CHAPTER II

ESSAY

Malaria in Pregnant Women in Samrong District, Oddar Meanchey, Cambodia

2.1 Introduction

Malaria is a major communicable disease of the tropical and subtropical areas which kills more than one million people a year (WHO, 1999).). Malaria is a disease of the poor, especially of those in remote areas with no easy access to health services. It is also associated with conflict or the aftermath of conflict, as it is a disease that flourishes in conditions of crisis and population displacement.

Cambodia is one of the countries which endured civil war for a long time. The war created many displaced persons and refugees who went to Thailand. After the end of fighting and peace returned to Cambodia in early 1999, the Cambodian refugees from Thailand were organized by UNHCR to return to their home country. Samrong district, Oddar Manchey province was heavily mined land, however this area was one of the most popular places of chosen by refugees to settle down. Currently Samrong

district has population of approximately 34,557 persons (source: district level); about 50 % were the returnees from the refugee camps and the rest were newcomers from other places in the country and people who have already lived there before the fighting started.

A needs survey organized by UNHCR to assess the needs of resettled people new resettlement was conducted in 1999. The result found that malaria was a major threat to the health of the people. In June 1999, Malteser, a German NGO was called to set up a health service assistance program in this district. Initially Malteser established six mobile roadside clinics and malaria was found as a major health problem. In following nine months, the ANC clinics were set up beside the existing six roadside clinics. All pregnant women who came to use the services were checked for malaria. The results presented a very high incidence of malaria cases (76%:116/152) in pregnant women, and remarkably after one month follow-up there were still 21 from 45 (47%) cases of pregnant women who were slide positive with malaria. Quinine was used as a first line treatment. Most reasons given by the pregnant women were incomplete treatment and non drug compliance. These main reasons could contribute to malaria relapsing, which could lead to drug resistance later.

Following these results, the study to explore the situation and factors associated with malaria in pregnant women will be proposed, and its finding will be beneficial in developing the possible strategies for malaria control in this particular group.

This essay will describe malaria and associated factors in general and the situation of malaria in Cambodia will be cited by review of secondary and tertiary data .

2.2 Malaria in Brief

Malaria is one of the most serious communicable diseases affecting people in developing countries with tropical and subtropical climates (WHO, 1996). Malaria in humans is caused by protozoa of the genus Plasmodium. The most severe manifestations are cerebral malaria, anemia (mainly in children and pregnant women) and kidney dysfunction. In P.falciparum malaria, red blood cells can obstruct blood cells of the brain, causing cerebral malaria, which can be fatal.

2.2.1 Malaria Transmission

Malaria is transmitted by the bite of a female Anopheles mosquito, which is infected with the malaria parasite. The malaria parasites multiply and develop in the mosquito. After 10-14 days they are mature and ready to be passed to people. The mosquito, which carries the malaria parasites and bites a human, is called the vector. The human being infected by the parasites is called the host. The incubation period in man from the bite of an infected mosquito until the start of symptoms and signs of malaria is usually about 2 weeks. Evidently, it is often much longer and it cannot be shorter than 8 days.

However, the infection may also be transmitted accidentally; this occurs not infrequently as a result of blood transfusion when the donor carries malaria parasites. Congenital infection of the newborn from an infected mother also occurs, but is comparatively rare.

There are four different types of parasites that cause malaria:

- Plasmodium falciparum is the most dangerous because it can invade any type of red blood cell and causes cerebral malaria and results in death.
- Plasmodium vivax causes a milder type of malaria but can remain dormant in the liver cells resulting in relapses of infection if not properly treated.
- Plasmodium ovalae and Plasmodium malariae are much less common.

2.2.2 Malaria Vectors

Human malaria can be transmitted by Anopheline mosquitoes. In addition to transmitted malaria, Anophelines also transmit filariasis and some arboviral diseases. There are about 422 species of Anopheles mosquitoes throughout the world, but only some 70 species are vectors of malaria under natural conditions; 40 species are of major importance. However, in each geographical area there are usually not more than three or four Anopheles species that can be regarded as important vectors (H.M.Gilles & D.A. Warrell, 1993, pp. 96-126).

Although Anopheles is most frequent in tropical or subtropical regions, it is also found in temperate climates and even in the Arctic during the summer. Various species of Anopheles have well defined behavior characteristics and these often determine the distribution of malaria. Thus, in addition to climatic conditions, other factors affecting the breeding, feeding and survival of Anopheles must be taken into consideration in any control program based on anti-mosquito measures.

2.2.3 Clinical Features of Malaria

Malaria causes an acute febrile illness, which may be characterized by periodic febrile paroxysm occurring every 48 or 72 hours with afebrile asymtomatics intervals and attendance to recrudesce or relapse over periods of months to many years. The severity and course of an attack of malaria depends on the species and the strain of infecting parasite and hence on the geographic origin of the infection; it also depends on the age, genetic constitution, state of immunity, general health and nutritional status of the patient and on any chemoprophylaxis or chemotherapy which has been used. There are no absolutely diagnostic clinical features of malaria except for the regular paroxysms of fever with virtually asymptotic intervals.

2.2.4 Malaria in Pregnancy

Pregnant women are sick with malaria more often and more severely than non-pregnant women in the same community. Malaria may lead to severe illness in the mother, particularly anemia. All types of malaria infection can lead to abortion. In P. falciparum infection, it can lead to severe illness and affects the mother and the baby: in the pregnant woman, severe hemolytic anemia may develop with few symptoms, so she may enter labor with dangerously low hemoglobin. This mainly is seen in primigravida. Microcirculatory arrest in the placenta may cause fetal death, low birth weigh and premature baby. Occasionally, congenital infection may occur in all species of malaria The usual syndrome is of a progressive hemolytic anemia in a child who is falling to thrive. Congenital infection is much rarer with P.falciparum than with P. vivax malaria (Dion R. Bell, 1990, p. 9).

2.2.5 Malaria and Immunity

Any person who is bitten by an infected Anopheles mosquito can get malaria. However, the likelihood of getting malaria and the seriousness of the disease depends on a person's immunity to the parasite. Immunity happens when the body learns to fight the parasites with antibodies and cells that kill and partially remove the infection. After repeated attacks, immunity develops and limits the severity of the disease.

In endemic areas, transmission of malaria is frequent so immunity develops quickly. In areas that are not endemic, immunity develops much slower or not at all because malaria occurs less often. Immunity in malaria is most pronounced in P.falciparum infection. In areas of very high transmission, if a child survives to the age of 5-6 years, it will have achieved a high degree of immunity to the lethal effects of the infection. This immunity has two main components: an ability to limit parasitemia by the development of specific protective IgG and cell mediated immunity (CMI), and a physiological tolerance such that low parasitaemia produces no fever or subjective illness. In order to maintain this immunity, frequent re-exposure to infection is required. If re-exposure does not occur, the immunity wanes over a period of a few years (Dion R. Bell, 1990, p. 9).

2.3 Factors Contributing to Malaria Transmission

2.3.1 Geographic Distribution and Environment

Location

Indigenous malaria has been recorded as far north as 64 degree N latitude (Archangel in the former USSR) and as far south as 32 degree S latitude (Cordoba in Argentina). It has occurred in the Dead Sea area at 400 meters below sea level and at Londian (Kenya) at 2600 meters above sea level or at 2800 meters in Cochabamba (Bolivia). Within these limits of latitude and altitude there are large area free from malaria, which is essentially a focal disease, since the transmission of malaria depends greatly on local environmental and other conditions such as topography. Areas and location of the country, and forests, lakes and reservoirs that are inside or close to the areas affect the vectors breeding and transmission of malaria as well (H.M. Gilles & D.A. Warrell, 1993, p.125)

Climate and Humidity

Variation in climate conditions has a profound effect on the life of a mosquito and on development of malaria parasites. Hence its influence on the transmission of the disease and on its seasonal incidence. Malaria parasites cease to develop in the mosquito when temperature is below 16 C. The best conditions for the development of plasmodia in the Anopheles and the transmission of the infection are when the mean temperature is within the range 20-30 C, while the mean relative humidity is at least 60%. A high relative humidity lengthens the life of the mosquito and enables it to live

long enough to transmit the infection to several persons. Strong winds can also affect the flight of Anopheles and may prevent their egg lying; however, in some cases they may extend their flight range well beyond the normal limits (H.M. Gilles & D.A. Warrell, 1993, p.126).

Rainfall

The association of malaria with rainfall is due not to only the greater breeding activity of mosquitoes, but also the rise in relative humidity and higher probability of survival of female Anopheles. Excessive rainfall or drought plays an important part in the production of regional epidemics of malaria. Rainfall, which normally increases the amount of surface water, may have, at times, a negative effect on the amount of transmission of malaria. Excessive rainfall may transform small streams into rapid torrents and thus strand many larvae and pupae on the edges of the water channel. Conversely, deficient rains in other parts of the world change many rivers into strings of pools in which certain Anopheles breed in profusion (H.M. Gilles & D.A. Warrell, 1993, p.127).

Health Service Facility

Health service is one of the factors determining malaria transmission. Availability, accessibility and affordability of the people to health service could also cut the cycle of transmission by reducing the number of carriers and promoting prevention of malaria.

Decision-makers or politicians also have an indirect affect on malaria control by prioritizing the health problems and affecting implementation strategies and budget allocation for implementation of the program.

Information and Technology

Information can influence knowledge and awareness of people about malaria It also can make people understand the nature of the vector and its transmission, which will help to identify possible interventions for malaria control later.

Technology such as microscopes and dipsticks for P.falciparum testing greatly contribute to early and more accurate detection, which results in reduction of numbers of carriers and inappropriate drug use. In addition, the finding of in vivo test also contributes to detect drug resistance of parasites, which indicate the situation of malaria in the area and recommend other sensitivity drugs for malaria treatment.

Air transportation could also bring malaria from one area to another if it carries the vector or the carrier and it could easily spread drug resistance to the next destination as well. However the rapid transportation of new medicine and technology could also benefit malaria control.

2.3.2 Host Factors

Gender and Age

Gender and age are not important factors with regard to the malaria infection, but children and pregnant women have low immunity and generally a higher degree of susceptibility than other adults. If a pregnant woman gets malaria, severe illness may rapidly develop and may even result in death.

Malaria can affect of both man and woman; however it is more likely that the man will get malaria although his innate immunity is usually stronger due to to the outdoor work which usually increase exposure to vector.

Immunity

In areas where malaria is very common, people may get malaria several times during their lives. This has given some resistance to the disease, so the attacks of malaria often become less severe.

Social and Economic Factors

Social and economic factors, such as sanitation, housing, occupation, poverty and level of income have an important effect since malaria is more prevalent in underdeveloped countries. Low literacy also affects living practice and contribute to lack of knowledge on disease prevention. This means these groups of people have less awareness and pay less attention to malaria which is dangerous for their health.

The level of income determines the affordability of protective measures such as mosquito screens in the house, bed nets, repellents and coils as well as affordable health care services. Therefore, the poor tend to have more chance of getting malaria and may delay treatment, which results in more serious illness or death.

House condition, poor sanitation and drainage are also favorable situations for man-vector contact which ultimately raise the risk of malaria infection (WHO, 1996). Some types of occupation such as woodcutting, rubber planting, and forest work are also at risk for malaria and may reintroduce malaria to communities when these types of workers return from other areas.

Sociopolitical Disturbance

Wars and large-scale population movements and labor forces from endemic areas have often been a factor in the spread of malaria. The return of troops from malaria war areas to England during the First World War resulted not only in a high number of cases of imported malaria, but also in an outbreak of local disease which caused nearly 500 cases of introduced malaria among the civilian population. Malaria was also reported during the period 1969-1974 in soldiers returning from Southeast Asia (H.M.Gilles & D.A.Warrell, 1993, p. 127).

Socio-Cultural

Long traditional belief and knowledge can lead to malaria infection. For example, some people believe in a ghost that causes malaria; therefore, they would not know how malaria could be prevented. If they get infected with malaria, they may end

up with no proper treatment carrying the parasite in their blood and spreading malaria later or even resulting in death.

Vector

The vector plays an important role for malaria transmission, thus all possible malaria control strategies must include the vector issue.

As mentioned before, more than 400 species of Anopheles are the vectors of malaria and each one has it own characteristics in terms of biting time habit, breeding site preference and resting time. Therefore, for effective malaria control all these characteristics of each vector should be identified.

2.4 Principles of Malaria Prevention and Control

Malaria control methods vary from the simplest to the most elaborate strategy. A realistic formulation of the control program requires an answer to the question whether the expenditure on it will be covered wholly from the central government or any other funding sources. It is also important to know the degree of commitment of the authorities to any long-term program. Evidently, the objectives of any malaria control program depend on the prevailing epidemiology of malaria, on effective available methods, as well as on the financial possibilities of the relevant health authorities, and on the degree of the support of the community.

Generally, the measures of prevention of malaria in individuals and for larger scale control of the disease can be divided according to the classification proposed by Russell (1952):

1. Measures designed to prevent mosquitoes from feeding on humans.
2. Measures designed to prevent or reduce the breeding of mosquitoes by eliminating the collection of water or by altering the environment.
3. Measures designed to destroy the larvae of mosquitoes.
4. Measures designed to destroy adult mosquitoes.
5. Measures designed to eliminate the malaria parasite in the human host.

Actually the principle of malaria prevention is protection from mosquito bites and many methods have been practiced. According to the strategies of WHO, there are three main ways to prevent malaria: 1) prevent mosquito from biting people 2) control mosquito breeding 3) killing adult mosquitoes. However the best control strategies should have both curative and preventive components (WHO, 1996).

2.4.1 Protection against Mosquito Bites

Nets

The use of mosquito nets as a protection from mosquito bites during the night has been practiced from very early times. They still remain one of the most important of all measures of personal protection. Mosquito nets will not prevent malaria unless they are used correctly.

Nowadays, mosquito nets are made of nylon or other synthetic materials, which is lighter and easy to wash. The best pattern is rectangular net, with reinforced lower ends; there should be no tears and no openings in the side for the purpose of entering the net. When it is used, it should be tucked all round under mattress or sleeping mat.

Impregnated Bed Nets (ITNs)

During almost twenty years several field trials have demonstrated that the protective effect of mosquito nets can be greatly enhanced by treating them with a repellent or insecticide. The substances that are most commonly used for mosquito net impregnation are the pyrethroids, permetrine and deltametrine. The positive impact of ITNs has shown that it not only protects against mosquito bite but it can also kill the mosquitoes when they get exposed to the nets. It is not harmful for health if used correctly (WHO, 1996).

House Screening

Mosquito screening of dwelling, especially where electricity is also available for light and fans has made a great difference to protect against the mosquito and enhance comfort in the tropics. There is no doubt that this type of protection is a practical and effective method of malaria control. However, effective screening is possible only in houses that are well constructed and in good maintenance. In terms of expenses, it is much higher than using the bed nets.

Protective Clothing

Long boots, a pair of thick socks, long sleeve shirts and trousers can provide good protection from mosquito bites. However, thick cloth is necessary because the mosquito may pierce through clothing, which is in contact with the skin. Special hoods and gloves are sometimes used to protect persons on guard at night.

Repellents

There are chemical substances, which can be applied to skin and can prevent mosquito bites. In the past, citronella or eucalyptus oil were used on the skin but its effect is very short, not exceeding 15-20 minutes (H.M.Gilles & D.A. Warrell, 1993, p.201). A new group of mosquito repellents have longer action (about 5-8 hours) but need to be applied again. This strategy is too expensive for many people who actually live in malarial areas therefore this method is especially recommended for those who are travelling or are temporarily in malarial areas.

Coils and Mosquito Mats

The mosquito coil and mat work on their smoke, which keep the mosquito away, and even is killed if it flies through the smoke. This method is similarly to the use of repellents. Some people may be allergic to the smoke that these coils and mat devices emit.

2.4.2 Chemotherapy as a Protection against Malaria (prophylaxis)

Regular prophylaxis anti-malarial drugs will stop the development of malaria parasites in the blood (trophozoits). They will therefore prevent clinical malaria, but they will also prevent the development of immunity to malaria.

Prophylactic anti-malarial drugs are therefore given only to certain groups of people:

1. People who:
   - have no immunity to malaria, and
   - have come to malarial area, and who
   - do not need to develop semi-immunity to malaria
   - do not wish to suffer the ill-health needed to develop semi-immunity to malaria
2. People who do have some immunity to malaria but this immunity is reduced for a while due to another condition such as pregnant woman, people sick from another illness (pneumonia etc.).
3. People who cannot develop normal immunity to malaria such as people who have had their spleens removed.

However as the drug resistant situation is still going on, the used of chemoprophylaxis should be considered on a case-by –case basis (Christopher R. Schull, 1999, pp.66-67).

2.4.3 Eliminate Reservoirs: Stop Transmission

This method is aimed to kill all malarial parasites in the bodies of all the original hosts by giving anti-malaria drugs. According to drug sensitivity and resistance, this varies is vary from one place to the next place. Therefore, each national guideline adapted to its own area is needed for a successful cure rate and to reduce further drug resistance. In addition, early diagnosis and treatment should be adopted in any endemic malarial area in order to reduce the number of carrier as soon as possible.

2.4.4 Control Mosquitoes

The control of mosquitoes is the best method of protecting a community against the disease. Many methods have already been practiced and the success of each method does not only depends on intrinsic factors but also extrinsic factors such as financial support, commitment from the community etc. The following proposed methods will mention only the main principle, therefore there will not be discussion about which method is the best. Because the selected methods will depend on particular topography, type of vector, financial support. To achieve this task, commitment from the central government and local authorities and finally the community is needed.

2.4.4.1 Environmental Management for Mosquito Control

Environment is a factor that influences malaria transmission by providing the breeding site to the vector. Many human activities also contribute to increase the number of breeding sites such as irrigation building and man made

artificial lakes. The concept of environmental management is to modify or manipulate the environment in order to prevent breeding site for the vectors.

For example, impoundment is the reservoir for the storage of the water behind the dam. The principle is the absence of floating vegetation, deep water, far from the edges of the reservoirs, the mosquito does not breed. The usual habitats of mosquitoes generally are along the indentations of the shoreline, in shallow water covered with floating vegetation.

Thus, mosquito control related to impoundment is based on: 1) proper preparation of the reservoir site and particularly the clearance of trees and other vegetation at all levels between high and low levels; 2) provision for fluctuating water levels in the reservoir; 3) appropriate marginal drainage to avoid pools along the reservoir; 4) maintenance of shoreline, vegetation control and drift removal (H.M.Gilles & D.A.Warrell, 1993, p.205).

The other environmental management such as sanitary landfills, environmental drainage and mosquito sources reduction can also be adopted for vector control.

2.4.4.2 Biological Method

This method of mosquito control is based on the introduction into the environment of various pathogens and predators of insect vectors of disease. The effective use of biological methods of control requires a good knowledge of bionics of

the vector species, as well as of local ecological conditions. The great potential of this method is applying it together with environment manipulation, with agriculture practices and even with pesticides. This is the essence of a combined attack on multiple factors of disease transmission implied in the concept of integrated control (H.M.Gilles & D.A.Warrell, 1993, pp.212-213).

Of all biological control methods, the use of **larvivorous fish** has been the most successful in many parts of the world. The use of larvivorous fish is limited to some special situations where the water and the other conditions are suitable.

2.4.4.3 Chemical Methods

Chemical pesticides are still the mainstays of most vector control programs. However the growing problem of resistance of many insects to insecticides and the present concern with the effect of some of these compounds on the environment has stimulated an intensive research program coordinated by WHO to develop a number of candidate insecticides and to test their activity and safety (WHO, 1985).

The efficacy of chemical control measures depends on a number of factors: the species of vector involved; efficacy of the pesticide; type of its formulation; thoroughness of its application; nature of the surface treated and climatic conditions; acceptability to inhabitants; and management of the control program (H.M.Gilles & D. A. Warrell, 1993, p. 216).

Many chemical substances for mosquito control have been used, but actually there are two concepts of applying them and each concept has a different control strategy aim.

A. Space praying: this concept aims to kill the mosquito at once or achieve a knock down effect by releasing the insecticides into the air as smoke, or as fine droplets. This technique can rapidly reduce the numbers of mosquitoes not only in dwellings but also temporarily in outside breeding grounds. However it lasts only for a short time.

B. Residual insecticides spraying: This technique is particularly useful in dwellings for those species of mosquitoes which feed preferentially on human beings inside their houses. These insecticides act slowly and some of them irritate the mosquitoes, leading to their flight away from the house and some may even die within 12-24 hours of exposure. This technique lasts for about 3 months; however it depends on the chemical substance used, formulation of the chemical agents, as well as the type of building materials of the house.

2.5 Strategies for Malaria Control

A strategy for malaria control has been formulated by WHO to address the serious worldwide malaria situation. It was presented to the Ministerial Conference on Malaria in Amsterdam in 1992. ***It requires an improvement in the capacity of existing***

health services to provide diagnosis and early treatment within the umbrella of primary health care, a reorientation of existing malaria control program to take into consideration epidemiological, ecological, environmental and social factors; as well as the primary goal of the new strategy (H. M.Gilles & D. A. Warrell, 1993, p.260).

The variability of malaria has already been pointed out and hence no uniform strategy applicable to all areas can be formulated. Nonetheless, four fundamental elements can be identified:

1. Early diagnosis and treatment.
2. Selective application of vector control including human-mosquito barriers.
3. Development of epidemiological information systems.
4. Early detection or forecasting of epidemics and rapid application of controlmeasures.

1. Early Diagnosis and Treatment

Malaria is a curable disease and timely diagnosis and treatment is a basic human right of all populations in endemic areas whatever their social and economic circumstances. In endemic areas where there are no microscopes or dipsticks available, the clinical diagnosis criterion is recommended. Any fever related to high risk groups (children and pregnant women etc.) should be regarded as malaria. The choice of drugs will depend on a variety of factors, such as pattern of resistance, cost, side effects and self-medication which is increasingly common, almost universal, yet knowledge among those who provide or sell anti-malarial drugs is quite often low which results in inappropriate or incomplete treatment. Thus, the key persons in the community like

shopkeepers, traditional healers, traditional birth attendants, teachers, monks and mothers could be taught the importance of early treatment and the proper use of anti-malarial drugs in different age groups, using up-to-date and culturally acceptable means of communicating.

2. Selective Application of Vector Control including Human-Mosquito Barriers.

The aim is progressive reduction of malaria transmission where this is sustainable and cost effective. Decisions on whether to apply vector control and which methods to choose must depend on an assessment of the relevant epidemiological, ecological, social and operational determinants including the local identification of epidemiological types.

The various methods available have been described earlier and are aimed at (a) a reduction of mosquito breeding, (b) a reduction in the longevity and/or density of adult mosquitoes, and (c) reduction in human-mosquito contact (H.M.Gilles & D.A.Warrell, 1993, p.261).

3. Development of Epidemiological Information Systems.

The collection and handling of malaria data should be part of the general health information system and is an essential prerequisite for the early detection and forecasting of epidemics. They are a means of monitoring the potential rapid changes in malaria transmission and disease. AS much as possible, data should be analyzed and

appraised as peripherally as possible-at regional or event district level (H.M.Gilles & D.A.Warrell, 1993, pp.261).

4. Early Detection or Forecasting of Epidemics

The aim here is the forecasting or early detection of epidemics in order to ensure rapid and effective control. Monitoring meteorological data and population movements might be useful since unusually heavy rains and/or increased temperatures are possible causes of malaria epidemics as are man made ecological changes often associated with influx of many non-immune persons. The Geographic Information System (GIS) and Global Positioning System (GPS) are effective tools in mapping malaria risk but are also expensive and hard to access for many developing countries (MFI, 1999).

Table 2.1: Classification of Malaria Control Measures

Type of measures	Individual and family protection	Community protection
Prevention of human-vector contact	Repellents, prospective clothing, impregnated mosquito nets, screening of houses	Site selection, screening of houses
Destruction of adult Anopheles vectors	Use of domestic space sprays including aerosols	Space spraying, ultra low volume sprays, residual insecticide spraying
Destruction of mosquito larvae	Peridomestic sanitation, intermittent drying of water containers	Larviciding of water surfaces, intermittent drying, sluicing, biological methods
Reduction of mosquito sources	Filling, small scale drainage and other forms of water containers	Prevention of man-made malaria, environmental sanitation, water management, drainage schemes, naturalistic methods of control
Measures against the malaria parasites	Diagnosis and early treatment, chemo prophylaxis	Diagnosis and early treatment, chemo prophylaxis to primigravida, mass drug administration (in epidemics)
Social participation	Motivation for personal and family protection	Community involvement, health education, expansion of rural health services. Training of staff.

Source: H.M.Gilles & D.A.Warrell, 1993, p.265.

2.6 Problem Statement

2.6.1 Malaria: Global and Regional Problem Statement

Malaria is the most common and deadly parasite disease in the world. About 100 countries are affected and 2,100 million people are at risk of malaria (WHO, 1999). Every year more than one million people are killed by malaria and about six to nine percent of global population (300-500 million) suffer from malaria annually (RBM, 1999).

Africa is terribly affected and accounts for over 80% of reported cases of malaria and the disease kills one child in twenty before the age of five. Globally, malaria kills one child every 4 seconds or the death rate is equal to seven jumbo jets, full of children, crashing everyday.

Pregnant women are also especially at risk. In highly malarious parts of Africa, women are more than four times as likely to suffer clinical attack of malaria during pregnancy than other times and only half as likely to survive bouts of life-threatening illness (MFI, 1999).

The Greater Mekong Sub-region is a part of the tropical climate area and most of the countries are developing countries. Therefore, this region is a home for malaria, as well as Africa and South America. About 80% of all cases are in Africa and most of the rest (15%) in South East Asia. The overall incidence of clinical (confirmed and not

confirmed case) malaria is about 1 to 2 cases per year in the Mekong region. Others, who live in villages in forested areas, experience more than 1 attack of the disease per person per year, and parasite rates are up to 60% in children below 10 years old (UNICEF/WHO/RBM, 2000). In part of South East Asia, strains of malaria have developed resistance to the four leading anti-malaria drugs, especially the cheapest drug- chloroquine is rapidly losing its effectiveness in South East Asia except Lao, PDR (RBM, 1999).

There has been considerable progress in the reduction of overall morbidity and mortality in the Mekong region over the last ten years. China, Thailand and Vietnam have made good progress over the decades and now have low morbidity and incidence levels. Some of this could be explained by economic growth and social stabilization and expansion of general health services. Progress has been slower and more limited in Cambodia, Lao, PDR and Mynmar, morbidity and mortality are relatively high in these countries (UNICEF/WHO/RBM, 2000).

Table 2.2: Population, Malaria cases and Malaria deaths in the Mekong region, 1998

Country	Total Population (x 1000)	Risk Population (x 1000)	Confirmed cases	P.falciparum cases	Death
Cambodia	11,400	2,500	73,160	53,795	621
Yunnan, China	38,725	14,099	12,988	2,280	18
Lao, PDR	4,900	4000	41,623	39,930	485
Mynmar	46,494	36,830	88,000	78,910	2943
Thailand	56,706	44,414	131,041	68,609	764
Vietnam	76,161	41,939	72,091	55,075	183
Total	234,396	143,755	418,903	298,594	5,014

Source: UNICEF/WHO/RBM, January 2000

The true morbidity and mortality attributed to malaria remain elusive because most patients live and die in areas where the health services are either weak or non-existent. It is estimated that in most countries the true number of cases of malarial disease occurring every year is 8-10 times higher than the reported number of confirmed cases (UNICEF/WHO/RBM, 2000).

2.6.2 Kingdom of Cambodia's Background and Profile

Cambodia is primarily rural agricultural country located in Southeast Asia, and shares borders with Vietnam, Laos and Thailand. Cambodia has 440 kilometers of coastal border facing the gulf of Thailand. With a total area of 181,035 square kilometers, the country is about one-third the size of Thailand or 293 times bigger than Singapore.

Cambodia is situated between the Tropic of Cancer and the Equator. The country has a warm and humid climate with an annual average temperature of 28.5 c. There are two different season: six months of dry season, from November to April, and six months of rainy season, from May to October. The warmth and humidity of the climate bring about the lushness of the vegetation and the forest which is habitat of many species of wild animals and also suitable for malaria vectors and their breeding sites.

According to the national census of March 1998, Cambodia had a total population of 11.4 million of which 51.78% are women. The majority of the population lives in rural areas and only 15.7% of the population reside in urban areas or towns. The country's estimated annual population growth rate is 2.4%. At this rate, the population is likely to double within less than 30 years (MoE, 1999).

For the past three decades, Cambodia was beset by civil conflict including the infamous genocidal rule of Khmer Rouge from 1975-1979. It emerged from the latter with basic infrastructure shattered and the human resource base of the country decimated. Over the following decades, efforts were made to reconstruct a health care system, starting with the training of new health personnel. However, activities were constrained by ongoing civil war in early 1997, and the country was insecure and lacked resources again.

Important population and economic indicators include: estimated Gross Domestic Product is rising between 7% and 7.5% per annum. However in 1998 Gross Domestic Product (GDP) per capita was $ 270, considerably less than 1997(GDP: $276). The actual government expenditure on health was $ 1 per capita in 1998. In the same year, the important health indicators were Life expectancy (at birth): 53 years old, NN:36/1000, IMR: 89/1000 and MMR: 473/100,000 (MoH, 1999).

2.6.3 Malaria Situation in Cambodia

Malaria is a serious disease affecting the lives of Cambodian people who live or work in the rural mountainous and forested areas including coastal mangrove region. Most of the endemic areas are found in the northeastern part of the country as well as in the northern and western regions located close to Thai-Cambodian border. A high prevalence of malaria occurs over 65% of the country's area (MoH, 1998).

In Cambodia, malaria is still a major public health concern due to geographic factors which offer breeding sites and a suitable tropical climate for the vectors. Furthermore, the overall health service covering in the country is still low especially in the remote areas where the people are more at risk to malaria.

Approximately 2.5 million Cambodian people are at risk for malaria; 5% (600,000) of the people live permanently in areas with high prevalence of malaria. Those who permanently inhabitant these area such as tradition forest inhabitants, new forest settlers in former Khmer Rouge areas, military, and ethic minorities. Also the transitional workers, estimated to be about 500,000 to 1.7 million people are the population at risk due to their working place which available to exposure to the vectors (MoH, 2000).

In Cambodia, the number of clinical malarial cases is higher than the number of confirmed malaria cases. The reason is the health services, which usually provide the laboratory test to confirm malaria cases, are not covering; all the country, therefore, the diagnosis of malaria has been done based upon clinical profile rather than laboratory test, especially in the rural areas.

Table 2.3 : Malaria cases compared between Clinical cases and Confirmed cases in 1996-1999

Year	1996	1997	1998	1999
clinical malaria cases	107,265	107,387	140,843	139,107
confirmed malaria cases	80,691	80,029	58,874	58,478

Source: EC-malaria, Cambodia, 2000

Table 2.4 : The Clinical Mmalaria Cases in Cambodia in 1996-1999

	Clinical malaria cases				
Year	Total cases	Severe cases	Death cases	CFR%	Inc/1000
1996	107,265	4,372	741	0.69	15.96
1997	170,387	5,645	864	0.5	16.2
1998	140,843	4,580	621	0.44	12.33
1999	139,107	6,570	891	0.64	11.76

Source: MoH, Epidemiology Section, 2000

Table 3 showed that the number of clinical malaria cases increased from 1996 to 1997 and started to decrease in 1998 and 1999, dramatically. In contrast, the number of severe cases and death cases increased in 1999 compared with 1997. The reason given by the epidemiology section was due to the political stability inside the country and established networks (health centers), they could go to some places where they could not reach before. And this year there emerged fake malarial drugs and people may get treatment with those fake drugs from the private clinic. Therefore, the number of deaths has increased. However, up to now, the health service could not cover all the country,

and the data was obtained only through the formal health services. Thus the number of malaria cases in general is still underestimated and does not represent the whole situation of malaria within the country.

Cambodia has one of the highest levels of drug resistance in the world. The first P. Falciparum strains resistant to Chloroquine appeared in 1962 (M.B.Denis, Health Messenger, Issue 6, July 2000). Incorrect treatment dosage was the main promoter of drug resistance. During the 1990's, there were studies done in different provinces to test the effectiveness of the different anti-malarial drugs available. The results revealed that there were different levels of drug resistance between the western and the eastern parts of the country. The northwestern provinces had a high level of resistance to Chloroquine (up to 70% in some places) and Fansidar (up to 100% in some places (M.B.Denis, Health Messenger, Issue 6, July 2000).

In 1999, fake drugs for malaria were detected in Cambodia. Two kinds of fake drugs were found: copies of Artesunate and copies of Mefloquine. Following this discovery, a survey was conducted to compare the amount of fake and original tablets that are available in pharmacies. 133 pharmacies in 12 marketplaces across the country were surveyed. The results showed that fake drugs have widely spread across the country. They are easily available, almost as much as original drugs (Health Messenger, Issue 6, July 2000).

Malaria vector: There are two main types of Anopheles mosquitoes that transmit malaria in Cambodia: A.minimus and A.dirus (Chea.N, Health Messenger, Issue 6, July 2000). A. minimus is a endophilic vector and respond well to residual

insecticide spraying, while A. dirus is a exophilic vector and does not commonly feed in human habitations , has not been affected (H.M.Gilles & D.A.Warrell, 1993, p.158) Transmission of malaria occurs all year long in Cambodia with the peak of transmission occurring during the rainy season between June and November. Plasmodium falciparum causes 90% of malaria cases in Cambodia while 7-10% of cases result from P.vivax and only 1-2 % of cases from P. malariae.

Malaria Control Strategy in Cambodia

At present there are two main components that have been launched by CNM to control malaria in Cambodia (MoH, 2000):

1) To reduce mortality and morbidity due to malarial disease by the following strategies:
    - Control of epidemics in former Khmer Rouge areas
    - Reduction of severe cases by earlier diagnosis and single dose treatment (Mefloquine) in remote health posts using Parasight dipsticks include training.
    - Reduction of the of severe malaria fatality rate in hospitals (using artemeter)
    - Drug resistance monitoring
    - Training of private drug vendors in areas without existing public health service (i.e. pre packaged drugs project)

2) To promote malaria prevention:
    - Systematic combined outreach activities to minority villages

- Prevention of epidemics in former Kmere Rouge areas (distribute impregnated bed nets)
- Social marketing of mosquito hammock nets for forest workers

The main form of malaria control in Cambodia is primary prevention from being bitten by the Anopheles mosquito and personal protection is emphasized. The main strategy is to encourage the use of insecticide treated bed nets.

The National Malaria Center (CNM) persistently distributes bed nets to the population permanently at risk (target population: 500,000). It started in1995 and continued to 1999. The distribution of bed nets has already covered 403,000 or about 80% of the target population. In addition, a new impregnated hammock net was developed and is being sold at a very low price to the migrant forest workers.

Health education is a second tool that is being used by the CNM in order to encourage personal protection against the mosquito. Rapid diagnosis and treatment for malaria is also addressed in the CNM strategies to prevent any serious complications due to malaria. In addition, the effective treatment guideline based on drug resistance is already established and has been distributed to the health centers and hospitals in Cambodia (MoH, 2000).

The Remaining Priority Problems and Constraints for Malaria Control (MoH, 1999):

- **Absence of services:** This is one of the main problems in relation to providing public services and malaria control in the area of resettlement in the west of the country.

- **Dominance of low quality private services:** Of the great majority of malaria cases, perhaps 90% are treated outside the formal health services (MoH, 1999). The most visible reason for this is the ubiquity of private drug outlets combined with the low motivation of underpaid public health providers. More important, however, is the low density of public health services in the areas where malaria occurs.

- **Low quality services in the public health system:** In many places within the public health system, poor quality services are provided and excessive charges are made including charges for supplies that have been deliveried free from donors. This has led to general distrust on the part of the population of the public health services (MoH ,1999).

- **Management:**

  I) There is insufficient decentralization, but also insufficient capacity in some of the most important provinces (malaria-wise) for provincial level functions, especially planning and supervision.

  II) CNM lacks central strategies, and coordinating and technical functions: planning, monitoring, evaluation, operational research, as

well as planning and technical support to provinces and peripheral levels.

III) The Health Information System does not function adequately at CNM or at the Ministry of Health Statistics Unit, or at the province and district levels.

2.6.4 Malaria Situation in Samrong District

During 1999, there were no government health services that could really function and serve the people. One existing Referral Hospital was still lacked equipment and medicine and one health center named Kron Kriel (36-km.up north to O'Smarch) was not equipped yet. Therefore, there was very low accessibility to the formal health service for the people in the area.

In 1999, Malteser, a German NGO, established the six mobile roadside clinics at the initial phase. The service was free of charge. Therefore many people came to utilize the services. Malaria was found as a priority health problem (see table 4). These clinics were run ten months and after that Malteser has been changed the strategy by giving technical supported and equipped the Referal Hosital and Krol Krial health center and has built up one health post named O' Pork, which has been run by Malters staffs.

Table 2.5 : Pattern of morbidity of patients Attending the six "roadside clinics" for the 3rd trimester 1999 and 1st trimester 2000

Disease	Sep-Dec 1999		Jan-April 2000	
	frequency	percentage	frequency	percentage
Malaria falciparum	1579	13%	1328	18%
Malaria vivax	850	7%	468	6%
Malaria symptoms, slide negative	3710	31%	2340	32%
URI	1667	14%	758	10%
LRI	311	3%	226	3%
Skin infection	432	4%	478	6%
Pyrexia of unknown origin	336	3%	18	0%
Gastero-intestinal problem(no diarrhea)	324	3%	324	4%
Diarrhea	304	3%	318	4%
ENT problems	247	2%	249	3%
No obvious clinical finding	1223	10%	292	4%
Total	11928	100%	7413	100%

Source: Malteser Germany Health report, April 2000

After following 9 months of six mobile roadside clinic services, ANC clinics were set up and all pregnant women were checked for malaria. The result showed a high incidence of malaria cases in this high-risk group (see table 5).

Table 2.6 : Morbidity of Malaria cases in Pregnancy at Malteser ANC clinic, Samrong commune, March-April 2000

Month	No. cases tested	PV+	PF+	% of total malaria positive
March	152	2	114	76%
April	58	1	43	76%

This table present the data obtained from Mateser mobile six roadside clinics, which was existing only two months from March to May in 2000. In both months, 76 % of all pregnant women who enrolled in ANC program were positive malaria.

2.7 Conclusion

Malaria is a serious health problem in many countries. Many factors; health systems' failure, drug resistance, population movement, deteriorating sanitation, climatic changes and, in some cases, unplanned development activities are contributing to the spread of malaria. In endemic countries pregnant women and children are more at risk of getting malaria. If pregnant women get malaria the result will be more severe than any other group.

Cambodia is one of malarious endemic areas. Lack of prevention has made the people suffer from malaria. Furthermore, the collapse of the health care system during

the war is one of the factors that delayed the development of a malaria control program and accessibility of the people to health services.

At present, an attempt for malaria control has been made by setting up the CNM. However the country has limited of resources; therefore government assistance does not reach some of the areas yet.

Samrong district is one of the areas that lacks a malaria control program. People at risk of getting malaria include pregnant women. Therefore the aim of this study will attempt to develop the appropriate malaria control strategies for this particular group. As the malaria control strategies vary from one to another place, a situation analysis of Samrong district and KAP on pregnant women towards malaria will be proposed in this study. Finally the results of the study will be used to identify and develop strategies for malaria control in this area.

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