Saharan African , South and Southeastern Asia, Oceania and Haiti where P.falciparum malaria prevails. P.vivax is prevalent in India the Middle East and a Central America. Though much less frequent in the US, malaria cases do occur. According to the Centers of disease Control and Prevention (CDC), 1337 malaria cases were diagnosed in 2002.

Almost all of which were linked to travel to endemic areas. Since 1986, only one outbreak of malaria occurred in the US. This was in West Palm Beach, Florida, in 2003, where seven cases of vivax malaria were diagnosed in unexposed individuals. (7) There is a rising trend in malaria infection in recent years, proposed reasons includes:

- Emergence of malaria resistance parasite.
- Resistance of anopheles mosquito to common insecticide.
- Global warming and associated climate changes.
- Globalization and international tourism to malaria endemic areas.

The WHO estimated that by the end of 2004, 107 countries were at risk of malaria transmission. People lives in these at risk areas are estimated about 3.2 billion falciparum malaria is implicated in over one million fatalities annually. It also secondary cause of many deaths mostly in young children and through a synergistic effect with other infection.

In malaria – endemic countries, transmission is heights in rural areas. Although seasonal variation exist, the heights rate of disease transmission are seen toward the end of the rainy season. However, higher attitude are associated with less disease transmission. The highest
rates of malaria transmission globally are found in Ocean and sub-Saharan Africa, followed by the Indian sub continent, southeast Asia, south America and central America. (2)
Problem statement and justification:

In spite of many efforts in malaria prevention WHO declares that there were 214 million cases of malaria and 438,000 deaths worldwide in 2015. Malaria infection during pregnancy is an enormous public health problem with substantial risks for the mother, her fetus and neonate. Pregnancy increases the risk of malaria in woman. Malaria during pregnancy may cause intrauterine death of the fetus. It may also cause premature or abortion.

Albageer Alwrane catchment area had high prevalence of malaria. Assessment of malaria in pregnancy is low in our community in spite of high morbidity and mortality rate. So the study was done to assess the prevalence of malaria among pregnant women and uses of prevention methods.
Objectives

General objective

To study the prevalence of malaria among pregnant women.

Specific objectives

1- To identify the prevalence of malaria among users and nonusers of preventive methods.
2 – To study causes that prevents pregnant women from using preventive methods.
3- To determine the effect of socioeconomic status on malaria prevalence.
Chapter (2)

Literature Review

Approximately 35 million pregnant women are at risk of malaria infection each year in sub-Saharan Africa. Adverse consequences of malaria infection during pregnancy include maternal anaemia, intra-uterine growth retardation, preterm delivery, stillbirth, and low birth weight. Low birth weight is associated with a marked increase in neonatal death. Pathophysiology:

Further information: *plasmodium falciprum pathology*

Micrograph of a placenta from a stillbirth due to maternal malaria. H&E stain. Red blood cells are anuclear; blue/black staining in bright red structures (red blood cells) indicate foreign nuclei from the parasites.

Malaria infection develops via two phases: one that involves the liver (exoerythrocytic phase), and one that involves red blood cells, or erythrocytes (erythrocytic phase). When an infected mosquito pierces a person's skin to take a blood meal, sporozoites in the mosquito's saliva enter the bloodstream and migrate to the liver where they infect hepatocytes, multiplying asexually and asymptptomatically for a period of 8–30 days.

After a potential dormant period in the liver, these organisms he blood and infect red blood cells to begin the erythrocytic stage of the life cycle. The parasite escapes from the liver undetected by wrapping itself in the cell membrane of the infected host liver cell.

Within the red blood cells, the parasites multiply further, again asexually, periodically breaking out of their host cells to invade fresh red blood cells. Several such amplification cycles occur.
Thus, classical descriptions of waves of fever arise from simultaneous waves of merozoites escaping and infecting red blood cells.

Some *P. vivax* sporozoites do not immediately develop into exoerythrocytic-phase merozoites, but instead produce hypnozoites that remain dormant for periods ranging from several months (7–10 months is typical) to several years. After a period of dormancy, they reactivate and produce merozoites. Hypnozoites are responsible for long incubation and late relapses in *P. vivax* infections although their existence in *P. ovale* is uncertain.

The parasite is relatively protected from attack by the body's immune system because for most of its human life cycle it resides within the liver and blood cells and is relatively invisible to immune surveillance. However, circulating infected blood cells are destroyed in the spleen. To avoid this fate, the *P. falciparum* parasite displays adhesive proteins on the surface of the infected blood cells, causing the blood cells to stick to the walls of small blood vessels, thereby sequestering the parasite from passage through the general circulation and the spleen. The blockage of the microvasculature causes symptoms such as in placental malaria. Sequestered red blood cells can breach the blood–brain barrier and cause cerebral malaria.[10]

**Genetic resistance**

**Main article:** Genetic resistance to malaria

According to a 2005 review, due to the high levels of mortality and morbidity caused by malaria—especially the *P. falciparum* species—it has placed the greatest selective pressure on the human genome in recent history. Several genetic factors provide some resistance to it including sickle cell trait, thalassaemia traits, glucose-6-phosphate dehydrogenase deficiency, and the absence of Duffy antigens on red blood cells.

The impact of sickle cell trait on malaria immunity illustrates some evolutionary trade-offs that have occurred because of endemic malaria. Sickle cell trait causes a change in the hemoglobin molecule in the blood. Normally, red blood cells have a very flexible, biconcave shape that allows them to move through narrow capillaries; however, when the modified hemoglobin S molecules are exposed to low amounts of oxygen, or crowd together due to dehydration, they can stick together forming strands that cause the cell to sickle or distort into a curved shape. In these strands the molecule is not as effective in taking or releasing oxygen, and the cell is not
flexible enough to circulate freely. In the early stages of malaria, the parasite can cause infected red cells to sickle, and so they are removed from circulation sooner. This reduces the frequency with which malaria parasites complete their life cycle in the cell. Individuals who are homozygous (with two copies of the abnormal hemoglobin beta allele) have sickle-cell anaemia, while those who are heterozygous (with one abnormal allele and one normal allele) experience resistance to malaria without severe anemia. Although the shorter life expectancy for those with the homozygous condition would tend to disfavor the trait's survival, the trait is preserved in malaria-prone regions because of the benefits provided by the heterozygous form.

**Liver dysfunction**

Liver dysfunction as a result of malaria is uncommon and usually only occurs in those with another liver condition such as viral hepatitis or chronic liver disease. The syndrome is sometimes called *malarial hepatitis*. While it has been considered a rare occurrence, malarial hepatopathy has seen an increase, particularly in Southeast Asia and India. Liver compromise in people with malaria correlates with a greater likelihood of complications and death.

**Diagnosis**

Main article: Diagnosis of malaria

The blood film is the gold standard for malaria diagnosis.
Ring-forms and gametocytes of *Plasmodium falciparum* in human blood

The blood Owing to the non-specific nature of the presentation of symptoms, diagnosis of malaria in non-endemic areas requires a high degree of suspicion, which might be elicited by any of the following: recent travel history, enlarged spleen, fever, low number of platelets in the blood, and higher-than-normal levels of bilirubin in the blood combined with a normal level of white blood cells.\[11\]

Malaria is usually confirmed by the microscopic examination of blood films or by antigen-based rapid diagnostic tests (RDT).\[10\] In some areas, RDTs need to be able to distinguish whether the malaria symptoms are caused by *Plasmodium falciparum* or by other species of parasites since treatment strategies could differ for non-falciparum infections. Microscopy is the most commonly used method to detect the malarial parasite—about 165 million blood films were examined for malaria in 2010. Despite its widespread usage, diagnosis by microscopy suffers from two main drawbacks: many settings (especially rural) are not equipped to perform the test, and the accuracy of the results depends on both the skill of the person examining the blood film and the levels of the parasite in the blood. The sensitivity of blood films ranges from 75–90% in optimum conditions, to as low as 50%. Commercially available RDTs are often more accurate than blood films at predicting the presence of malaria parasites, but they are widely variable in diagnostic sensitivity and specificity depending on manufacturer, and are unable to tell how many parasites are present.

In regions where laboratory tests are readily available, malaria should be suspected, and tested for, in any unwell person who has been in an area where malaria is endemic. In areas that cannot afford laboratory diagnostic tests, it has become common to use only a history of fever...
as the indication to treat for malaria—thus the common teaching "fever equals malaria unless proven otherwise". A drawback of this practice is over diagnosis of malaria and mismanagement of non-malarial fever, which wastes limited resources, erodes confidence in the health care system, and contributes to drug resistance. Although polymerase chain reaction-based tests have been developed, they are not widely used in areas where malaria is common as of 2012, due to their complexity.[3]

**Classification**

Malaria is classified into either "severe" or "uncomplicated" by the World Health Organization (WHO).[3] It is deemed severe when any of the following criteria are present, otherwise it is considered uncomplicated.

- Decreased consciousness
- Significant weakness such that the person is unable to walk
- Inability to feed
- Two or more convulsions
- Low blood pressure (less than 70 mmHg in adults and 50 mmHg in children)
- Breathing problems
- Circulatory shock
- Kidney failure or hemoglobin in the urine
- Bleeding problems, or hemoglobin less than 50 g/L (5 g/dL)
- Pulmonary oedema
- Blood glucose less than 2.2 mmol/L (40 mg/dL)
- Acidosis or lactate levels of greater than 5 mmol/L
- A parasite level in the blood of greater than 100,000 per microlitre (µL) in low-intensity transmission areas, or 250,000 per µL in high-intensity transmission areas

Cerebral malaria is defined as a severe *P. falciparum*-malaria presenting with neurological symptoms, including coma (with a Glasgow coma scale less than 11, or a Blantyre coma scale greater than 3), or with a coma that lasts longer than 30 minutes after a seizure.[12]
Prevention

An Anopheles stephensi mosquito shortly after obtaining blood from a human (the droplet of blood is expelled as a surplus). This mosquito is a vector of malaria, and mosquito control is an effective way of reducing its incidence.

Methods used to prevent malaria include medications, mosquito elimination and the prevention of bites. There is no vaccine for malaria. The presence of malaria in an area requires a combination of high human population density, high anopheles mosquito population density and high rates of transmission from humans to mosquitoes and from mosquitoes to humans. If any of these is lowered sufficiently, the parasite will eventually disappear from that area, as happened in North America, Europe and parts of the Middle East. However, unless the parasite is eliminated from the whole world, it could become re-established if conditions revert to a combination that favours the parasite's reproduction. Furthermore, the cost per person of eliminating anopheles mosquitoes rises with decreasing population density, making it economically unfeasible in some areas.[12]

Prevention of malaria may be more cost-effective than treatment of the disease in the long run, but the initial costs required are out of reach of many of the world's poorest people. There is a wide difference in the costs of control (i.e. maintenance of low endemicity) and elimination programs between countries. For example, in China—whose government in 2010 announced a strategy to pursue malaria elimination in the Chinese provinces—the required investment is a small proportion of public expenditure on health. In contrast, a similar program in Tanzania would cost an estimated one-fifth of the public health budge.

In areas where malaria is common, children under five years old often have anemia which is sometimes due to malaria. Giving children with anemia in these areas preventive antimalarial medication improves red blood cell levels slightly but did not affect the risk of death or need for hospitalization.[12]
Mosquito control

Further information: Mosquito control

Man spraying kerosene oil in standing water, Panama Canal Zone 1912

Vector control refers to methods used to decrease malaria by reducing the levels of transmission by mosquitoes. For individual protection, the most effective insect repellents are based on DEET or picaridin. Insecticide-treated mosquito nets (ITNs) and indoor residual spraying (IRS) have been shown to be highly effective in preventing malaria among children in areas where malaria is common. Prompt treatment of confirmed cases with artemisinin-based combination therapies (ACTs) may also reduce transmission.

Walls where indoor residual spraying of DDT has been applied. The mosquitoes remain on the wall until they fall down dead on the floor.
A mosquito net in use.

Mosquito nets help keep mosquitoes away from people and reduce infection rates and transmission of malaria. Nets are not a perfect barrier and are often treated with an insecticide designed to kill the mosquito before it has time to find a way past the net. Insecticide-treated nets are estimated to be twice as effective as untreated nets and offer greater than 70% protection compared with no net. Between 2000 and 2008, the use of ITNs saved the lives of an estimated 250,000 infants in Sub-Saharan Africa. About 13% of households in Sub-Saharan countries owned ITNs in 2007 and 31% of African households were estimated to own at least one ITN in 2008. In 2000, 1.7 million (1.8%) African children living in areas of the world where malaria is common were protected by an ITN. That number increased to 20.3 million (18.5%) African children using ITNs in 2007, leaving 89.6 million children unprotected and to 68% African children using mosquito nets in 2015. Most nets are impregnated with pyrethroids, a class of insecticides with low toxicity. They are most effective when used from dusk to dawn. It is recommended to hang a large "bed net" above the center of a bed and either tuck the edges under the mattress or make sure it is large enough such that it touches the ground.

Indoor residual spraying is the spraying of insecticides on the walls inside a home. After feeding, many mosquitoes rest on a nearby surface while digesting the bloodmeal, so if the walls of houses have been coated with insecticides, the resting mosquitoes can be killed before they can bite another person and transfer the malaria parasite. As of 2006, the World Health Organization recommends 12 insecticides in IRS operations, including DDT and the pyrethroids cyfluthrin and deltamethrin. This public health use of small amounts of DDT is
permitted under the Stockholm Convention, which prohibits its agricultural use. One problem with all forms of IRS is insecticide resistance. Mosquitoes affected by IRS tend to rest and live indoors, and due to the irritation caused by spraying, their descendants tend to rest and live outdoors, meaning that they are less affected by the IRS.\cite{21}

There are a number of other methods to reduce mosquito bites and slow the spread of malaria. Efforts to decrease mosquito larva by decreasing the availability of open water in which they develop or by adding substances to decrease their development is effective in some locations. Electronic mosquito repellent devices which make very high frequency sounds that are supposed to keep female mosquitoes away, do not have supporting evidence.

**Other methods**

Community participation and health education strategies promoting awareness of malaria and the importance of control measures have been successfully used to reduce the incidence of malaria in some areas of the developing world. Recognizing the disease in the early stages can stop the disease from becoming fatal. Education can also inform people to cover over areas of stagnant, still water, such as water tanks that are ideal breeding grounds for the parasite and mosquito, thus cutting down the risk of the transmission between people. This is generally used in urban areas where there are large centers of population in a confined space and transmission would be most likely in these areas. Intermittent preventive therapy is another intervention that has been used successfully to control malaria in pregnant women and infants,\cite{7} and in preschool children where transmission is seasona.

**Roll Back Malaria (RBM):**

**Goals and Strategies:**
The RBM initiative aims to reduce the global malaria burden through the use of evidence based intervention and to strengthen health system. Current malaria control strategies are based on:

- early diagnosis and effective treatment of malaria cases;
- prevention through vector control measures and, in some particular situations chemotherapeutic measures;
- prevention and control of epidemics.

In most areas of Africa where malaria transmission is rated from moderate to intense, control strategies are based on a combination of three core interventions. (WHO 2005)

(i) Access to prompt and effective treatment.
(ii) Universal use of insecticide-treated nets (ITNS), with priority to young children and pregnant.

(iii) Intermittent preventive treatment (IPT) with at least two fulldoses of an effective safe antimalarial drug in the second and third trimesters of pregnancy. (WHO 2005)

**Abuja Malaria Summit In 2000:**
Aimed to strengthen national health systems with the following goals and targets by the year 2005:

- 60% malaria patients have access to a appropriate treatment in 24 hours of onset of symptoms;
- 60% of children and pregnant women are protected from malaria using ITNS;
- 60% of pregnant women have access to appropriate malaria chemoprophylaxis / intermittent preventive treatment. (WHO 2005)

**The Millennium Development Goals (MDGs):**
Agreed in 2000, the goals and targets specific to malaria are:

- Goal 6: Combat HIV/AIDS, malaria other diseases.
- Target 7: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases. (WHO 2005)

**The main strategic direction of RBM in Sudan:**
Based on analysis of the situation in Sudan. Seven main strategic direction have been used to achieve objectives.

- To ensure that epidemics of malaria are prevented and adequately controlled, through the strengthen surveillance system establishment system for proper forecasting, early detection and rapid response;
- To improve the capacity for access to early diagnosis and adequate treatment of malaria at all levels of the health system through the institution of early recognition and appropriate management of malaria cases at the individual, family, and community and health facility levels.
- To reduce man-vector contact through the deploy of multiple cost-effectiveness and sustainable preventive measures according to the local epidemiological characteristics with special focus on community and personal level;
- To strengthen researches capabilities to ensure the availability of appropriate and timely information for evidence-based decision making in the prevention, control and management of malaria;
To increase community awareness about socio-economic impact of malaria and control measures as an inducement for active community participation and contribution in malaria prevention and control.

To build and faster partnership among all stakeholders to social movement to roll back malaria;

To contribute for advocacy and support the strengthening of overall health system development and policies in line with the general strategic health plan through primary health care to facilitate efforts to roll back malaria. (NMP 2001). RBM aims to tackle the disease in a concerted and systematic way, to enable national health system to combat malaria more effectively and to respond to the sanitary and health needs of populations conditions have been set out for creating a world wide network of governments, development agencies, non-governmental organizations and the private sectors, each participating in a global partnership to roll back malaria. (WHO 2002) The novelty of RBM approach is that it works not only by developing new tools controlling malaria but also by strengthening already existing health services available to affected populations. RBM seeks to build up health systems and ensure better delivery of health care, especially at district and community levels, as well as encourage the development of more effective and new ant malarial drugs and vaccines. (WHO 2002). The RBM Programme in Eastern Mediterranean Region was launched in 1999. Because the countries in the region have reached various levels of malaria control. The objectives are equally varied. However, the overall objectives of the regional RBM Programme are to:

• Have the malaria burden (incidence, severity and mortality) in countries with a severe malaria problem and/or with damaged health systems by 2010 (Group 4: Afghanistan, Djibouti, Somalia, Sudan and Yemen).

• Prevent malaria mortality and reduce malaria morbidity by 50% 2010 in countries with low/moderate endemicity and functional health systems and effective malaria programmes (Group 3: Islamic Republic of Iran, Iraq, Pakistan and Saudi Arabia).

• Eliminate residual foci of malaria by 2006 in countries where malaria transmission has been recently interrupted or where there are only a few residual foci for which eradication is feasible and sustainable (Group 2: Egypt, Morocco, Oman and Syrian Arab Republic).
• Prevent re-establishment of malaria transmission in malaria free countries (Group 1: Bahrain, Cyprus, Kuwait, Lebanon, Libyan Arab Jamahiriya, Palestine, Qatar, Tunisia and United Arab Emirates). (WHO 2004).

GLOBAL TECHNICAL STRATEGY FOR MALARIA 2016-2030:

Has the following vision and goals principles:

The vision of WHO and the global malaria community is a world free of malaria. As part of this vision, the strategy sets ambitious yet feasible global targets for 2030 with milestones for measuring progress for 2020 and 2025. Countries will set their own national or subnational targets, which may differ from the global targets.

These goals apply to all types of human malaria and have been developed after reviewing (1) the targets of national malaria programmes as stated in their national strategic plans, (2) the magnitude of decreases in the numbers of cases and deaths due to malaria between 2000 and 2012, as reported to WHO, and (3) the results of mathematical modelling of transmission of falciparum malaria in order to estimate the potential impact of applying different combinations of recommended interventions between 2016 and 2030. Modelling suggests that, if coverage of malaria interventions remains at current levels, incidence could increase moderately as a result of a partial loss of malaria immunity among populations that have experienced marked reductions in transmission intensity. However, this rise and its consequences could be averted through a concerted effort to optimize the use of currently available tools, particularly vector control, at levels above 80% coverage of at-risk populations, which could significantly reduce incidence of and deaths due to malaria. Given that reaching this level of coverage will be operationally difficult, further innovations in tools and approaches are needed for elimination of transmission in areas where transmission rates are high; they are also needed in areas and for population groups that are presently hard to reach with current interventions.

Five principles underlie the technical strategy for malaria. All countries can accelerate efforts towards elimination through combinations of interventions tailored to local contexts. Country ownership and leadership, with involvement and participation of communities, are essential to accelerating progress through a multisectoral approach.

Improved surveillance, monitoring and evaluation, as well as stratification by malaria burden, are required to optimize the implementation of malaria interventions. Equity in access to health services, especially for the most vulnerable and hard-to-reach populations, is essential. Finally, innovation in tools and implementation approaches will enable countries to maximize their progression along the path to elimination.
PATH TO MALARIA ELIMINATION

The heterogeneity in incidence and transmission rates is likely to further increase. A key approach to optimizing malaria responses within a country will be structuring programmes in response to stratification by malaria burden and based on an analysis of past malaria incidence data, risk determinants related to the human host, parasites, vectors and the environment that together with an analysis of access to services. The performance of national health systems and their adaptability to new opportunities are two of the key determinants of the rate of progress along the path.

As malaria programmes reduce transmission to low or very low rates, they should shift the focus from preventing, detecting and treating clinical cases to preventing, detecting and treating every malaria infection. This change requires strengthened and vector control interventions can be introduced or modified as necessary.

STRATEGIC FRAMEWORK

In order to accelerate progress towards elimination, WHO urges affected countries and the global malaria community to maximize the impact of existing life-saving tools and strategies. Until new and improved tools and approaches become available, there is an urgent need to adopt and expand implementation of all WHO-recommended strategies so as to increase the effectiveness of responses and end preventable malaria deaths. The strategy is built on three pillars with two supporting elements that guide global efforts to move closer to malaria elimination. These are summarized below.

• **Pillar 1. Ensure universal access to malaria prevention, diagnosis and treatment.** The WHO-recommended package of core interventions – namely quality-assured vector control, chemoprevention, diagnostic testing and treatment – can dramatically reduce morbidity and mortality. In areas of moderate-to-high transmission, ensuring universal access of populations at risk to interventions should be a principal objective of national malaria programmes. The metrics of success are the reductions in malaria case incidence and malaria mortality rates. WHO recommends implementing two sets of interventions in a complementary way: (1) prevention strategies based on vector control, and, in certain settings and in some population groups, administration of chemoprevention, and (2) universal diagnosis and prompt effective treatment of malaria in public and private health facilities and at community level. Structuring programmes in response to stratification of malaria by disease burden and including an analysis of past malaria incidence data, risk determinants related to the human host, parasites, vectors and the environment that together with an analysis of access to services
will enable the tailoring of interventions to the local context and ensure efficient use of resources.

- **Pillar 2. Accelerate efforts towards elimination and attainment of malaria-free status.** Countries need to intensify efforts to reduce onward transmission of new infections in defined geographical areas, particularly in settings where transmission is low. In addition to core interventions, attaining this objective will entail targeting both parasites and vectors in well-defined transmission foci, guided by active case detection and case investigations as part of a malaria surveillance and response programme. In some settings, the achievement of elimination may require the use of medicines for prophylaxis, or other possible new approaches to remove the infectious reservoir once those are recommended by WHO. The development and adoption of innovative solutions will be essential to respond to the spread of insecticide resistance and residual transmission, and to target the hypnozoite reservoirs of *P. vivax*.

- **Pillar 3. Transform malaria surveillance into a core intervention.** Strengthening malaria surveillance is fundamental to programme planning and implementation and is a crucial factor for accelerating progress. All countries where malaria is endemic and those susceptible to the re-establishment of malaria should have an effective health management and information system in place for helping national malaria programmes to direct resources to the most affected populations, identify gaps in programme coverage, detect outbreaks, and assess the impact of interventions in order to guide changes in programme orientation. At very low levels of transmission, surveillance should trigger a locally-tailored response to every detected infection, the detection of gaps in programme coverage, declines in the effectiveness of tools, or the occurrence of outbreaks.

- **Supporting element 1. Harnessing innovation and expanding research.** In support of these three pillars, countries where malaria is endemic and the global malaria community should harness innovation and increasingly engage in basic, clinical and implementation research. Successful innovation in product development and service delivery will make a major contribution to accelerating progress. Basic research is essential for a better understanding of the parasites and the vectors, and to develop more effective diagnostics and medicines, improved and innovative vector control methods, and other tools such as vaccines. Implementation research will be fundamental to optimizing impact and cost-effectiveness, and facilitating rapid uptake in populations at risk.
• Supporting element 2. Strengthening the enabling environment.

Strong political commitment, robust financing and increased multisectoral collaboration are key factors for further progress. To optimize national malaria responses, an overall strengthening of health systems and improvement in the enabling environment are also crucial. Strong health systems, both public and private, are important for reducing both the disease burden and the potential for onward transmission of parasites, and enable the adoption and introduction of new tools and strategies within the shortest possible time frame. In turn, the expansion of malaria interventions can be used as an entry point for strengthening health systems, including maternal and child health programmes and laboratory services, and to build stronger systems for health information and for disease and entomological surveillance. Finally, the empowerment of communities, capacity building and supportive supervision for a strong health workforce and regulatory frameworks are important in ensuring achievement of the vision, goals and milestones in this strategy.

THREE PILLARS OF THE STRATEGY

PILLAR 1. ENSURE UNIVERSAL ACCESS TO MALARIA PREVENTION, DIAGNOSIS AND TREATMENT

The WHO-recommended package of core interventions to prevent infection and reduce morbidity and mortality comprises vector control, chemoprevention, diagnostic testing and treatment. These elements are detailed in the following paragraphs.

Vector control

Maximize the impact of vector control. Vector control is an essential component of malaria control and elimination. The capacity of vectors to transmit parasites and their vulnerability to vector control measures vary by mosquito species and are influenced by local environmental factors. Vector control must be implemented on the basis of local epidemiological and entomological data. At present, the two core, broadly-applicable vector control interventions are long-lasting insecticidal nets and indoor residual spraying. National malaria programmes need to ensure that all people living in areas where the risk of malaria is high are protected through the provision, use and timely replacement of long-lasting insecticidal nets or, where appropriate, the application of indoor residual spraying. A second core intervention should not be introduced as a means of compensating for deficiencies in the implementation of the first. However, spraying may be added in certain situations in order to either prevent or mitigate resistance in areas where nets are routinely used – the decision being informed by local data. When those two interventions are deployed together, an insecticide
with a different mode of action to that used on nets should be used for spraying. Supplementary methods may be appropriate in specific settings, for instance larval source management where mosquitoes’ aquatic habitats are few, fixed and findable. Effective planning, application and monitoring of larval source management require specialized capacity that is currently lacking in most malaria programmes. This capacity needs to be built.

Numerous situations exist where transmission of malaria parasites continues even when universal coverage with insecticidal nets or spraying has been achieved. For optimal impact of these interventions, programmes should ensure that vectors are exposed and susceptible to the insecticides used. Long-lasting insecticidal nets counter late-night and indoor-biting mosquitoes, and indoor residual spraying targets indoor-resting mosquitoes. This means that mosquitoes that bite in the early evening, or which are outdoor biting or resting, can evade the most frequently used interventions, leading to residual malaria transmission. Transmission can continue when people are away from houses or otherwise not under nets at the times when and places where malaria vectors prefer to bite. To maximize the impact of current vector control tools where they are appropriate, countries should implement such tools effectively and should not compromise on quality through poor implementation or use of substandard products.

**Maintain adequate entomological surveillance and monitoring.** To enable an effective vector control response, entomological surveillance and monitoring of coverage and impact of vector control interventions must be included in national surveillance systems. Vector control should be guided by local epidemiological and entomological data including insecticide resistance and vector behaviour.

Countries should collect data across all settings, including those areas that are malaria free but at risk of re-establishment of malaria.

Entomological surveillance must include periodic assessment of vector species present, their abundance and seasonality, time and place of biting, resting and host preference (vector behaviour), insecticide susceptibility status and underlying resistance mechanisms in order to predict vulnerability to interventions. Also essential is routine monitoring of coverage and impact of interventions, the physical condition of long-lasting insecticidal nets, the actual use of nets and their perceived usefulness by end users, and the residual effect of insecticides. The data generated should be used to inform decisions on the timing of spraying activities, contribute to net-replacement strategies, and guide the development and deployment of tools including behavioural change communication activities.
Manage insecticide resistance and residual transmission. Even though core vector control interventions continue to be effective in most areas, growing physiological resistance of mosquitoes to insecticides and the combination of vector and human behaviour that sustains continued transmission are major challenges that require an urgent and coordinated response. If left unchecked, insecticide resistance could lead to substantial increases in malaria incidence and mortality, with devastating public health consequences. All countries where malaria is endemic, including those where resistance has yet to be detected, are urged to develop and implement plans for monitoring and managing insecticide resistance. Strategic use of current tools pre-serves their efficacy. Methods of managing resistance include use of insecticides with different modes of action through either periodic changes (rotations) between rounds of indoor residual spraying or multiple combined interventions. Vector behavior that compromises the effectiveness of core interventions must be tackled through the use of new tools. The cost of vector control products is a major barrier to the implementation of strategies to prevent and mitigate insecticide resistance and reduce residual transmission. Countries should better forecast vector control product requirements and support pooled procurement. Such steps should enhance manufacturers’ confidence, help to stabilize the market, lead to price reductions and encourage innovation.

Strengthen capacity for evidence-driven vector control. For effective delivery and monitoring of vector control interventions, national malaria programmes need to invest in human resources and organizational and infrastructural development that will boost capacity to generate and analyse essential data.11 A long-term strategic plan should be developed for building sustainable human resource capacity and establishing career structures and systems to ensure optimal delivery of vector control interventions. Such capacity underpins all activities for malaria control and elimination, and prevention of the re-establishment of the disease.

Implement malaria vector control in the context of integrated vector management. To maximize the impact of malaria vector control – including maintaining adequate entomological surveillance and monitoring, managing insecticide resistance and strengthening capacity for evidence-based vector control – national malaria programmes should apply the principles of integrated vector management.

Integrated vector management is a rational decision-making process for the optimal use of resources for vector control. It seeks to improve the efficiency, cost-effectiveness, ecological soundness and sustainability of disease-vector control with the ultimate goal of preventing the transmission of vector-borne diseases. Countries should develop and implement national plans on integrated vector management as part of their broader strategy to control malaria. Because
implementation of vector control involves different sectors, countries should also strengthen intersectoral coordination for maximum impact.

**Chemoprevention**

Expand preventive treatment to prevent disease in the most vulnerable groups. Preventive treatment strategies are key elements of the multipronged strategy to reduce disease burden and transmission, and they need to be substantially expanded to help countries to reduce their malaria burden. This intervention suppresses existing infections and prevents the consequences of parasitaemia, including disease and death. The strategies for preventive treatment vary, depending on the intensity of transmission and the level of parasite resistance to antimalarial medicines in a given region.

WHO-recommended preventive treatment against malaria presently includes intermittent preventive treatment of pregnant women, intermittent preventive treatment of infants, and seasonal chemoprevention for children aged under 5 years. These interventions are recommended in areas of moderate-to-high malaria transmission in sub-Saharan Africa, with seasonal malaria chemoprevention being recommended only in areas of highly seasonal transmission across the Sahel subregion. Preventive treatment strategies currently target falciparum malaria and need to be developed for other types of human malaria.

**Protect all non-immune travellers and migrants.** Chemoprophylaxis is the administration of subtherapeutic doses of antimalarial medicines at regular intervals sufficient to prevent malaria disease. Chemoprophylaxis should be given to individuals exposed to high malaria risk in combination with advice about measures to reduce vector bites, particularly non-immune travellers, who are more susceptible to malaria illness and death. It is also recommended for travellers within countries from malaria-free areas to areas with high malaria risk. Diagnostic testing and treatment

**Ensure universal diagnostic testing of all suspected malaria cases.** All patients who are suspected to have malaria should have the diagnosis confirmed by parasite detection methods such as quality-assured microscopy or a rapid diagnostic test. Both public and private sector health services should confirm diagnosis before administering antimalarial treatment. Every confirmed case should be tracked and reported in the surveillance system in order to inform programme planning. Ensuring universal diagnostic testing will reduce the over-use of artemisinin-based combination therapies – the first-line treatment for uncomplicated malaria – and reduce the drug pressure on parasites. Expansion of diagnostic testing will provide timely and accurate surveillance data based on confirmed rather than suspected cases. Additionally, it will lead to improved identification and management of the many non-malarial febrile illnesses
presumed to be malaria solely on the basis of the presence of fever. Expanding access to prompt diagnostic testing has lagged behind vector control prevention efforts, but strengthening diagnosis and treatment in all settings will help to reduce malaria morbidity and mortality. WHO recognizes that testing and radical treatment of vivax malaria safely and effectively currently requires two diagnoses: the presence of \textit{P. vivax} parasites and glucose-6-phosphate dehydrogenase status.

**Provide quality-assured treatment to all patients.** Ensuring universal access to WHO-recommended antimalarial medicines is crucial in all settings in order to prevent the progression of uncomplicated malaria to severe illness and death. After diagnostic confirmation, every patient with uncomplicated \textit{P. falciparum} malaria should be treated with quality-assured artemisinin-based combination therapy.

In areas where chloroquine-susceptible \textit{P. vivax} is present, uncomplicated nonfalciparum malaria should be treated with either chloroquine or an artemisinin-based combination therapy known to be effective in the area. In addition to the artemisinin-based combination therapy or chloroquine, all non-pregnant adults and children with \textit{P. vivax} or \textit{P. ovale} who are not glucose-6-phosphate dehydrogenase deficient should receive a 14-day course of primaquine to prevent future relapse. Every severe case of malaria caused by \textit{P. falciparum}, \textit{P. vivax} or \textit{P. knowlesi} should be treated parenterally with artesunate or artemether, followed by a full oral course of an artemisinin-based combination therapy. Severe malaria requires urgent medical attention and WHO’s detailed recommendations have been made available to countries.

Malaria programmes should develop detailed national treatment guidelines that take into account local antimalarial drug resistance patterns and health service capacities.

Countries should select WHO-recommended artemisinin-based combination therapies with more than 95% efficacy demonstrated through therapeutic efficacy monitoring in local sites. Fixed-dose formulations (combining two different active ingredients co-formulated in one tablet) are strongly recommended as they facilitate adherence to treatment and reduce the potential misuse of individual components of co-blistered medicines. Oral artemisinin-based monotherapy should never be used for the treatment of uncomplicated malaria as this may promote the development of resistance to artemisinin.

**Scale up community-based diagnostic testing and treatment.** Training and deployment of community health workers and volunteers can substantially complement and extend the reach of public health services, particularly in rural and remote areas, where health infrastructures tend to be the weakest and malaria transmission the highest. The strategic use of community health workers and volunteers in malaria prevention and care not only bridges health system
gaps, but ensures a continuum of care for the most disadvantaged populations. National malaria programmes should expand integrated community case management of malaria, pneumonia and diarrhoea, with a focus on children under 5 years of age.

**Monitor safety and efficacy of antimalarial medicines and manage antimalarial drug resistance.** Enhanced pharmacovigilance and surveillance of the efficacy of antimalarial medicines are essential in order to detect unexpected adverse events and reduced efficacy so that the most appropriate combinations can be selected for national treatment policies. Countries should monitor every two years the efficacy of first-line malaria therapies – against both falciparum and vivax malaria – using the standard WHO protocol for therapeutic efficacy studies.15

A treatment failure rate exceeding 10% should prompt a change in the national antimalarial treatment policy. For the time being, artemisinin-based combination therapies remain highly effective, provided that the partner medicines remain efficacious.

Caution is required, however, as the emergence of artemisinin resistance increases the risk of resistance to the partner medicines in the combination.

**Contain antimalarial drug resistance.** Protecting the efficacy of artemisinin based combination therapies and developing new combinations should be a top priority for both countries where malaria is endemic and the global malaria community.

In countries and areas where artemisinin and artemisinin-based combination therapies continue to be fully effective, there is a need to promote correct medicine use with special attention to expanding diagnostic testing and quality-assured treatment and to extend all basic malaria interventions, including vector control, in order to reduce the potential emergence of resistance.

Countries where artemisinin resistance is reported are urged to intensify malaria control in order to reduce the burden of the disease and delay or prevent spread of resistance. In areas of low transmission but where resistance to artemisinin is present, countries should target rapid elimination of falciparum malaria.

**Eliminate falciparum malaria from the Greater Mekong subregion.**

*P. falciparum* resistance to artemisinin has emerged independently in multiple geographical locations in the Greater Mekong subregion in South-East Asia. The situation is worst along the Cambodia –Thailand border, where *P. falciparum* has become resistant to almost all available antimalarial medicines. The emergence of multidrug resistance could seriously threaten progress achieved in this region to date, and could lead to a rise in the disease burden in other parts of the world.17 Elimination of
*P. falciparum* malaria is the only strategy that can prevent the spread of resistance; this should be an urgent priority in the Greater Mekong subregion, while current tools are effective.

**Remove all inappropriate antimalarial medicines from markets.** All countries in which malaria is endemic should ensure that all inappropriate antimalarial medicines are removed from private sector markets. National regulatory authorities are urged to regulate against production, marketing authorization, export, import and use of oral artemisinin-based monotherapies. Countries should also take decisive steps, including surveillance and regulatory action as well as stringent follow-up, to remove ineffective antimalarial medicines from health facilities and pharmacies, including their provision through informal providers. These efforts will be crucial for preserving the efficacy of artemisinin-based combination therapies, and will make a substantial contribution to accelerating progress on the path to elimination.

**All countries should aim to eliminate malaria.** Attaining this objective will entail targeting both the vectors and parasites. Preventing contact between people and vectors will reduce onward transmission of new infections, while clearing the parasites from the large number of people with undiagnosed infections will speed declines in transmission. Over the next decade, new tools and approaches will become available which will help to target the infectious parasite reservoir in humans. The main technical recommendations summarized under this pillar are based on existing tools and approaches but the recommendations are expected to be expanded with 2–3 years.

**Pillar 2. Accelerate Efforts Towards Elimination and Attainment Of Malaria-Free Status**

**Refocus programmes.** Once the number of malaria cases has been reduced to low levels in a given country or subnational area, the malaria programmes’ priorities and activities may need to be readjusted to complete the final phase of elimination.

Thus, in addition to the interventions mentioned under Pillar 1, programmes should enhance surveillance to ensure that every infection is detected, implement targeted measures for attacking both parasites and vectors in order to interrupt local transmission, eliminate all parasites from humans, and manage the risk of re-establishment through imported malaria.

**Enact legislation.** New legislation is needed in order to support changes in programme prioritization, namely to ensure that the over-the-counter sale of antimalarial medicines is banned and that surveillance is further strengthened to include compulsory notification of all confirmed cases of infection detected in both public and private health care facilities. In addition, health ministries – with the support of relevant authorities – need to assume direct oversight of supply management for malaria medicines; build a centralized reporting system.
for epidemiological surveillance of malaria, for vector control data, outbreak reporting, and preparedness and response; and intensify coordination between public, private and community-based agencies and services.

**Renew political commitment and deepen regional collaboration.** The final phase of elimination needs strong political commitment, predictable long-term financing, and increased collaboration between neighbouring countries. In many countries, there is an urgent need to expand efforts to support at-risk communities in low-transmission areas, especially in remote and hard-to-reach areas. Solutions should be found for protecting itinerant population groups and migrant workers within and across countries by informing them of the potential dangers of the disease, and providing access to prevention tools and treatment through accessible health clinics.

**Reduce the number of undetected infections.** Ensuring that malaria parasites are fully cleared from infected people through public health interventions will require new approaches that are not yet part of the WHO-recommended arsenal of tools. Strategies such as mass administration of medicines have been successfully used in the past, and are currently being explored in a range of transmission settings.

Research is evaluating the potential role of administering transmission-blocking medicines in high-transmission settings in order to accelerate progress towards elimination.

Other research is evaluating the impact and longer-term effect of administration of effective antimalarials to either an entire population or targeted population groups, including treatment of infected individuals screened for malaria parasites with highly sensitive tests.

**Implement targeted malaria vector control.** As transmission decreases to low levels in countries or subnational areas, universal coverage of populations at risk of malaria with vector control interventions should be maintained in most settings to prevent resurgences. For a given area, the defined population at risk will likely differ as programmes proceed along the path to elimination. A shift from universal coverage to targeting of vector control to specific populations or areas may be justified in circumstances where the inherent transmission potential is low, surveillance systems are strong, there is a high level of preparedness and the ability exists to respond quickly in the event of a resurgence. Targeted indoor residual spraying plays an important role in some settings as a response to outbreaks and resurgences, or to eliminate transmission foci. As transmission declines there may be an increased need for supplementary measures such as larval source management.
Prevent re-establishment of local malaria transmission. Even after the disease has been eliminated from a country or subnational area, continued importation of malaria cases means that the quality of case detection must remain high. Vigilance for possible renewed local transmission is a responsibility of the general health services as part of their normal function in communicable disease control, in collaboration with other relevant sectors (such as agriculture, environment, industry and tourism). Individuals who plan travel to areas where malaria is endemic should be provided with health information, chemoprophylaxis and advice about measures to protect against mosquito bites, aimed at reducing the importation of parasites. Visitors and migrants from endemic areas should be informed of the risks of malaria and given easy access to free-of-charge diagnostic and treatment facilities. Vector control must continue to be used to contain local outbreaks and protect areas that are known to be receptive to the resumption of transmission as well as exposed to frequent importation of malaria parasites. The patterns of vigilance that need to be applied in order to ensure the successful maintenance of the malaria-free status depend on the vulnerability and receptivity of an area. The programme for prevention of re-establishment of transmission has an unlimited duration. Thus, surveillance should be maintained in countries that no longer have transmission.

Implement transmission-blocking chemotherapy. Transmission-blocking chemotherapy is the use of effective antimalarial medicines to reduce the transmission of gametocytes, the sexual stage of plasmodia that are infectious to mosquito vectors, thereby interrupting the malaria transmission cycle. WHO recommends transmission-blocking chemotherapy to reduce malaria transmission, particularly in areas threatened by resistance of *P. falciparum* to artemisinin and as part of strategies to eliminate *P. falciparum*. This intervention is currently recommended in areas with low transmission and where treatment coverage is high. Transmission-blocking strategies are currently available for falciparum malaria but have not been developed for other malaria parasites.

Detect all infections to attain elimination and prevent re-establishment. In settings where the rate of transmission is very low, active detection and investigation of infections in addition to free malaria care and notification at health facilities are important for clearing residual foci of transmission. Case investigations and detection of infections among people who share the living environment with someone diagnosed with malaria at a health facility will provide information on potential exposure to the same sources of infection in order to elucidate whether local transmission is occurring or if cases have been imported.
Use of medicines to reduce the parasite pool. Use of antimalarials is an element of the elimination strategy as they can eliminate the parasite pool in the treated population and, when used preventively, reduce both the pool of susceptible individuals and transmissibility of gametocytes. In the future, WHO will assess the potential role of medicines in killing mosquitoes before they are able to transmit malaria parasites, and their potential role in treating all infections regardless of clinical symptoms or health-seeking behaviour. In work aimed at elimination, all patients with laboratory-confirmed vivax or ovale malaria should be treated with a regimen for a radical cure to clear all remaining hypnozoites, which could later cause a relapse.

Devise *P. vivax*-specific strategies. For elimination to succeed, greater attention must be given to *P. vivax*, a parasite less well understood than *P. falciparum*. Vivax malaria presents multiple challenges and needs specific strategies. The challenges include the following:

- *P. vivax* tolerates a wider range of environmental conditions than *P. falciparum* and therefore has a wider geographical range;
- *P. vivax* can be transmitted from humans to mosquitoes before infected people develop symptoms;
- conventional vector control methods (long-lasting insecticide-treated nets and indoor residual spraying) may be less effective against *P. vivax* because, in many areas where *P. vivax* predominates, vectors bite early in the evening, obtain blood meals outdoors and rest outdoors;
- dormant hypnozoites are more difficult to detect because the parasitaemia is typically low and because the dormant hypnozoites residing in the liver cannot be detected with existing diagnostic tests;
- hypnozoites can give rise to multiple relapses and contribute to significant morbidity and onward transmission;
- *P. vivax* hypnozoites can only be eliminated through a 14-day course of primaquine, which can produce serious side effects (haemolytic anaemia) in patients who have glucose-6-phosphate dehydrogenase deficiency, and such treatment is contraindicated in vulnerable population groups such as infants and pregnant or breastfeeding women;
- testing for glucose-6-phosphate dehydrogenase deficiency is challenging and not available in many settings;
- chloroquine-resistant vivax malaria is spreading.

Use surveillance as an intervention in elimination programmes. As malaria programmes progress towards elimination, the aim of surveillance is to detect all malaria infections, whether symptomatic or not; to investigate each individual case of infection, differentiating imported cases from those acquired locally; and to ensure
that each detected case is promptly treated in order to prevent secondary infections. Although infections occur sporadically or in distinct foci, surveillance systems must cover an entire country, with particular attention to areas with ongoing or a recent history of transmission. Countries should monitor imported infections, which represent a significant proportion of all infections in the elimination phase and may pose a risk for re-establishment of transmission in areas in which it had previously been interrupted.

Pillar 3. Transform Malaria Surveillance Into A Core Intervention

Irrespective of where countries are on the path to elimination, surveillance of malaria should be upgraded to a core intervention in national and subnational malaria strategies. Surveillance as an intervention encompasses tracking of disease and programmatic responses and taking action in response to data received. At present, most high-burden countries are not in a position to capture essential malaria data on a continuing basis, thereby making it difficult to optimize responses, assess disease trends and respond to outbreaks. Surveillance may function most intensively as an intervention when programmes are closest to elimination, but effective surveillance is required at all points on the path to elimination. The benefits of effective surveillance and the actions needed to transform surveillance are described below.

Strong malaria surveillance enables programmes to optimize their operations, by empowering programmes:

* to advocate investment from domestic and international sources, commensurate with the malaria disease burden in a country or subnational area;
* to allocate resources to populations most in need and to interventions that are most effective, in order to achieve the greatest possible public health impact;
* to assess regularly whether plans are progressing as expected or whether adjustments in the scale or combination of interventions are required;
* to account for the impact of funding received and enable the public, their elected representatives and donors to determine if they are obtaining value for money;
* to evaluate whether programme objectives have been met and learn what has worked and not worked so that more efficient and effective programmes can be designed.

**Surveillance in areas of high transmission.** Data analysis and programme monitoring are based on aggregate numbers, and actions are undertaken at a population level to ensure that all populations have access to services and there are no adverse disease trends. Accurate and timely information on numbers of and trends in malaria-associated deaths is a key requirement
for tracking the progress of malaria control. Concerted efforts should be made to ensure that all admissions for malaria to hospitals and health centres and deaths from malaria therein are confirmed by a parasitological test and reported through a national surveillance system. The representativeness of hospital data should be characterized in selected sites with well-defined catchment populations and that continuously track the cause of death.

**Surveillance in areas of low transmission.** In areas where rates of transmission are low or moderate, there is appreciable heterogeneity in the distribution of malaria and it becomes increasingly important to identify the population groups most susceptible to disease, and to target interventions appropriately. Malaria can be concentrated in marginalized populations, such as those living in remote or border areas, itinerant and migrant workers, and tribal populations with limited access to services. It may be necessary to take diagnostic testing and treatment services directly to populations without access to services (i.e. to undertake proactive case detection and treatment). As the immunity of populations at risk wanes as interventions take effect, it is important for programmes to be vigilant against potential outbreaks, with intensified reporting (e.g. weekly) of the incidence of infections and the monitoring of major determinants of transmission, such as meteorological data.

**Surveillance in areas targeted for elimination of malaria.** Malaria-specific reporting systems are increasingly needed to satisfy the additional information demands for targeting and monitoring interventions in particular risk groups and foci. As progress is made towards elimination, it becomes necessary to investigate individual cases of infection or clusters of cases in order to understand risk factors and eliminate foci of transmission. It also becomes increasingly important to ensure that surveillance systems capture data on cases detected by private sector care providers, both formal and informal. Increasing resources and capacity are required to run and maintain malaria surveillance systems that become more complex and resource intensive in moving to the elimination phase, and additional skills, training and activities will have to be provided for the personnel involved. Strong surveillance systems need to be maintained to sustain the status of elimination once it is achieved; countries also need to monitor the risk of importation (vulnerability) and the transmission potential in risk areas (receptivity).

**Invest in routine information systems.** Routine information systems are crucial for surveillance at all stages of malaria control and form the basis for monitoring of malaria programme activities. Sufficient investments must be made in the management and use of data from improved routine information systems in order to generate the information needed for programme planning, implementation and evaluation. Adequate financial and logistical support
is needed for provision of office supplies and equipment, training and retraining of staff, supervision of health facilities, and communications. Data reporting requires management with quality controls in place and good follow up. Building the technical capacity of staff for data analysis and interpretation is the overriding need in order to enable programmes to use surveillance information most effectively.

**Collect necessary data for understanding disease trends and overall programme performance.** Necessary information includes data on resources available for malaria control (programme financing, staff and commodities), existing levels of service provision (access to services and intervention coverage), and trends in health services utilization. It also covers data on populations affected, including malaria parasite prevalence rates and factors that are associated with a higher risk of acquiring malaria. Multiple sources of data include routine information systems (to track finances, commodity flows, service delivery, and disease trends), health facility surveys (to track implementation of services delivered by health facilities), household surveys to track programme coverage and parasite prevalence (in populations), and findings of implementation research. Entomological monitoring systems are required to update information periodically on vectors and their behaviour and susceptibility to insecticides. Therapeutic efficacy studies are essential for detecting resistance to antimalarial medicines. The weight given to different data sources will vary according to the level of malaria transmission and the maturity and capacities of a malaria programme.

**Develop national strategic plans that take into account the epidemiology and heterogeneity of malaria in a country.** As intervention coverage is increased and malaria incidence is reduced, the heterogeneity in incidence and transmission rates increases. A key approach to optimizing malaria responses within a country or territory will be stratification, in which a country or area is divided into smaller units where different combinations of interventions may need to be delivered. National strategic plans should take into account the readiness of health systems to expand malaria programmes and identify the resources required to achieve intended levels of coverage and impact. They should define the role of different stakeholders in the implementation of the plan and set targets for monitoring progress and ensuring accountability.

**Monitor the implementation of national malaria strategic plans at regular intervals.** In particular, annual reviews should be undertaken before budgets are prepared; mid-term reviews may be conducted to assess interim progress; and a final programme review should be undertaken before development of the next strategic plan. Feedback showing the status of selected key indicators should be communicated to districts and health facilities on a monthly
or quarterly basis and include private health facilities. It is important that data are summarized in ways that staff in health facilities and districts can readily assess the facilities’ performance. Programme monitoring and surveillance should not be confined to malaria programme managers and implementers. Other government departments, elected leaders, community members and donors have a stake in ensuring high quality malaria programmes and need to be able to scrutinize the operations they are supporting. If involved in the review process, they can help to ensure that malaria programmes are responsive to populations’ needs and that malaria control and elimination are promoted as a development priority.

**Ensure the surveillance system is monitored.** Routine health information systems and well-functioning disease surveillance enable programmes to monitor malaria financing, intervention coverage and disease trends. It is important that performance of the surveillance system itself is also monitored through metrics such as the percentage of health facilities submitting monthly reports, the proportion of health facilities receiving quarterly feedback, and, in the advanced phase of malaria elimination, the proportion of cases and deaths investigated. Other important characteristics that should be evaluated periodically include timeliness, accuracy, representativeness and validity. Monitoring the surveillance system itself will identify weaknesses and enable actions to be taken to improve surveillance, which in turn can improve the performance of the malaria programme and accelerate progress towards malaria elimination[15]

**Treatment of malaria** The World Health Organization (WHO) recommends artemisinin-based combination therapies (ACTs) as first-line treatment for uncomplicated malaria [1]. ACTs consist of two anti-malarial compounds: an artemisinin derivative, which induces rapid reduction of parasite load in blood over a period of days, and a partner drug, which eradicates remaining parasites.

Recently, artemisinin resistance has been observed in four Southeast Asian countries (Cambodia, Myanmar, Thailand, and Viet Nam). This has been attributed to factors including irrational prescribing practices, poor patient compliance with prescribed regimens, improper use of artemisinin monotherapies, and inadequate access to quality assured forms of the drug. Fortunately, ACTs remain effective as long as resistance to the partner drug has not developed. But while resistance to ACTs has not yet been observed, concern exists that poor treatment practices may promote ACT resistance in the future, a situation similar to the global spread of chloroquine resistance that has occurred.
In 2011, WHO encouraged the scale-up of interventions to protect the efficacy of ACTs, which was supported by the release of the Global Plan for Artemisinin Resistance Containment [3]. Currently, WHO recommends five forms of ACTs: artemether-lumefantrine (AL), artemunate-sulfadoxine/pyrimethamine (ASP), artesunate-amodiaquine (ASAQ), artesunate-mefloquine (ASMQ), and dihydroartemisinin-piperaquine (DHAPQ). Malaria-endemic countries in Sub-Saharan Africa have adopted several of these different formulations of ACTs in their national strategies for malaria control and elimination [3].

Meta-analysis of malaria in pregnancy (MiP) studies conducted in Eastern and Southern Africa between 1990 and 2011 showed that 32.0 % (95 % confidence intervals [CI], 25.9–38.0; N = 47,433) of pregnant women attending antenatal care (ANC) facilities had peripheral parasitaemia. When the time period was restricted to studies conducted between 2000 and 2011, parasitaemia was 29.5 % (95 % CI, 22.4–36.5; n = 18,375). These estimates were calculated using a standard method for correcting errors of magnitude based on the known specificity and sensitivity of individual diagnostic methods[16].

Various diagnostic methods can be used in malaria detection. In this study microscopy and polymerase chain reaction (PCR) methods were employed. One advantage of standard microscopy is that the method requires a relatively short time for diagnosis when used in areas of high transmission and parasites are present in high concentrations [approximately 1000 parasites per microlitre (µl) of blood]. However, if parasite densities are very low, examination of each slide is labour-intensive. Moreover, the sensitivity and specificity are greatly influenced by the skills and workload of microscopists. In contrast, the use of PCR for the diagnosis of malaria is highly sensitive and consistent in the detection of parasites; PCR has the ability to measure infections where parasite counts are as low as 5 per µl of blood. However, some problems arise with false-negative results when DNA isolation is inappropriate[16].

In Zambia, malaria is endemic in all 10 provinces and *Plasmodium falciparum* is responsible for approximately 95 % of all cases. Since 2006, the National Malaria Control Programme has conducted a Malaria Indicator Survey (MIS) every 2 years to measure the prevalence of malaria by microscopy in children under 5 years of age in selected sites. The prevalence of malaria parasitaemia decreased in Zambia from 2006 to 2010 in some regions, while little change was observed in others. Of concern is that parasitaemia declined between 2006 and 2008 in Eastern, Northern, and Luapula Provinces, but was higher in the 2010 survey. There has been a 48.3 % decline in the national overall malaria prevalence in children under 5 years of age between 2006 and 2012 (22.1 versus 14.9 %), although there was only a 2.5 % reduction in Luapula Province (32.9 versus 32.1 %).
An estimated 200,000 pregnancies in Zambia are at risk of malaria each year [16], however the MIS has not reported any estimates of malaria infection among pregnant women to date. Thus, this study was conducted to determine the prevalence of peripheral parasitaemia and risk factors for malaria infection from a cross-section of first ANC attendees in Luapula Province, an area known to have intense malaria transmission. According to the Zambia Demographic and Health Survey 2013–2014, 94.6% of women between 15 and 49 years of age in Luapula Province reported having received ANC from a skilled health care provider during pregnancy for their most recent birth in the preceding 5 years. The coverage of IPTp-SP reported in the MIS at provincial level was as follows: 89.7, 76.6, and 57.6% of women took at least one dose, two or more doses, and three or more doses of IPTp-SP, respectively. The prevalence of HIV among ANC attendees at the two recruitment sites for the study, Kashikishi and Nchelenge health centres, in 2014 was 13.0 and 13.3%, respectively. This estimate combined new cases and already known HIV positive cases.

Methods: This was a prospective cohort study of ANC attendees involving recruitment at ANC booking with follow-up to delivery. The study site was the catchment area for two health centres in Nchelenge District which is located on the shores of lake Mweru and has a population of 173,680. Recruitment of participants was done at the two health centres between November 2013 and April 2014, the high malaria transmission period.

The main study was designed to estimate the prevalence of malaria, curable sexually transmitted and reproductive tract infections and their co-infection, to explore determinants of poor birth outcomes in pregnancy, and to assess in vivo efficacy of SP over 28 days following administration.

The sample size of 1086 was based on the assumption that the incidence of adverse birth outcomes (low birth weight, stillbirth, preterm delivery or intra-uterine growth retardation) among women who have a malaria infection or a curable sexually-transmitted and reproductive tract infections infection during pregnancy would be at least 10%. Thus, the sample size had 80% power with 95% CIs to detect risk factors that have an odds ratio >2 (n = 984); 10% (n = 102) more pregnant women were recruited to account for expected losses to follow-up as observed in another MIP study in Zambia [16]. Women were enrolled upon providing informed written consent if they had not been exposed to anti-malarial and/or antibiotic therapy within the previous 4 weeks, were willing to have a member of the study team record their HIV test results following routine HIV screening, and had a gestational
age of <32 weeks. The prevalence of malaria identified by microscopy was 31.8 \% (95 \% confidence intervals [CI], 29.0–34.5; N = 1079) and by PCR was 57.8 \% (95 \% CI, 54.9–60.8; N = 1074). HIV infection was 13.2 \% among women on their first antenatal visit; the prevalence of malaria detected by PCR among HIV-uninfected and HIV-infected women was 56.7 \% (531/936) and 65.2 \% (90/138), respectively. In the final model, the risk of malaria infection was 81 \% higher among pregnant women recruited from Nchelenge health centre compared to those attending the Kashikishi health centre (adjusted odds ratio = 1.81; 95 \% CI, 1.38–2.37, P < 0.001), and HIV-infected women across health centres had a 46 \% greater risk of malaria infection compared to HIV-uninfected women (adjusted odds ratio = 1.46; 95 \%, 1.00–2.13, P = 0.045).

Conclusion: High burden of malaria detected by PCR in these pregnant women suggests that past prevention efforts have had limited effect. To reduce this burden of malaria sustainably, there is clear need to strengthen existing interventions and, possibly, to change approaches so as to improve targeting of groups most affected by malaria.

On the status of malaria among pregnant women in Lagos, Nigeria. A study was carried out on the status of malaria among 800 randomly selected pregnant women in Lagos State, Nigeria. Blood samples were obtained from finger pricking and tested for malaria parasites in thin blood films and 60\% prevalence of malaria parasites was obtained. Interviews were conducted and structured questionnaires were administered to the pregnant women to obtain information on the clinical and social aspects of malaria. Results show that primigravidae accounted for a greater part of the 60\% prevalence of malaria that affected mainly women in their 1st to 3rd month of pregnancy. The ages of the infected women ranged from 30 to 39 years (77\%). Women with blood groups A and O had the highest prevalence of malaria, but there was no statistically significant difference between them and the uninfected women. Women with genotype AA had the highest prevalence of malaria, while pregnant women in Ikeja division had the highest incidence of malaria (41.7\%). Majority of the infected women believed that mosquito bites and stress were responsible for their infection. Only 21.8\% of the women did not associate mosquitoes with malaria. All the women were familiar with the symptoms of malaria but did not see it as a serious disease that could lead to death. Most of the women used bed nets but not the impregnated brands. There is need to educate women, especially during antenatal visits, on the severity of malaria and the risk of their susceptibility to it during pregnancy[22].

Malaria in Pregnancy in Sudan: Previous studies Hospital-based cross sectional descriptive study conducted in Ed-Duweim Teaching Hospital, White Nile State (2009) showed that 38.1\% of the
pregnant women were infected with malaria. Falciprum malaria is the commonest 97.8% specie among pregnant women who contracted malaria. Malaria found to be more common 51.6% among women reported from rural areas. The high proportion of malaria 45.9% was found among the age group 25-34 years. Women with Intermediate level of education 85% were more infected. The family income of the most infected pregnant women range between 301-500 Sudanese pounds per month. 84.8% of women who contracted malaria where not aware about malaria. 53.8% of the women who had positive malaria mentioned that there was accumulation of water near their houses. 55.3% of women who contracted malaria reported that there was no organized vector control activates concerning malaria control. 84% of the women who used bed nets did not contract malaria. It has also been noticed that there is total absence of IPT utilization[19].

New Halfa Teaching Hospital, eastern Sudan, during October 2003- April 2004: The study aimed to demonstrate the prevalence and risk factors for malaria (age , parity andgestational age ) among pregnant women of eastern Sudan , which is characterized by unstable malaria transmission. (Ishag et al 2005)The prevalence and possible risk factors for Plasmodium falciparum malaria were investigated in 744 pregnant Sudanese women attending the antenatal clinic of New Haifa Teaching Hospital, eastern Sudan, during October 2003- April 2004.A total 102 (13.7%) had P. falciparum malaria , 18(17.6%) of these were severe cases (jaundice and severe anaemia) Univariate and multivariate analysis showed that , age and parity were not associated with malaria .Women who attended the antenatal clinic in the third trimester were at highest risk for malaria.Women with malaria had significantly lower mean hemoglobin versus . Asignificantly lower mean hemoglobin was observed in those with severe falci parum malaria compared to non- severe form. The results suggest that P. falciparum malaria is common in pregnant women attending antenatal care and that anaemia is an important complication . Preventive measures (chemoprophlaxis and insecticidetreated bed nets) my be beneficial in this area for all women irrespective of age or parity.The presentation of malaria during pregnancy varies according to the preexisting immunity of the mother. Women living in areas of low transmission have little immunity to malaria and pulmonary oedema[26].

A prospective hospital based study carried out at Khartoum Teaching Hospital as well as Omdurman Maternity Hospital during the period from 1st August 2004 to 1st March 2005 : The studied population were 80 pregnant Sudanese ladies , whose age range from 15-40 years they were admitted with sever malaria as diagnosed by thick and thin blood films Gimsa’s stain. The aim was to determine the maternal and fetal outcome as malaria infection poses a major public health problem in Sudan . Medical problems were excluded in this study. Although no maternal mortality was encountered among the studied women
morbidity was high. The prevalence of anaemia in the studied group was 70% of whom 10 % were severely anaemic, 30% were found to be jaundiced. Hypoglycemia and dehydration were encountered in 21-25% and 12.5% respectively, while the prevalence of cerebral malaria was only 1.25%. The incidence of preterm babies was less than 7 at 5 minutes, stillbirths and early neonatal deaths occurred in 8.7%. The national protocol for treatment of malaria in pregnancy was adopted in the management of all women. (Intisar 2005) Morbidity from malaria in pregnancy is mainly due to fever, vomiting and abdominal pain. Most of studied population encountered more than one attack of malaria during the index pregnancy, no one out of 80 patients studied received antimalarial prophylaxis malaria is a risk factor for adverse pregnancy out come with increased incidence of preterm delivery, low birth weight Intrauterine Growth Retardation IUGR, low apgar score at delivery, as well as poor prenatal outcome.

Hospital based descriptive study was conducted to study the epidemiology of malaria among pregnant women attending at Alturky hospital March 2008. The objectives were to find out the proportional incidence among women, to investigated the knowledge of pregnant women towards malaria, to identify the self-protection that used by pregnant women and to highlight the contributory factors behind malaria. The study found that 20.8% of the pregnant women were infected with malaria. The infection was frequent (28.1%) in age group 15-25. Education level, occupation and the presence of mosquito in the house were the risk factors behind infection. The study conducted that malaria is still major health problem in Khartoum state and all population at the area at risk of infection especially pregnant women. (Amani 2008)
Chapter (3)

Material and methods

Study design:

This descriptive analytic facility based study, conducted at Albageer Alwrane health center in October 2015.

Study area:

Albageer Alwrane area located in Gezira state, total number of population (3500) about 80kilo meter north kamleen city different tribes living the area. Houses are of different fashions, most of people work in trading.

Albageer Alwrane health center:

The oldest health center build in the area, rebuild on 2000, consist of 9 rooms. The medical staff consist of family doctor, medical assistant, lab teq, lab assistant, 2midwives, and others.

Study population:

Every pregnant women attending Albageer Alwrane health center in October (total sample)

Sample size:

57 pregnant women attending Albageer Alwrane health center in October

Sample technique:

All pregnant women attending Albageer Alwrane health center.

Ethical consideration:

Ethical clearance and approvals obtained from university of Gezira. Verbal consent was taken from the women without recording their names. Data will be stored in personal computer. The participant has been told that the information from them will be treated with complete confidentiality. Also consent was taken from Ministry of health and Health center administration.
Data collection tools

1/Questionnaire

*Demographic data (age-educational level-occupation).

*Socioeconomic data (water source -electricity-house building – water cycle – electrical equipments)

* Number of parity.

*Gestational age.

*Use of preventable method and type.

*Malaria in previous pregnancy.

*Malaria in the current pregnancy.

*Clinical presentation.

*Type of medication: artesunate artemether inj quinine tabs

* Questionnaire done by direct interview with patient after permission was taken.

2/Data analysis:

Data were analyzed on set of objectives descriptive statistic through <SPSS>, Simple descriptive statistic, frequency, percentage. Result obtained were presented in tables and figures.

3/interview

Interview with old people lives in the catchment area to collect data about the area
Chapter (4)

Result

Result of studying 57 pregnant women attending Albageer Alwrane health center.

Age:

The result showed that less than 20 years was 4%, 20-25 years was 37%, 25-30 years was 28%, 30-35 years was 17%, 35-40 years was 11%, above 40 years was 3% Table (1).

Education level:

Literacy 19%, primary 23%, secondary 35%, university 23% table (2).

Parity:

With regarding to parity Primigravida were 31%, Secundigravida were 14% Gravid three were 22% Gravid four were 14% Gravid five and more were 19% as show in figure (1).

Gestational age:

37% in 1st trimester, 42% in 2nd trimester, 21% in 3rd trimester table (4).

Prevalence of malaria:

67% malaria positive (38) 33% malaria negative table (5).

Socioeconomic status among malaria positive women:

High: 15%, high moderate: 66%, moderate: 8%, low moderate: 11, low: 0 table (6).

Utilization of prevention method:

The result showed 42% of the women use prevention methods while 58% not use as show in table (7).
Comparison of Prevalence between users and non users of preventive methods:

among users was 54%, among non users was 76% table(8).

Type of prevention methods:

Nets 63%, chemoprophylaxis 25%, repellants 12% figure(2).

Causes precluding utilization of prevention method:

12% think they are expensive, 21 think they are not available, 40% think they are not important, 27% don’t know table (9).

Prevalence of malaria in the previous pregnancies:

53% had malaria while 47% hadn’t malaria

Clinical presentation table (10):

Fever: present in 84%

Headache: present in 58%

Jaundice: present in 5%

Skin rash: present in 13%

Sore throat: present in 16%

Convulsion: present in 0%

Coma: present in 0%

Fatigue: present in 24%

Anxiety: present in 18%

Urinary symptoms': present in 11%
Types of medication:

Artesunate 19%, aretemether inj 76%, quinine tabs 5% figure (3)

Table (1) Age of pregnant women in Albageer Alwrane health center in October 2015.

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 20</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>20-25</td>
<td>21</td>
<td>37</td>
</tr>
<tr>
<td>25-30</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>30-35</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>35-40</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>40 and above</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100</td>
</tr>
</tbody>
</table>

Table (2) Education level of pregnant women in Albageer Alwrane health center in October 2015.

<table>
<thead>
<tr>
<th>Education level</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Primary</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>Secondary</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>University</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100</td>
</tr>
</tbody>
</table>

Most of pregnant women are of secondary level education (35%)
Table (3): Number of parity among pregnant women in Albageer Alwrane health center in October 2015.

<table>
<thead>
<tr>
<th>Parity</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primigravida</td>
<td>18</td>
<td>31%</td>
</tr>
<tr>
<td>Secundigravida</td>
<td>8</td>
<td>14%</td>
</tr>
<tr>
<td>Gravidthree</td>
<td>12</td>
<td>22%</td>
</tr>
<tr>
<td>Gravid four</td>
<td>8</td>
<td>14%</td>
</tr>
<tr>
<td>Gravid five and more</td>
<td>11</td>
<td>19%</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100%</td>
</tr>
</tbody>
</table>

Most of women are primigravida (31%)
Figure (1) Number of parity among pregnant women in Albageer Alwrane health center in October 2015.
Table (4) Gestational age of pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th>Trimester</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st trimester</td>
<td>21</td>
<td>37%</td>
</tr>
<tr>
<td>2nd trimester</td>
<td>24</td>
<td>42%</td>
</tr>
<tr>
<td>3rd trimester</td>
<td>12</td>
<td>21%</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table (5) Prevalence of malaria among pregnant women in Albageer Alwrane health center in October 2015.

<table>
<thead>
<tr>
<th>Result</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ve</td>
<td>38</td>
<td>67%</td>
</tr>
<tr>
<td>-ve</td>
<td>19</td>
<td>33%</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100%</td>
</tr>
</tbody>
</table>

67% were malaria positive (38), 33% were malaria negative (19)
Table (6) Socioeconomic status among malaria positive pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th>Socioeconomic status</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>High moderate</td>
<td>25</td>
<td>66%</td>
</tr>
<tr>
<td>Moderate</td>
<td>3</td>
<td>8%</td>
</tr>
<tr>
<td>low moderate</td>
<td>4</td>
<td>11%</td>
</tr>
<tr>
<td>low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>38</td>
<td>100</td>
</tr>
</tbody>
</table>

Table (7): Utilization of prevention method among pregnant women in Albageer Alwrane health center in October 2015.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>24</td>
<td>42%</td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>58%</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100</td>
</tr>
</tbody>
</table>

Most of the women are non user of prevention methods (58%)
Table (8): Comparison of Prevalence between users and non users of methods among pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>users</td>
<td>54%</td>
</tr>
<tr>
<td>non users</td>
<td>76%</td>
</tr>
</tbody>
</table>

Higher percentage in non user of preventive method (76%)
Figure (2): Type of malaria prevention methods among pregnant women in Albageer Alwrane health center in October 2015:
Table (9): Type of malaria prevention methods among pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th>Type of method</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net</td>
<td>15</td>
<td>63%</td>
</tr>
<tr>
<td>chemoprophylaxis</td>
<td>6</td>
<td>25%</td>
</tr>
<tr>
<td>repellants</td>
<td>3</td>
<td>12%</td>
</tr>
<tr>
<td>total</td>
<td>24</td>
<td>100</td>
</tr>
</tbody>
</table>

Net is the most type of the prevention method used

Table (10): Causes precluding utilization of malaria prevention method among pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th>Causes precluding utilization</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expensive</td>
<td>4</td>
<td>12%</td>
</tr>
<tr>
<td>Not available</td>
<td>7</td>
<td>21%</td>
</tr>
<tr>
<td>Not important</td>
<td>13</td>
<td>40%</td>
</tr>
<tr>
<td>Don’t know.</td>
<td>9</td>
<td>27%</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>100</td>
</tr>
</tbody>
</table>

Most of the pregnant women thought preventive are not important
Table (11): Clinical presentation of malaria among pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>32</td>
<td>84%</td>
</tr>
<tr>
<td>Headach</td>
<td>22</td>
<td>58%</td>
</tr>
<tr>
<td>Jaundice</td>
<td>2</td>
<td>5%</td>
</tr>
<tr>
<td>Skin rash</td>
<td>5</td>
<td>13%</td>
</tr>
<tr>
<td>Sore throat</td>
<td>6</td>
<td>16%</td>
</tr>
<tr>
<td>Gastrointestinal symptoms</td>
<td>16</td>
<td>42%</td>
</tr>
<tr>
<td>Convulsion</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Coma</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fatigue</td>
<td>9</td>
<td>24%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>7</td>
<td>18%</td>
</tr>
<tr>
<td>Urinary symptoms’</td>
<td>4</td>
<td>11%</td>
</tr>
<tr>
<td>Cough</td>
<td>7</td>
<td>18%</td>
</tr>
</tbody>
</table>
Table (12): Types of medication received by malaria positive pregnant women in Albageer Alwrane health center in October 2015:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artesunate tabs.</td>
<td>7</td>
<td>19%</td>
</tr>
<tr>
<td>Artemether inj.</td>
<td>29</td>
<td>76%</td>
</tr>
<tr>
<td>Quinine tabs.</td>
<td>2</td>
<td>5%</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>100</td>
</tr>
</tbody>
</table>

Most of the women received Artemether inj (76%)
Figure (3): Types of medication received by malaria positive pregnant women in Albageer Alwrane health center in October 2015:
Chapter (5)

Discussion

This was descriptive analytic community based study done to all pregnant women attending to Albageer Alwrane health center in October 2015 to study the prevalence of malaria among pregnant women.

Prevalence of malaria was 67% in comparison with studies conducted in other countries; in study done in Zambia prevalence was 31.8%[16], (60%)in Lagos, Nigeria [22] and (38.1%) in Ed-Duweim Sudan[19].

Also the study highlighted that high prevalence of infected pregnant women. This finding agree with (Park 2007) who demonstrated that malaria is predominantly a rural disease. The highest proportion of malaria 37% was observed among the age group 20 - 25 years. This reflects that there is no significant association between malaria and age, which agrees (Lander 2002) who mentioned that age didn't have any significant associate with malaria.

The result illustrated that high prevalence among nonuser of preventing methods, net was more used. This agrees (WHO 2003), which demonstrated, that insecticide treated nets are effective means of individual protection prevention.

The study shows that the primigravidae women 18% have prevalence of malaria than others; this finding (Brahin 1983, Mc Gregor 1984) who demonstrated that "In areas where transmission is immunity against malaria is expected to be significant, primigravidae will be more affected". This represents the group of pregnant women who are at a higher risk for adverse outcomes.

The study shows most of the pregnant thought preventive methods are not important that means health education for all pregnant women about malaria will improve the situation.

The results were illustrated 25% of studied pregnant women received ITP Intermittent preventive treatment as mean of anti malarial prophylaxis in this area. In comparison with no pregnant women used ITP prophylaxis in Ed-Duweim.
Prevalence of malaria among pregnant women was 67% this high burden of malaria suggests that past prevention efforts was of limited effect.

To reduce this burden of malaria sustainably, there is clear need to improve our health services, continuity of services quality, quantity and cheap services lead to health community

Strengthen existing interventions and, possibly, to change approaches so as to improve targeting of groups most affected by malaria
**Recommendation**

*Community health education for any pregnant about malaria in pregnancy and important of prevention methods.*

*Improve ante natal care services by giving intermittent preventive treatment during pregnancy (IPTp) for every pregnant woman*

*More research needs to be conducted to evaluate the situation in rural areas.*

*Increase health prevention activities by using mass media, posters, small groups lectures and distribution of insecticide-treated mosquito nets (ITNs) for any pregnant women*

*Health worker training about proper way of performing indoor residual spray (IRS).*
References

1- The national protocol for treatment of malaria (Sudan, June 2004).


15- GLOBAL TECHNICAL STRATEGY FOR MALARIA 2016–2030 WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland
17-the diagnosis and treatment of malaria in pregnancy Green–top Guideline No. 54b April 2010 by NICE
19-Prevalence of malaria among pregnant Women admitted to Ed-Duweim Teaching Hospital (Proportion and risk factors)By: Amira Ibrahim Ahmed
21- Minakawa N, Munga S ; Atieli F, Mushinzimana E; Zhou G, Githeko A;Yan G: Spatial distribution of anopheline larval habitats in Western Kenyan highland Effects of land cover type and topography. Amj Trop med Hyg, ,
22- Infectious Diseases of Poverty2013:19 DOI: 10.1186/2049-9957-2-19© Agomo and Oyibo; licensee BioMed Central Ltd. 2013
Appendix

Questionnaire

Age: less than 20 years (  ) 20 to less than 25 (  ) 25 to less than 30 (  ) 30 to less than 35 (  ) 35 to less than 40 (  ) 40 and above.

Educational level: Literacy (  ) primary (  ) secondary (  ) university (  ).

Occupation: housewife (  ) employee (  ) others.

* Water source: continuous water pipe (  ) uncontinuous source (  ).

Electricity: continuous source (  ) temporary source (  ) not available (  ).

House building: cement (  ) bricks (  ) mud (  ) (  ) (  )

Water cycle: septic (  ) ordinary (  )

Electrical equipments: television (  ) refrigerator (  ) air condition (  ) biogas (  ) car (  ).

* Number of parity: primigravida (  ), secundigravida (  ), gravid three (  ), gravid four (  ), gravid five and more (  ).

Gestational age: 1st trimester (  ), 2nd trimester (  ), 3rd trimester (  ).

Used of prevention method of malaria: yes (  ) no (  ).

If yes what is the type: mosquito net (  ), repellent (  ), chemoprophylaxis (  ), others mention: .....................

If no why: they are expensive. Causes precluding utilization of prevention method:

12% think they are expensive (  ), think they are not available (  ), they are not important (  ), I dont know (  ).

Suffering of malaria in the previous pregnancies: yes (  ) no (  ).

Clinical presentation:

Fever (  ), Headache (  ), present in 5% Skin rash (  ), Sore throat (  ), Convulsion (  ), Coma (  ), Fatigue (  ), Anxiety (  ), Urinary symptoms (  ).

Microscopic result: positive (  ) negative (  ).

Types of medication: Artesunate (  ), Arteether inj (  ), Quinine tabs (  ).