EVALUATION OF MALARIA CONTROL IN KISUMU MUNICIPALITY, KENYA: A CASE STUDY.

BY

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DECLARATION

I CERTIFY THAT THIS DISSERTATION IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY.

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D E D I C A T I O N

To my late Father, my Mother in her struggle for us, and to Moses and Michael.

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Glossary

CBS	=	Central Bureau of Statistics
DDC	=	District Development Committee
DVBD	=	Division of Vector Borne Disease of the Ministry of Health
KAP	=	Knowledge, Attitudes and Practices
K£	=	Kenya pound
KSH	=	Kenya shilling
K£	=	20 KSh = 1K£.
MRC	=	Medical Research Centre
URE	=	Upper Railways Estate
VBCR	=	Vector Biology and Control Research Centre
W.H.O.	=	World Health Organization
HOUSEHOLD	=	Persons or groups of persons normally living together under one roof or several roofs within the same compound or homestead area sharing a community life by their dependence on a common holding as a source of income and food, which normally, but not necessarily, involves them in eating from a common pot. (Source: Integrated Rural Survey, 1974-75 CBS, Ministry of Finance and Planning, March, 1977).
"FLOATING ISLANDS"	=	Materials made of mud, weeds reeds, etc that break from the mainland into the lake. These have been, thought to

harbour the anopheline mosquitoes that transmit malaria.

SUMMARY

A study was carried out from September, 1986 to February, 1987 in Kisumu Municipality, Kisumu District, Kenya; to evaluate the current anti-malaria activities and the present status of malaria infection and transmission.

The study included an interview to the Municipal Health Authorities both by questionnaire and person to person,on the current antimalaria activities and the distribution of personnel, health facilities and budget allocation for malaria control. Records were also looked at and compared with the information from the interviews.

A KAP survey was conducted in three selected areas within the Council boundaries. These were Upper Railways Estate in the main Kisumu town, Nyalenda sublocation, a peri-urban slum, and Mkendwa sub-location which is rural. A total of 316 households were studied.

A Clinical and Parasitological survey was carried out in the same study areas. 325 children aged 2-9 years were studied. An Entomological survey was also carried out in the three study areas. All female anopheline mosquitoes were dissected and sporozoites looked for in their salivary glands. Larvae were also collected and classified into their species.

The results showed the following:-

The current antimalaria activities in the municipal Council were geared mainly to controlling the mosquito vector and the parasite. Although recommendations were made within the Council as to how best to control the mosquito vector, these were not implemented due to lack of funds and shortage of staff. It was also observed that there had been very little expansion of the Council's services since 1974 although the population of the Municipality was growing fast. From the records, it was clear that not all the budget allocated to malaria control was used for that purpose. Health education to the Municipal residents was lacking as one way to control malaria. These findings are fully discussed.

From the KAP Survey, it was found that the general knowledge of malaria diagnosis by symptoms and of the mosquito as the vector was very high.

However, knowledge about prophylaxis against malaria was poor. The majority of the people practised correct protective measures against mosquitoes. The attitude of the people was found to be that the government or Council was responsible for their health, and so it was up to the government/Council to protect them against mosquitoes. The results are presented in full and discussed.

In the Clinical and Parasitological survey, 118 children from Nyalenda, 102 children from upper

Railways Estate (URE) and 105 children from Mkendwa, all aged 2-9 yrs were examined for splenomegaly and by thick and thin blood smears for malaria parasites. The overall spleen rate was found to be 13.85% with an overall parasite rate of 21.53%. Differences were observed in both parameters when each area was analysed separately. The spleen rate for Nyalenda was 27.1% as compared to 5.9% and 4.8% for URE and Mkendwa respectively. The parasite rate for Nyalenda was 38.13% as compared to 13.72% and 10.48% for URE and Mkendwa respectively. The differences here were thought to be due to the fact that Mkendwa is situated on a hill about 8km from the town. It is basically sandy and so does not favour the breeding of the anopheline, mosquitoes. URE is urban. The transmission rate is lower in urban eco-systems due to free usage of drugs. Nyalenda is an over crowded slum area with half of it falling under marshy ground that favours the breeding of mosquitoes. Further analysis is given and discussed.

In the Entomological survey, a total of 118 adult mosquitoes were collected from 6 selected catching stations in Nyalenda. 46.6% of these were found to be A. gambiae s.l.; 16.1% were A. funestus and the remaining 37.3% were culicines. The anopheline density was 12 (Anophelines per house). No Anopheline

larvae were found. In Upper Railways Estate, a total of 55 culicines were collected in the 4 selected catching stations. No larvae were collected. In Mkendwa, a total of 21 mosquitoes were collected from the selected catching stations; of these 9.5% were found to be A. gambiae s.l.; all in the 4th stage of development. The total anopheline density was 0.5 per house.

All Female anophelines were dissected and their salivary glands examined. No sporozoites were found in any of them. The results are presented in detail and discussed.

Recommendations were made and these are:-

(a) Health education to the community

(b) Community Participation in formulating and implementing control programmes;

(c) Intersectional cooperation in planning control measures;

(d) A good information system for

i) Communication,

ii) Evaluation,

iii) Surveillance.

(e) Manpower development for research into new methods of control.

CHAPTER 1

INTRODUCTION

Malaria is a protozoan infection affecting mainly populations in the tropical world. It is a disease that has been with the human race since time immemorial. It is either an acute or chronic infection caused by four species of protozoan parasites belonging to the genus Plasmodium. Four species of Plasmodium are known to infect man. These are Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale and Plasmodium malariae. These parasites are transmitted from man to man by anopheline mosquitoes in which part of the life cycle of the parasite takes place.

The transmission of malaria depends on the distribution of the anopheline vectors. This means that in areas where there are no suitable anopheline mosquitoes, malaria is absent as long as the mean monthly temperatures do not exceed 15.6^{o}C. This is the minimum temperature for P. vivax development in the mosquito, 20^{o}C being the minimum for P. falciparum[1]. The presence of mosquito vectors without malaria is called anophelism without malaria.

In 1983, it was estimated that there were 220 million cases of malaria in the world. Out of these, 160-170 million infections were estimated

to be from Africa. Over 85% of infections in Africa were thought to be due to P. falciparum. This species is thought to be responsible for one million deaths annually world wide in children aged less than 14 years[2,3].

In Kenya, due to poor diagnosis and/or reporting, exact figures on malaria mortality are not known. However, malaria is a major cause of morbidity in malarious areas. In Kisumu District, for example, the following figures show malaria morbidity for the years 1983 and 1984:-

1983 (Jan.-Dec.) - 251,156 malaria cases

1984 (Jan.-Dec.) - 509,469 malaria cases

(outpatient clinical cases of malaria)[4]

It is evident from the above figures that malaria morbidity in Kisumu District was worse in 1984 than 1983. This may be a reflection of what is happening in the rest of the country. The above figures may not give the correct picture as often diagnosis is on clinical findings only. Although malaria is a major public health problem in Kenya, it is difficult to measure the economic loss caused by the sick in the working force. There is, therefore, a need to improve our diagnostic techniques and to set up a surveillance system so that each case is detected, treated and followed up appropriately depending on our economy.

RATIONALE

In tropical Africa, most countries have centred malaria control in the urban areas to protect the urban dweller so that work hours are not lost due to absence from work. Much work has been done by various town (urban) councils before and after independence in an attempt to solve the malaria problem.

In Dar-es-Salaam (Tanzania), a malaria control programme was in existence as early as 1903[5]. In the first decade, only chemotherapy and chemoprophylaxis were instituted and these failed miserably. Quinine was the chemotherapeutic agent used. There was no change in the prevalence and incidence of malaria.

After the 1st World War, the health authority decided to tackle the mosquito vector. This was done by larviciding and residual spraying using DDT and dieldrin.
Permanent drains were constructed and maintenance kept up-to-date. Drainage works kept pace with the growth of the city. This control method was still being used after independence. Periodic parasitological and entomological surveys were carried out to assess the progress of the control programme. Although vector control proved effective, this programme could not be maintained because of the costs of operation, lack of trained personnel and poor maintenance of equipment.

In Mombasa Municipality (Kenya), a similar control programme to that of Dar-es-Salaam is in operation[6]. The difficulties here are the rapid growth of the city, lack of personnel and inadequate funds. Whereas in Dar-es-Salaam most of the malaria cases were reported to h from outside town, in Mombasa, all cases of malaria recorded in 1984 were reported to be resident in the town.

The above mentioned control programmes were both vertically oriented and so expensive. This poses the question as to how effective and efficient these programmes are.

In Tropical Africa malaria control programmes are vertical, as are other control programmes for various endemic diseases.

The World Health Organisation's Expert Committee on malaria control recognises the difficulties faced in malaria control in Tropical Africa and so recommends that each country should formulate within its economic and social capabilities, antimalaria measures which are most effective and cheap[2]. This can be achieved by assessing through field experiments, the effectiveness of different antimalaria measures.

The Kenya National Antimalaria Strategy of 1981 stresses the need to reduce malaria prevalence using

all available control methods, and to coordinate and evaluate the antimalaria activities in progress in order to lower transmission and eventually eradicate malaria[7].

These facts and problems formed the basis and initiative to undertake an evaluation study of malaria control in Kisumu Municipality. It is hoped that the findings will be benefial not only to Kisumu Municipality but also to other urban councils in Kenya and Tropical Africa as a whole in the ever continuing struggle against malaria and other vector borne diseases.

OBJECTIVES

1.1. The purpose of the study was to assess, in Kisumu Municipality, past and present anti-malaria measures and their impact upon the prevalence and transmission of malaria.

1.1.1. To compare the budget, personnel distribution and health facility resources allocated to malaria control in the years 1974-5 and 1984-5.

1.1.2. To conduct a house to house Knowledge, Attitudes and Practices survey to determine the existence of a malaria control surveillance system.

1.1.3. To undertake a point prevalence malariometric survey by:

(a) blood slide examination)
(b) splenic size examination) in the 2-9 years age group,
(c) estimation of mosquito population by Pyrethrum Spray Catches and larval catches and species identification.

CHAPTER 2

BACKGROUND TO CONTROL MEASURES OF MALARIA

Malaria is a worldwide public health problem. In the 1950s there was a world wide campaign to eradicate malaria but continental Africa, was not included in this campaign[8]. Over the years, eradication has proved difficult and case prevention and treatment of malaria remain the major steps in the control of the disease.

Various antimalaria activities have been undertaken in various parts of the world but malaria, especially in the developing countries remains a serious public health problem. This has been attributed mainly to the vectors developing resistance to the insecticides used against them and more recently, the parasites becoming resistant to the commonly available chemotherapeutic agents[8].

By 1983, 48% of the world's population lived in areas where activities to control transmission of malaria were being undertaken. 8% of this population lived in areas where prevalence had hardly changed inspite of antimalaria activities[8].

Control measures against malaria are carried out world wide. The most commonly used measures are chemotherapy, chemoprophylaxis, vector control and more recently, health education so as to facilitate community participation in disease

control in an effort to achieve Health for All by the Year 2000. To be successful, the control programmes must be continuous. Constant surveillance and evaluation are necessary and should be built-in components of the malaria control programme as recommended by the World Health Organization's Expert Committee on malaria in 1974[2].

In the Punjab, it was found that a malaria control programme started in 1976 was effective only as long as the residual spraying of insecticide continued. Once this stopped, there was a resurgence of malaria. Three main problems were encountered and these are still world wide problems, hindering the continuity of most control measures:

a) Technical or administrative difficulties
b) Budgetary problems
c) Resistance of mosquitoes to the insecticide used.

Due to the technical and budgetary problems coverage was not realised and malaria transmission continued[9].

In Western Africa, a study was carried out in South Ghana to compare urban and rural malaria. A survey of parasitaemia, antibody titres and antimalaria practices by individuals was carried out in two communities, one rural and the other urban. Both

adults and children were sampled, except pregnant women[10]. It was found that the urban population practised more antimalaria measures than the rural population. In children aged 1-10 years, 40% of urban children had no antibodies against malaria as compared to only 3.4% of rural children. 7% of urban adults had no antibodies against malaria while all rural adults had antibodies. 37% of the urban population used chloroquine for prophylaxis while only 3% of the rural population did. 50% of the urban population protected themselves against mosquitoes and their houses had wire gauze window screening. In both populations, febrile illnesses were treated with chloroquine[10].

Although malaria eradication has proved difficult, control of transmission can be successfully instituted as has been shown by Zuluetta J. et al[11] in the Highlands of Kigezi, Uganda. This is an area of hyperendemic malaria. A research project carried out from 1959-62 by Zuluetta J. et al showed that transmission of malaria was completely eradicated by continuous DDT spraying and mass chemotherapy. Active case detection was done thereafter. By 1962, Anopheles funestus, the only vector in the study area, had been eliminated and there were no indigenous malaria cases.

In Kenya, malaria is a major public health problem. It is a major killer disease although exact mortality

figures are not available. In 1979, the population of Kenya was estimated as 16 million people. Out of these, 12 million lived in malarious areas. The proportion of those aged 14 years and below and pregnant women constituted about 50%. In 1975, malaria ranked 4th as a cause of hospitalisation. It ranks first in morbidity reports. It is estimated that in endemic areas like Kisumu about 5 school children out of a class of 40 are absent in any given day due to malaria (absenteeism rate = 12.5%)[7]. Malaria is endemic in most parts of Kenya although the degree of endemicity varies from place to place. Nyanza Province is a holo endemic area[7] (appendix 7). A WHO research project was carried out in Kenya from 1972-1976 to evaluate the impact of fenitrothion spraying on transmission[12]. The project was located in Kisumu town over an area of about 200 km^2 on the shores of Lake Victoria. No chemotherapy was given. All new borns were examined and followed up thereafter. Fenitrothion was sprayed inside dwellings at intervals of 3 months in two areas. One zone was untreated and this served as a barrier zone to protect the evaluation zone against re-introduction of the insect vectors. The observations made indicated a relationship between the efficacy of control and a decrease in mortality. The daily parasitological inoculation rate was reduced from 0.00958 infective bites per individual before treatment to 0.00037 after treatment (a decrease of 96%).

In two years, general mortality decreased from 23.9 to 13.5 deaths per 1000 population and infant mortality decreased from 157 to 93 per 1000 live births.

Most of these projects show that malaria control and therefore reduction in morbidity and mortality from malaria, is feasible. The WHO Expert Committee on Malaria [2] has recommended that any malaria control programme must be adjusted to the socio-economic profile of the country.

FIG. 1

THE MAP OF KENYA: PROVINCIAL BOUNDARIES

FIG.2
THE STUDY AREA

MUNICIPALITY OF KISUMU
SCALE 1:100,000

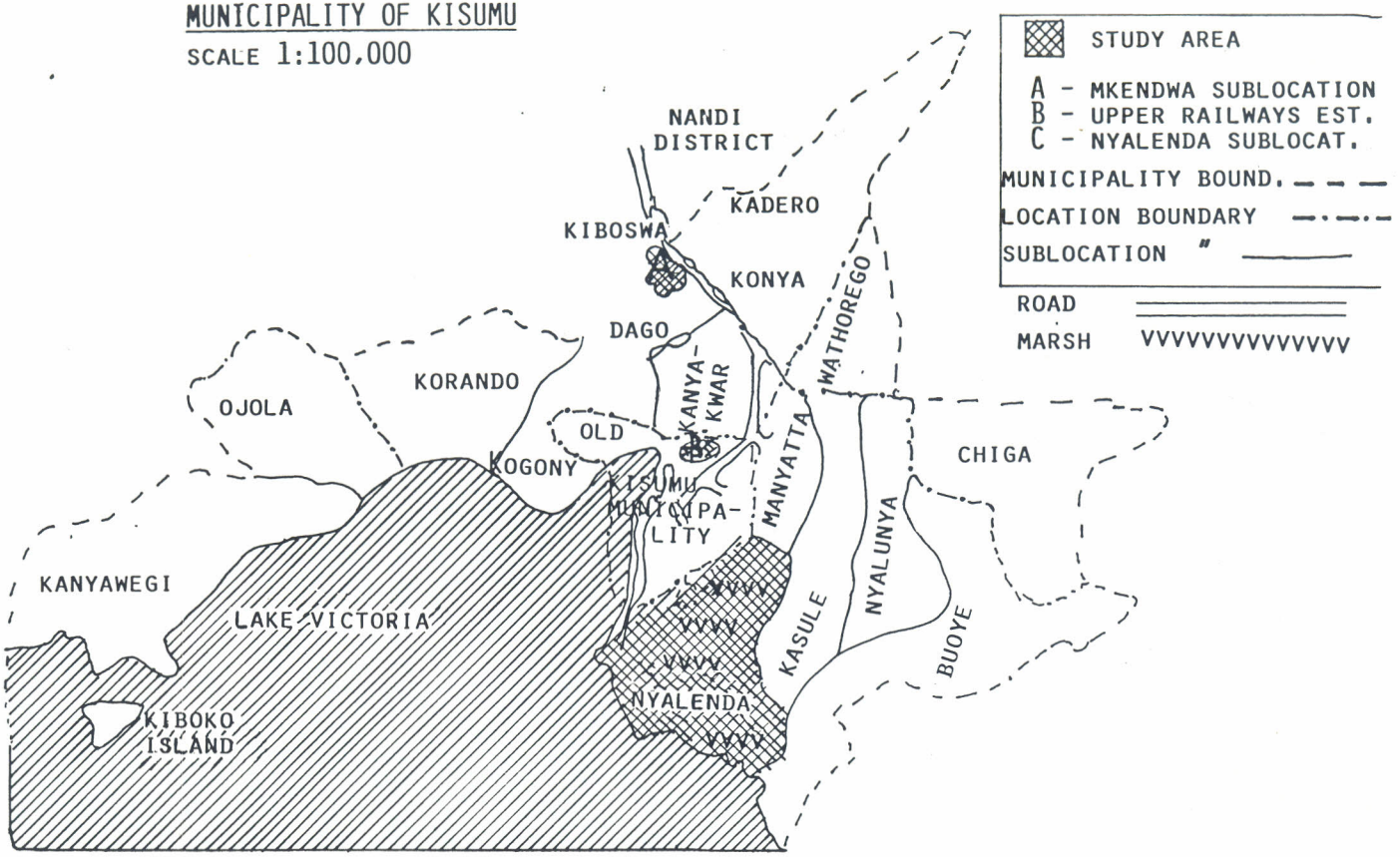

FIG. 2.

KISUMU DISTRICT

ALTITUDE 3750 FT.

MUNICIPAL BOUNDARY

LONG. 34° 25'E & 35° 25'E.

LAT. 0° 15'N & 0° 30's.

Kanyawegi, Ojola, Korando,Kogony, Kanyakwar and Mkendwa (Swahili) sublocations (figure 3). The town lies on latitude $0^{o}65'$ South and longitude $34^{o}48'$ East. It is 3750ft. above sea level.

3.1.ADMINISTRATION

Kenya is divided into various administrative units. The largest of these is the Province which is headed by the Provincial Commissioner (PC). There are a total of eight Provinces in Kenya. The area under study here falls under Nyanza Province (fig.1).

The Province is further divided into districts which are headed by a District Commissioner (DC). There are a total of 42 districts in Kenya. The district is then divided into locations. A location is headed by a Chief. Locations are sub-divided into sub-locations which are headed by Assistant Chiefs. These report to the Chiefs. A sublocation is informally divided into sub-units which are headed by headmen selected by the residents in the subunit. Headmen are not employees of the government but Assistant chiefs are. In the Sublocation, there are other small voluntary groups that help with administrative matters. The Kenya National African Union (KANU) Youthwing group is one such group.

A district is also divided into Divisions which are headed by a District officers (DO). These divisions

merge in most places with the parliamentary constituencies. The Assistant Chief, together with his elders, hold local courts to discuss various projects and even solve problems. These are called "Barazas". The local population is allowed to attend these courts. The Chief also holds similar "Barazas" which the Assistant Chiefs must attend. The general public may or may not attend these.

3.2. DEMOGRAPHIC PROFILE

The population of Kisumu District according to the 1979 Kenya Census was estimated at a total of 482,327 people. At an annual growth rate of 3.33%, the projected district population for 1986 is 562,634. The population of Kisumu Municipality in 1979 was 152,643 with a male to female ratio of 1.03 to 1. The population is projected to 178,058 for 1986 at an annual growth rate of 3.33% The projected population for children aged 0-10 years in 1986 in the district is shown in table I

TABLE 1: PROJECTED POPULATION OF CHILDREN 0-10 YEAR IN KISUMU DISTRICT FOR 1986

AGE (YEARS)	MALES	FEMALES	TOTAL
0 - 4	68403	68013	136,416
5 - 9	51174	50876	102,050
TOTAL	119,577	118,889	238,466

(Source: CBS) - Population Projection for Kenya (1980-2000 March 1983, UNICEF)

The population density for Kisumu District in 1979 was 230 persons/km^2 and for the Municipality was 565 persons/km^2.

3.2.1 NYALENDA SUBLOCATION

Nyalenda is a peri-urban sub-location whose population in 1979 was 21778 people with a population density of 886 people/km^2. It lies east of the Municipality. It is bounded by Buoye sub-location on the east, Kasule and Manyatta sub-locations on the north, and Lake Victoria on the South. The sub-location is divided into eight sub-units. Each sub-unit is headed by a headman who reports to the assistant chief. The KANU youth wing group is strong and works hand in hand with the headman. Almost half of this sublocation is marsh and floods during the rainy season. This area is not inhabited. Nyalenda is 1140m above sea level.

3.2.2. MKENDWA SUBLOCATION

This is a small sublocation surrounded by Dago Sublocation on the eastern, southern and western sides and by Konya sublocation and Nandi district on the north. Unlike Nyalenda, it is situated on top of a hill. It is a muslim community. The population in 1979 was 426 persons

per square km.

A single primary school serves the area. Mainly cassava and maize are grown. The majority of the people are unemployed. There are no domestic animals. This sublocation is 1420 metres above sea level.

3.2.3. UPPER RAILWAYS ESTATE

The Kenya Railways has many estates in which its employees live. Upper Railways is one such estate. This estate is in the old Municipality next to the Aga Khan Hospital and Primary School. It is 1180 metres above sea level.

3.3.0 CLIMATE

3.3.1 The area experiences both long and short rains. The long rains last from March to May and the short rains from September to November. Average annual rainfall for Kisumu town is 1280mm on average (Table 2).

TABLE 2: RAINFALL FOR THE YEAR 1986, KISUMU TOWN

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
RAINFALL (mm)	68.0	88.3	228.4	45.9	145.5	72.1	68.4	38.4	104.9	68.9	94.8	89.6	1313.4
NO. OF DAYS WITH RAIN	6	8	12	20	20	11	9	6	9	6	13	11	131

Average monthly Rainfall = 109.45mm

3.3.2 TEMPERATURE

The area experiences high temperatures which favour the breeding of mosquitoes. The mean minimum and maximum temperatures for the year 1986 are shown below (Table 3).

TABLE 3: TEMPERATURE OF KISUMU TOWN, 1986

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
MAXIMUM TEMPERATURE ^{o}C	30.4	30.5	29.8	28.1	28.0	27.1	28.2	30.1	30.3	30.9	29.7	28.6
MINIMUM TEMPERATURE ^{o}C	17.2	17.5	17.6	18.2	17.1	16.9	16.1	15.9	16.5	17.4	17.0	17.2

From these figures, January and February were the hottest months just before the long rainy season (March to May). September and October were also hot just before the short rainy season (November to December).

3.3.3. HUMIDITY

The mean relative humidity for the area as recorded at 06.00 hours and 12.00 hours for the year 1986 is shown in Table 4.

TABLE 4: HUMIDITY IN KISUMU TOWN, 1986

MONTH	JAN.	FEB.	MAR.	APR:	MAY	JUNE	JULY	AUG.	SEP.	OCT	NV	I
RELATIVE HUMIDITY AT 06.00 HRS:	59	66	63	77.5	73	77	71	62	60	58	63	6
AT 12.00 HRS	52	44	34	57.5	55	57	46	38	39	43	47	5

All these records are done at the Kisumu Airport on daily basis.

CHAPTER FOUR

4.1. MATERIALS AND METHODS

A familiarization tour of the area was undertaken in the month of September, 1986. The whole Municipality was covered and the three areas of study were selected. Selection was based on the easy accessibility to these areas by road and in their difference in that one is urban, another peri-urban and the third rural.

During this time, the relevant authorities were met. The chiefs, assistant chiefs and the headmen were met and appropriate dates arranged for "barazas" to introduce and explain to the residents the purpose and conduct of the study.

While waiting for the barazas to take place, field assistants were recruited. These were Form IV school leavers who could speak English, Kiswahili and Dholuo, the most widely spoken local language in the area. These were trained to administer the KAP household questionnaires so that they understood the questions and could translate them into Kiswahili and dholuo. A laboratory technician was also recruited. The four recruits were introduced to the assistant chiefs, the headmen and the local population in the three areas.

Later, the MOH of the Municipality was contacted and explained of the study. His verbal consent was obtained and his staff were introduced to the principal investigator.

4.2. THE STUDY DESIGN AND SAMPLING

The study design is basically a cross-sectional descriptive study to find the point prevalence of malaria and to assess the current antimalaria activities undertaken in the Municipality. Retrospectively, comparison was made for resources allocated to malaria control between two past periods, 1974-5 and 1984-5.

4.2.1. SAMPLING FRAME AND SAMPLING UNIT

For the household K.A.P. survey the whole selected sublocation was the sampling frame. The household was the sampling unit. For the children aged 2-9 years the population of this age group in the already sampled households formed the sampling frame. The child in this age group was the sampling unit.

4.2.2. SAMPLE SIZE ESTIMATION

For descriptive studies, when the prevalence of the study condition is known, the lowest sample size can be calculated from the formula

$$N = \frac{z_{\alpha}^2 P(1-P)}{C^2}$$ by Snedecor and Cochran[13].

where N= Total minimum sample size,

z_{α} = z value at the desired confidence level,

C = α-error for the desired confidence limit,

P = the prevalence of the study condition.

The level of confidence was selected to be 95%. This gives a z value of 1.960. The corresponding α- error or C is 0.05.

4.2.2.1. ESTIMATION OF SAMPLE SIZE FOR KAP STUDY

The variable compound spraying by the Municipal Council was chosen to represent the study condition. Since there is no prevalence for this, I selected 50% to be my compound spraying prevalence for the whole Municipality as this gives the maximal sample size. Using this prevalence, the sample size for households was calculated thus:

$$N = \frac{(1.960)^2 \ (0.5)(0.5)}{0.05^2} = 384.$$

Dividing this by 3, the minimum number of households for each selected sublocation was 128. In the study, a total of 316 households were studied. Of these, 128 were covered in Nyalenda, 146 in Upper Railways Estate and 42 households in Mkendwa. All households were studied in Mkendwa.

4.2.2.2. ESTIMATION OF SAMPLE SIZE FOR CHILDREN AGED 2-9 YEARS

The prevalence of malaria in Nyalenda Sublocation was *estimated to be 10% in 1984 and 11% in* Mkendwa Sublocation. The prevalence of malaria in the Upper Railways Estate was found to be zero in the same year.

These figures were arrived at by a study carried out among nursery school children aged below 6 years by Blood sample survey (unpublished Report, DVBD Kisumu).

Using an overall prevalence of 7%, the minimum sample size required for each area was calculated as follows:

$$N = \frac{1.960^2 \ (0.07)(0.93)}{0.052}$$

$$= 100$$

A total of 325 children was studied. Of these 118 were from nyalenda, 105 from Mkendwa was 102 from Upper Railways Estate.

4.3. HEALTH AUTHORITY QUESTIONNAIRE

This questionnaire (Appendix 1) was addressed to the Public Health Officer in charge of Communicable Disease Control in the Municipal Council. The aim of this questionnaire was to find out what anti-malaria activities the Council is involved in, the personnel allocated to malaria control, the physical facilities distribution and the budget allocated for malaria control. Comparison was made for the two years 1974-5 and 1984-5 for any significant change.

Informal interviews with the Deputy Medical Officer of Health and the Chief Public Health Officer of the Council were conducted. Records review was also done on those files which were available to the investigator. Reference was made to the Kenya Laws governning

Public Health and control of malaria.

4.4. KAP HOUSEHOLD QUESTIONNAIRE

This questionnaire was designed to test the knowledge, attitudes and practices of the residents concerning malaria, and to establish the existence of a malaria control programme in the area. This questionnaire was administered by Form IV school leavers who could speak English, Kiswahili and Dholuo well. The survey was conducted simultaneously in the three areas (Appendix 2).

4.4.1. SELECTION OF HOUSEHOLDS

Random sampling was done. A currency note was used whose serial number was $\frac{E}{38}$ 484880. The 4 points of the compass were randomly numbered thus:

North - 1
East - 2
South - 3
West - 4

The first number of the series is chosen. In this case, the number is 4. Therefore, the starting point was west. A central point in each area was selected as the starting point.

4.4.2. MKENDWA

The headman's house was selected as the starting point. The nearest door to the west was our first

house.

Subsequently, the whole sublocation was covered. Here, the area assistant chief had just retired and the assistant chief of Dago sublocation was acting assistant chief at the time.

4.4.3. Upper Railways

A canteen serves the residents of this area. This was used as the starting point and the nearest door west was the first household. Subsequently, the nearest door west was the next household.

4.4.4. NYALENDA

This sublocation is divided into 8 sub units. Each subunit is headed by a headman. Each headman's house was taken as the starting point. The nearest house west was chosen as the first house and subsequently, the nearest door west was chosen. In each subunit at least fifteen households were covered.

In each area, the consent of the head of household or whoever was in the house at the time was sought. If consent was not given, the next household was taken. Some houses were also found to be locked especially where the owners lived alone and worked away from the area. These were also left out and the nearest house taken.

4.5. MEASUREMENTS

Children aged 2 to 9 years were studied. These were selected from the already sampled households. Consent to examine them was given by the parents. No instances of refusal were encountered. Those of school age who were not at home were followed to the school if this was within walking distance. Only children resident in the area for not less than six months were studied.

4.5.1. SPLEEN EXAMINATION

A form was filled recording the particulars of each child (Appendix 3). Each child had a separate form. A general examination was done by the investigator paying particular attention to the abdominal examination. Splenomegaly was classified according to Hackett's classification of enlarged spleens (Appendix 4). All subjects were examined standing with the examiner sitting on a low stool or squatting. When the spleen was not palpable, the subject was asked to inhale deeply. This was to enable the examiner to determine class I splenomegaly.

4.5.2. BLOOD SLIDE EXAMINATIONS

All children aged 2-9 years who had undergone a physical examination were subjected to index finger pricks. Both thick and thin blood smears

were made on the same slide. The slides were labelled and put in a rack to dry. Slide labelling was done according to name of child, serial number of child and area of residence. Slides were transported to the laboratory in a covered rack. The thin smears were fixed in methanol and both thin and thick smears were stained with Giemsa stain and left to dry overnight, ready for examination. Parasite counts per 300 white blood cells (WBC) was done on thin films. Parasites were also identified by species on the same slides.

4.5.3. ENTOMOLOGICAL SURVEY

4.5.3.1 This survey was done to find out whether the anopheline vectors that transmit malaria were present in the households studied. Houses of temporary nature were selected from each area. 6 houses were selected in Nyalenda one of which was semi-permanent. 4 houses were selected in Mkendwa and in Upper Railways Estate. Adult mosquitoes were collected by spraying the houses with 0.11% pyrethrum extract in kerosene. This procedure was undertaken in the mornings before 9.00 a.m. This time is appropriate as most people are still in their houses before going out to work. At this time, it is easy to identify newly fed anopheline mosquitoes. The residents were asked to cover cooked foods

and drinking water tightly to avoid their contamination with the pyrethrum insecticide. Two people were involved. One on the inside and the other on the outside of the house. All exists from the house were closed. Using spray guns, the two people sprayed the eaves of the houses simultaneously going in one direction. The operation lasted less than two minutes. A period of 7-10 minutes was allowed for the mosquitoes to be knocked out. These were collected on white sheets spread on the floor prior to the spraying. Mosquitoes collected were counted and placed in labelled transparent plastic containers lined with moist blotting paper to avoid dessication of the mosquitoes.

In the laboratory, mosquitoes were counted, identified and all anophelines were identified by species into A. gambiae s.l. and A. funestus. All female anophelines were classified according to whether they were fed, unfed or gravid. These were then dissected and the salivary glands identified and examined for sporozoites.

.5.3.2. In the three areas, possible collecting stations for larvae were selected. In the Upper Railways Estate, there were no sites suitable for the breeding of anopheline mosquitoes as all water was flowing. In Mkendwa, a nearby pool was selected situated about 1.5k.m. away. This

pool had hoof marks and human foot prints as this water was used by the surrounding population. Cows also drank directly from the pool. 3 collections were made out of at least 2 dips by lardle. Larvae were put into labelled bottles.

In Nyalenda, larvae collection was also done in a field with human foot prints and cattle hoof prints. The lake shore water yielded no larvae. As for Mkendwa, 3 collections were made by a least 2 spoon scoops. Larvae were put in labelled bottles.

In the laboratory, lactophenol was added to each bottle. This reagent kills and preserves the larvae. All identified anopheline larvae were categorized by species. Identification was done microscopically.

4.6. DATA ANALYSIS

KAP data and measurement data were fed directly into a computer using a code book (Appendix 5). An IBM XT personal computer type belonging to the Medical Reseach Centre of the Kenya Medical Research Institute was used. Frequencies and cross tabulations of the variables were worked out.

4.7. ETHICAL CONSIDERATIONS

Permission to conduct this study was granted by the Chiefs and Assistant Chiefs of the respective areas. The Railways Welfare Officer was also informed. The local population was informed of the stud during barazas organized by the assistant chiefs. The Council's Medical Officer of Health also granted permission for study.

Severely ill persons were referred to the general hospital. All children with positive blood slides were treated with chloroquine. Multi-vitamin tablets were distributed in those households where children were treated for malaria. The dose of chloroquine was estimated according to the age of each child. The tablets were then placed in envelops labelled with each child's name. Those given multi-vitamin tablets were advised to give one tablet per day to each child. The dose of chloroquine was estimated as shown (TABLE 5).

TABLE 5: CHLOROQUINE DOSAGE

AGE GROUP	START DOSE	DAILY DOSEx 3 DAYS
2-4YEARS	1 tablet	$1/_2$ tablet
5-7YEARS	2 tablets	1 tablet
8-9YEARS	3 tablets	$1^{1}/_{2}$ tablets

CHAPTER FIVE

RESULTS

MALARIA CONTROL IN THE MUNICIPALITY

5.1. THE QUESTIONNAIRE TO THE PUBLIC HEALTH OFFICER IN CHARGE, COMMUNICABLE DISEASE CONTROL DEPARTMENT

TABLE 6

Distribution of personnel, health facilities and budget allocation for malaria control within the Municipality

Year	Budget allocated for Chemotherapy and Prophylactic drugs (in K£)	Budget actually spent on malaria Chemotherapy and Prophylactic drugs (in K£)	Total personnel involved in malaria control activities	Total personnel involved in malaria treatment	Health faciliti in the Municipality	
					Hospitals	HEALTH CENTRE Dispensarie
1974-5	3,000	2,500	120	8(6.7%)	4(5)	18
1984-5	5,200	7,942	142	10(7.0%)	4(7)	34

Figures in brackets were given by the Chief Public Health Officer.

There are no hospitals directly under the Municipality. Those health structures which were directly under the Municipality were as follows:-

In 1974-5 there were seven (7) health centres and dispensaries under the Municipality and 11 of the same in 1984-5. All health centres offer MCH and family planning services.

Chemoprophylaxis against malaria is given in all MCH clinics to expectant mothers and to pre-school children in nursery schools. From Table I above, there was over expenditure in the year 1984-5 and yet there was no external aid to the Council.

Current antimalaria activities were mainly geared to control of the mosquito vector and treatment of malaria cases. Health Education was not mentioned as part of the control activities.

The antimalaria activities mentioned were;

a) grass cutting and bush clearance,
b) drain construction and maintenance,
c) canalisation of drains and river banks,
d) adult mosquito surveys,
e) larviciding,
f) disinfection,
g) fogging/fumigation,
h) Chemotherapy and chemoprophylaxis.

5.2. Records Review

From the records review, malaria control falls under the Communicable Disease Control Department (CDC). This Department has a total of seven personnel distributed as follows:

i) I CDC Offficer who is a Public Health Officer
He is in charge of the CDC team.
ii) I Health Officer
iii) 2 Public Health Technicians

iv) 1 Copy Typist

v) 1 messenger and

vi) 1 storeman

The personnel working in the various clinics are not included as these attend to all cases of illnesses. The department of CDC is then divided into sections. One such section is the Mosquito Control Section which comprises of

- 2 mosquito "overseers"
- 22 mosquito searchers, and
- 15 oilers.

These have the task of visiting all mosquito breeding sites, do adult and larval collections, and take the necessary measures to minimise vector breeding.

The other section in the CDC department is drain building and cleaning. The personnel under this section are responsible for building and maintaining drains.

During one general Council meeting, it was recommended that the number of staff be increased in various sections. This was not realised due to financial difficulties.

Grass cutters are employed on casual basis. These are responsible for grass cutting and bush clearing. It was recommended again to employ grass cutters on permanent basis. Again, this was not realised.

The control activities to be carried out by the council were outlined as follows:-

i) Larval searching - identifying the breeding sites of mosquitoes and larviciding all stagnant waters and places of mosquito breeding.

ii) Adult mosquito searching - a visit to several selected catching stations once a week and mosquito identification.

iii) Adult mosquito spraying to be limited to fenced hedges and homes.

iv) Drug administration; prophylaxis given to Nursery and Primary School children.

v) Grass cutting and bush clearing.

vi) Destruction of "floating" Islands.

vii) Permanent Drain building. A grant from DVBD of £500 per annum was allocated for this.

viii) Lakeshore Reclamation.

ix) Manpower development and Research.

With the District Focus for Rural Development strategy, a "Malaria Eradication" Committee was set up in September, 1986 following a Presidential decree for such committees. This committee, at its first General Meeting, came up with the following recommendations:

i) Intensify environmental changes,

ii) Encourage community participation,

iii) Enforce the Public Health Act,

iv) Intensify Health Education, and

v) Surveillance,

in the control of malaria and other communicable diseases. For mosquito control, it was decided that the Fisheries department be involved in the rearing of larvivorous fish. This Committee is chaired by the District Commissioner (DC). The District Medical Officer of Health (DMOH) is the secretary. The other members are the Medical Officer of Health of the Municipal Council, the Communicable Disease Control Officer, the Chief Public Health Officer, the District Public Health Officer, the Public Health Officer, the Officer in-charge of DVBD, the District Hospital Superintendent the Clerk to the Council and a Health Education Officer.

5.2.2. BUDGET REVIEW FOR 1976

The budget estimate for the year 1976 was looked at. It was found that out of a total of 26,810 for malaria control, £19,190 (76.6%) were set aside for salaries, wages and retirement benefits. Excluding wages, only £3,300 (12.3%) was actually spent on malaria control. The rest was spent on staff travelling expenses, housing allowances, staff medical expenses and uniforms.

5.3. *THE INFORMAL INTERVIEW WITH THE DEPUTY MEDICAL OFFICER OF HEALTH AND THE CHIEF PUBLIC HEALTH OFFICER*

Although aerial and residual spraying of insecticides were recommended, these are not done as

both measures are expensive and the necessary equipment and technical know-how are lacking.

Fumigation and/or fogging are done on an irregular basis after the long rains but only when the equipment can be borrowed, usually from a drug company like Wellcome (K) Ltd.

As regards "floating" islands, manual destruction is done. Before and for sometime after independence prisoners were used for this exercise. Now, labour has to be hired and usually, the finance is limited.

These floating islands can be very dangerous as some harbour poisonous snakes or hippopotamii which can harm those destroying the Island. The Council does not own a boat which could be used to transport labour to these islands. As a result, they have to wait for these islands to come to shore before destroying them. These "floating" Islands are made of mud, weeds, reeds or portions of land breaking off from the mainland on the lake shores. As the wind blows these drift onto the lake and float.

Although in their general meetings it has been recommended that the Council should rebuild the wall along the lake-shore, this has not been realised due to lack of funds. Before independence, a wall was built along the shores of lake Victoria in Kisumu town to prevent overflowing of lake water on land during the rainy season as this

created favourable breeding conditions for the anopheline mosquitoes. However, with time and lack of maintenance, this has sunk below the water level. The shore is now overgrown with reeds and weeds which are favourable breeding sites for anopheles funestus. Reconstruction of this wall will prevent the breeding of this mosquito along the lake shore.

The Council is also responsible for inspecting and approving privately constructed buildings to ensure proper drainage systems. Inspection is to be done before and after construction.

Although there is a shortage of staff, the Ministry of Health allows trainee nurses from the Medical Training Centre, to work in the health centres and dispensaries of the Council. Manpower development is emphasized but not many staff go for courses to improve their knowledge and skills.

Prior to June 1980, the Council received a grant of £500 annually from the DVBD for drain construction and maintenance. Revenue comes from fines (imposed for various offences), licences and rents.

Constraints faced in the control of malaria are lack of finances, shortage of staff and poor communication between the Council, the DVBD section of the Ministry of Health and the Vector Biology and Control Research Centre.

CHAPTER SIX

RESULTS

K.A.P. SURVEY

The results reported here were obtained by feeding raw data directly into an IBM Personal Computer XT of the Medical Research Centre by a code book in Nairobi. A list of all the variables and the code book used are given in the appendix (Appendix 5).

A total of 316 households were included in the survey regarding knowledge, attitudes and practices with respect to malaria and the mosquito vector. The interviews were carried out over a month. The respondents were classified by age and sex and the age ranged from 13 years to 80 years. The mean age was 30.67 years overall with a standard deviation of 11.489. For the three areas, it was noticed that the age in years was usually given preferentially to the nearest 5 years. One person did not give his age. The level of education and occupation were characteristics of the respondents and these are shown in tables 7 and 8 respectively. The sex of the respondent was recorded. The majority were females 251 (79.4%) and males were only 65 (20.6%).

The total annual income in K£ or KShillings was included in the questionnaire, but the responses were not included in the analysis as the majority of respondents did not know the correct figures and only guessed. Some said their income depended on the business and so

could not say how much they earned by the end of the year.

TABLE 7: LEVEL OF EDUCATION BY AREA

LEVEL OF EDUCATION	ALL AREAS	UPPER RAILWAYS ESTATE	NYALENDA	'MKENDWA
NONE	76(24.1%)	31(21.4%)	29(22.4%)	16(38.1
PRIMARY	179(56.4%)	77(57.2%)	79(61.7)	23(54.8
SECONDARY	57(18.3%)	37(25.3%)	17(13.3%)	3(7.1%)
NO RESPONSE	4(1.3%)	1(0.7%)	3(2.3%)	0

Primary education here included anybody who could read and write and who either completed or did not complete 8 years of Primary Education. Secondary Education included all who had one year of secondary education and all who had other training post-secondary. No respondent had University education. The majority of the people had primary education.

TABLE 8: OCCUPATION OF RESPONDENTS BY AREA

	ALL AREAS	UPPER RAILWAYS	NYALENDA	MKENDWA
Unemployed	91(28.8%)	5 (3.4%)	80 (62.5%)	6 (14.3%
Employed	46.(14.6%)	27.(18.5%)	15 (11.7%)	4 (9.5%)
Child	1(0.3%)	1(0.7%)	-	-
Student	9(2.8%)	9(6.2%)	-	-
Farmer	22(7.0%)	-	4 (3.1%)	12(42.9
No response	91(28.8%)	83(56.8%)	4 (3.1%)	4 (9.5%

In the unemployed group, housewives were included. The only child in the Upper Railways Estate was 13 years old and was a baby sitter. Business here included odd business like hawking to actually owning shops, restaurants or rental buildings.

'Farmer' here included small scale farming to large pieces of tilled land. In practice, there was nobody who owned a farm. Majority of the farmers own shambas. The majority of those who gave no response in Upper Railways were either employed as house-girls or were sub-tenants. In Nyalenda, the 4(3.1%) who gave no response were later found to be brewers of chang'aa - the local alcoholic brew.

When asked about family problems encountered in the area, 77(52.6%) respondents in Upper Railways Estate said diseases, 75(58.6%) in Nyalenda said diseases but only 12(28.6%) of those in Mkendwa said diseases. In U.R.E. 32(21.9%) had no problems, 25(19.5%) in Nyalenda had no problems. 24(16.4%) respondents in U.R.E. complained of mosquitoes. 29(69.0% respondents in Mkendwa complained of financial difficulties. Overall 164(51.9%) complained of diseases.

In Mkendwa, 42 or all respondents complained about poor environmental sanitation when asked about community problems. These felt they should be given water, bushes should be cleared and thieves arrested. In Nyalenda, 32(25%) complained about thefts, 100(48.4%)

thought there were no community problems and 22(17%) said they needed water, drains to be constructed and garbage collected. Others wanted latrines constructed for them. In U.R.E., 34(23.3%) said there were no community problems, 18(12.3%) said diseases were problem. 25(17.1%) said Environmental sanitation should be improved i.e., clean toilets, drainage, water, clear bushes etc. When asked about their main health problems 226(71.5 said malaria and fever (106, 72.6% - U.R.E., 95(74.2%) Nyalenda, 25(59.5%) Mkendwa). When asked about the cause of malaria the majority of the respondents 243(76.9%) associated mosquitoes with malaria and 300(94.9%) knew at least one correct symptom of malaria (Tables 9 and 10).

TABLE 9: CAUSES OF MALARIA BY AREA

CAUSES OF MALARIA	ALL AREAS COMBINED	U.R.E.	NYALENDA	MKENDWA
MOSQUITOES	239(76.6%)	86(56.2%)	123(96.1%)	38(90.5%)
ENVIRONMENT	15(4.8%)	7(4.8%)	5(3.9%)	3(7.1%
OTHERS	4(1.3%)	4(2.7%)	-	-
DO NOT KNOW	54(17.3)	53(36.3%)	-	1(2.4%

Environment here includes rain, stagnant water or change of climate. Others include tsetse flies, worms and house flies. In U.R.E., 53(36.3%) respondents did not know the cause of malaria. These were mainly house-girls employed by the tenants.

TABLE 10 DIAGNOSIS OF MALARIA BY AREA

DIAGNOSIS	ALL AREAS	U.R.E.	NYALENDA	MKENDWA
CORRECT SYMPTOM	300(94.9%)	134(91.8%)	128(100%)	38(90.5%)
WRONG SYMPTOM	3(0.9%)	1(0.7%)	-	2(4.8%)
DO NOT KNOW	13(4.1%)	11(7.5%)	-	2(4.8%)

Wrong symptoms here were red eyes, yellow urine, stomachache Correct symptoms included high temperature, fever, chills and rigors, vomiting, joint pains and headaches. When asked about what they do to protect themselves against mosquitoes, they gave the following responses (Table 11):-

TABLE 11: ACTION TAKEN AGAINST MOSQUITOES

	ALL AREAS COMBINED	U.R.E.	NYALENDA	MKENDWA
CORRECT MEASURES	294(93%)	127(87%)	128(100%)	39(92.9%)
WRONG MEASURES	15(4.7%)	14(9.6%)	-	1(2.4%)
NO ACTION TAKEN	4(1.3%)	4(2.7%)	-	-
NO RESPONSE	3(0.9%)	1(0.7%)	-	2(4.8%)

Correct protective measures against mosquitoes here included the mosquito coil, nets, insecticides, clearing bushes and draining stagnant waters. Wrong measures here included answers like a good diet, blankets, sheets. Nobody talked of burning eucalyptus leaves or any other traditional measures. 2.7% of the people in Upper Railways Estate did not take any action against mosquitoes. In

Nyalenda 128(100%) people used one or a combination of the standard measures against mosquitoes. 93% of the total sample of households took some action against mosquitoes. 162(51.3%) people either bought medicine from the shop or went to hospital when a member of the family was suspected to be ill. This was 91(71.1%) people for Nyalenda and 56(38.4%) for URE. 26(62%) of people in Mkendwa went to hospital when ill and 15(35.7%) either went to hospital or bought medicine from the shop. 75(51.4%) people in URE went to hospital when a member of the family was suspected to be suffering from malaria. 190(60.4%) people in all areas combined said that the government was taking some action against malaria. 117(80.1%) in URE, 63(49.2%) in Nyalenda and 11(26.2%) of Mkendwa said the same. 28 (66.7%) people in Mkendwa said the government was not taking any action against malaria. 63(49.2%) people in Nyalenda, 28(19.2%) of those in URE and 3(7.1%) of those in Mkendwa did not know whether the government was taking any action against malaria.

Of those who said there was some action being taken by the government 11(36.4%) said the government provided free medical services, 64(20.3%) said the government was controlling the spread of diseases and 7(2.2%) said the government provided Health Education to the people so that they learned how to protect themselves against mosquitoes. Respondents were asked whether their compounds had ever been sprayed, 79(54.1%) people in URE said no, or could not remember. 114(89.1%) of

people in Nyalenda said yes and 34(81.0) of people in Mkendwa said no spraying had ever been done. When asked how often the spraying was done 167(52.8%) said occassionally, 59(40.4%) in URE said never, 114 (89.1%) in Nyalenda said occassionally and 34(81%) in Mkendwa said never.

The respondents were asked about prophylaxis against malaria. Although 226(71.5%) of the population said they take prophylaxis, only 34(10.8%) knew that prophylaxis is taken weekly. Only 78(24.7%) took chloroquine for prophylaxis with 25.9% taking both antimalaria drugs and analgesics. 112(35.4%) people said all family members take prophylaxis against malaria. 31(73.8%) in Mkendwa said all family members take prophylaxis but only when sick. 64(50%) people in Nyalenda said all family members took prophylaxis against malaria but 36(28.1%) took analgesics and 39(30.5%) took both chloroquine and analgesics. 177(56.0%) of all people bought their medicine for prophylaxis from the shop with only 28 (8.9%) getting medicine from the hospital. Overall 167(52.8%) took medicine only when sick. Children were given the drugs by either parent in 207(65.5%) people. When asked about what they felt the government or Council could do to better protect the people against malaria, the answers were given as in table 12.

TABLE 12 GOVERNMENT ACTION TO PROJECT AGAINST MALARIA

GOVERNMENT ACTION AGAINST MALARIA	ALL AREAS	U.R.E.	NYALENDA	MKENDWA
Provide enough drugs	58(18.4%)	53(36.3%)	3(2.3%)	2(4.8%)
Improve Environmental Sanitation	129(40.8%)	29(19.9%)	98(76.6%)	2(4.8%)
Health Education and Inspection	37(11.7%)	12(8.2%)	22(17.2%)	3(7.1%)
Medical Services close to the people	31(9.8%)	2(1.4%)	-	29(69%)
All possible methods to control malaria	8(2.5%)	4(2.7%)	-	4(9.5%)
Do not know/ no response	53(16.8%)	46(31.5%)	5(3.9%)	2(4.8%)

Environmental sanitation here includes, water supply, construction of drainage systems, clearing of bushes, spraying of compounds and refuse collection. 29(69.0%) people in Mkendwa thought the government should bring hospitals close to them and increase visits by the Mobile unit. Respondents were also asked whether there are health workers in their area. 84(65.6%) respondents in Nyalenda said there were, while 13(8.9%) and 4(9.5%) respondents from URE and Mkendwa respectively said there were. When asked what these workers do, 80(62.5) Nyalenda respondents said they teach health education. Only 22 (17.2%) respondents said these health workers were very effective. 61(47.7%) said they were effective.

The house structure was also studied. 140(95.9%) houses in URE were permanent but only 16(11.0%) had ceilings. 100(78.1%) houses in Nyalenda were semi-permanent with only 2(1.6%) houses having ceilings, 27(64.3%) houses in Mkendwa were semi permanent and 29(69%) had no ceilings.

The total number of sleeping rooms was recorded. 89(59.6%) of houses in URE had one sleeping room, 49(33.6%) had two sleeping rooms and 10(5.5%) had three sleeping rooms. Only 1.4% had four sleeping rooms. In Nyalenda 84(65.6%) had one sleeping room, 39(30.5%) had two sleeping rooms and 5(3.9%) had three sleeping rooms.

In Mkendwa 15(35.7%) had one sleeping rooms, 18(42.9%) had two sleeping rooms 6(14.3%) had three sleeping room and 3(7.1%) had four sleeping rooms.

The total sleeping rooms was cross-tabulated with area and a chi-square test done suing Yate's correction factor of 0.5:(Table 13).

TABLE 13: TOTAL SLEEPING ROOMS BY AREA

Sleeping	U.R.E.	NYALENDA	MKENDWA	TOTALS
1	87(86)	84(75)	15(25)	186
2	49(49)	39(43)	18(14)	106
3	10(11)	5(10)	9(3)	24
TOTALS	146	128	42	316

$X_4^2 = 20.00; \quad P < 0.005$

This is statistically significant.

In URE, there is no difference between observed and expected values. However, in Mkendwa, there are less ( ) households with one sleeping room than expected and three times the expected households with three or more sleeping rooms. For Nyalenda, there are more households with one sleeping room and fewer with three or more sleeping rooms than expected.

The total number of people sleeping in each household was also recorded. The cumulative frequencies of total sleepers were plotted on a graph (figure 4). The 50th percentile, which gives the median was found to be 5. The mode was 6 sleepers per household.

When the level of education was taken as a constant characteristic and cross-tabulated against other variables, the chi-squire obtained were as given in Table 14A below.

FIG. 4.

NUMBER OF HOUSEHOLDS AND COMMULATIVE FREQUENCY OF TOTAL SLEEPERS PER HOUSE

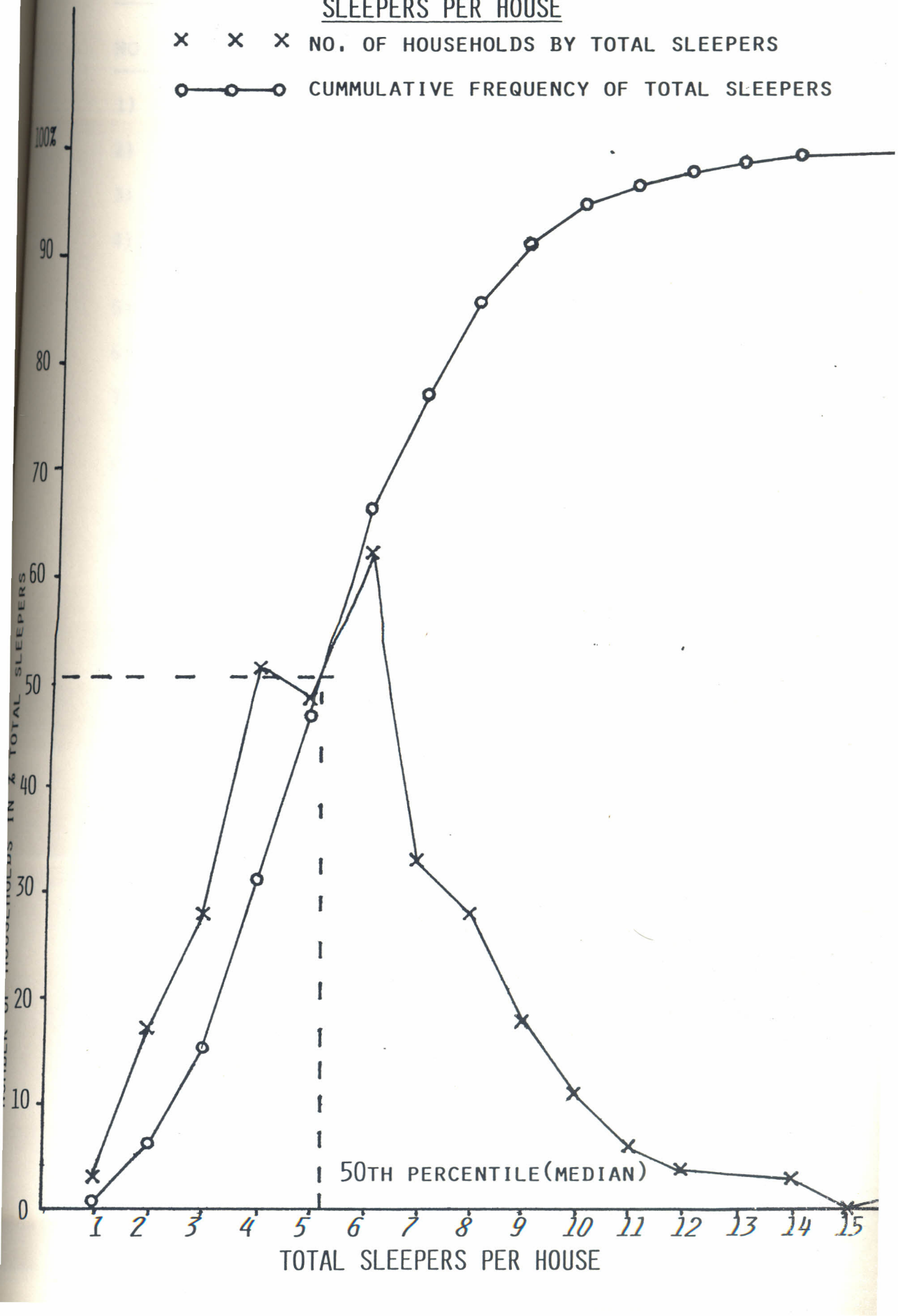

TABLE 14A. CROSS TABULATIONS BETWEEN VARIABLES

NO.	COMPARISON	CHI-SQUARE	D.F.	(P) SIGNIF
1)	Education by occupation	43.333	10	0.000
2)	Education by family problems	22.697	8	0.003
3)	Education by Community problems	22.919	10	0.011
4)	Education by main health problems	10.068	18	0.929
5)	Education by causes of malaria	19.660	6	0.003
6)	Education by malaria diagnosis	9.970	4	0.044
7)	Education by mosquito protection	2.597	4	0.627
8)	Education by action against malaria	8.631	6	0.194
9)	Education by Government action	4.158	4	0.385

To find out whether these chi-squire values were not arrived at by chance, a student's t-test was performed as follows:

	X^2	Degree of freedom (DF)
n	9	9
EX	143.853	70
X(mean)	15.984	7.778
SD (Std. deviation)	12.75312	4.5215533
SEM(Std. error of the mean)	$\frac{SD}{\sqrt{n}}$=4.2510	1.5072

The mean differences, $D = \bar{X}_1 - \bar{X}_2$

$= 15.984 - 7.778$

$= 8.2059$

$t = \sqrt{SEM_1 + SEM_2}$

$= \frac{8.2059}{2.3996}$

$= \underline{3.41965}$

Degrees of freedom $= (9-1) + (9-1)$

$= 16$

Therefore $t_{16} = 3.41965$; $0.001 < P < 0.01$

This is statistically significant. This means that the chi-square values were not arrived at by chance. These show real relationship between the variables.

Cross-tabulations were also done between study areas and other variables. Chi-square tests were also performed on these. These are shown as in table 14B below:-

TABLE 14B CROSS-TABULATIONS BETWEEN VARIABLES

NO	COMPARISON	CHI-SQUARE	D.F.	SIGNIFICANCE(P)
1.	Study area by sex	2.781 .	2	0.2489
2.	Study area by education	13.608	4	0.0087
3.	Study area by Malaria, causes	79.386	6	0.0000
4.	Study area by Malaria, diagnosis	17.800	4	0.0013
5.	Study area by mosquitoes, protection	19.54	4	0.0006
6.	Study area by malaria, action against	41.270	6	0.0000
7.	Study area by malaria, government protection	208.868	4	0.0000
8.	Study by Action taken, govern.	153.270	6	0.0000
9.	Study area by compound sprayed	125.403	6	0.0000
10.	Study area by frequency of spray	149.974	8	0.0000
11.	Study area by Prophylaxis against malaria	46.014	4	0.0000
12.	Study area by those taking prophylaxis	123.554	8	0.0000
13.	Study area by what taken, prophylaxis	55.505	8	0.0000
14.	Study area by where from, prophylaxis	73.434	6	0.0000
15.	Study area by who gives, prophylaxis	54.638	6	0.0000
16.	Study area by how often, prophylaxis	99.130	8	0.0000

No.	Comparison	Chi-Square	D.F.	Significance (P)
17.	Study area by Protection, government	342.328	10	0.0000
18.	Study area by Presence, Health workers	152.587	4	0.0000
19.	Study area by action, health workers	157.724	6	0.0000
20.	Study area by effectiveness, H/workers	149.035	6	0.0000
21.	Study area by house structure	224.637	4	0.0000
22.	Study area by Presence of Ceiling	30.511	2	0.0000
23.	Study area by sleeping room, total	22.347	6	0.0000
24.	Study area by total sleepers	3.588	4	0.4647

A student's t-test was worked out on these chi-squares to test the *hypothensis that these were arrived at by* chance. This was done as follows:-

	X^2	DF
n	24	24
$\overline{X}$	97.789	5.5
SD	84.1483	1.978
SEM	17.1767	0.4038

$D = \overline{X}_2 - \overline{X}_2 = 92.2888$

CHAPTER 7

CLINICAL AND PARASITOLOGICAL SURVEY

The minimum sample size required for the clinical and parasitological survey has already been stated in Chapter IV. As already stated, only children aged 2-9 years old were studied. These had to be resident in the area for a period of not less than six months.

A total of 325 children were studied. The spleen sizes were recorded according to Hackett's classification of enlarged spleens (Appendix 4). The children were divided into two age groups, namely, 2-4 years and 5-9 years (small children and Juveniles respectively). For all areas combined 70(21.53%) of the children aged 2-9 years had positive blood slides for malaria. Of these 55(78.57%) were due to P. falciparum, 1(1.43%) due to P.ovale and 8(11.43%)due to P. malariae 6(8.57%) had mixed infections. The number of positive films for URE was 14(13.72%), 45(38.13%) for Nyalenda and 11(10.48%) for Mkendwa. *These are tabulated in Table 15. Spleen sizes were also recorded and similarly, the children were* divided into two age groups.(Table 16).

The Spleen Rate for all the areas combined was 13.85%,27.1% for Nyalenda 5.9% for URE and 4.8% for Mkendwa. The average enlarged Spleen (EAS) was also calculated and this was found overall to be 2.2. The EAS figures for the three areas are all close to this figure. The EAS is a better index showing how many children

$$t = \sqrt{SEM_1 + SEM_2}$$

$$= \sqrt{\frac{92.2888}{17.586}}$$

$$= \underline{\underline{22.010681}}$$

Degrees of freedom are (24-1) + (24-1)

$$= 46$$

Therefore t_{46} - 22.0107; $P < 0.001$

This is statistically significant. The Chi-squares obtained were not arrived at by chance. These show real relationships between the variables. Therefore the null hypothesis is rejected.

have had malaria recently. Since every malaria infection is likely to increase the size of the spleen, the AES is more sensitive to variations of transmission.

Table 15:

Positive blood slides by age and malaria species by area

All Areas. (a)

Age Group	No. of Slides Examined	No. of Positive films	P. falci-parum	P. Ovale	P. Mala-riae	Mixed Infect-ions	Nega-tive Slides
2-4 yrs	150	34	26	-	5	3	116
5-9 yrs	175	36	29	1	3	3	139
Totals	325	70	55	1	8	6	255
%	100	21.53%	78.57%	1.43%	11.43%	8.57%	78.46%

UPPER RAILWAYS ESTATE (b)

Age Group	No.of Slides Examined	No.of Positive Films	P. Falci-parum	P. Ovale	P. Mala-riae	Mixed Infect-ions	Nega-tive Slides
2-4 yrs	54	8	4	-	2	2	46
5-9 yrs	48	6	4	-	1	1	42
Totals	102	14	8	-	3	3	88
%	100	13.72	57.14%		21.43%	21.43%	86.27%

NYALENDA (c)

Age Group	No. of Slides examined	No. of Positive films	P. Falci-parum	P. ovale	P. Mala-riae	Mixed infect-ions	Negati-slides
2-4 yrs	51	21	18	-	2	1	30
5-9 yrs	67	24	19	1	2	2	43
Totals	118	45	37	1	4	3	73
%	100	38.13	82.22	2.22	8.89	6.67	61.86

MKENDWA (d)

Age Group	No. of Slides examined	No. of Positive films	P. Falci parum	P. ovale	P. Mala-riae	Mixed Infect-ions	Negativ-slides
2-4 yrs	45	5	4	-	1	-	40
5-9 yrs	60	6	6	-	-	-	54
Totals	105	11	10	-	1	-	94
%	100%	10.48%	90.9%	-	9.09%		89.5%

Table 16 Spleen Sizes by age in the three areas

All areas (a)

Age group (years)	No. of Spleens Examined	SPLEEN CLASS				
		OO	1	2	3	4
2-4yrs	150	132	3	8	5	2
5-9	175	148	6	14	5	2
Totals	325	280	9	22	10	4
%	100%	86.1%	2.77%	6.77	3.1%	1.23%

Total enlarg Spleen 45

Speen Rate =13.85

======

UPPER RAILWAYS ESTATE (b)

Age group (years)	No. of Spleens Examined	SPLEEN CLASS				
		O	1	2	3	4
2-4 yrs	54	48	-	3	2	-
5-9	48	47	-	1	-	-
Totals	102	95	-	4	2	-
%	100%	93.1%	-	3.9	2.0	-

SR=5.9

NYALENDA (c)

Age group (years)	No. of Spleens Examined	SPLEEN CLASS					SR=2
		0	1	2	3	4	
2-4 yrs	51	42	1	4	3	1	
5-9	67	44	5	11	5	2	
Totals	118	86	6	15	8	3	
%	100	72.9	5.1	12.7	6.8	2.5	

MKENDWA (d)

Age group (Years)	No. of Spleens Examined	SPLEEN CLASS					SR=4.8
		0	1	2	3	4	
2-4yrs	45	41	2	1	-	1	
5-9	60	57	1	2	-	-	
Totals	105	98	3	3	-	1	
%	100	93.3	2.86	2.86	-	1.0	

The parasite density was calculated by counting malaria parasites against 300 white blood cells (WBCs). The density ranged from 1 to 1020 parasites per 300 WBC with a mean of 110 parasites and a mode of 30 parasites per 300 WBC. Comparison was then made between Splenomegaly and parasite presence or absence. A chi-square test was done and was found to be statistically significant:(table 17):-

Table 17: Splenomegaly versus Parasitaemia

SPLENOMEGALY	PARASITES		TOTALS
+	23(9.7)	22(35.3)	45
-	47(60.3)	233(219.7)	280
Totals	70	255	325

$$X_1^2 = \left(\frac{(O-E)}{E}\right)^2$$

$$= 26.985773$$

$$P < 0.005$$

All figures in brackets are expected values. It is evident that there were more children observed with splenomegaly who had malaria Parasites in their blood than expected. Similarly, there were fewer children observed with splenomegaly who had no parasites in their blood (expected of 35 and observed 22). This means that splenomegaly is related to parasitaemia. Then splenomegaly was compared with parasite density(Table 18):

Table 18: Splenomegaly versus parasite Density

SPLENOMEGALY	PARASITES DENSITY/300 WBC		TOTALS
	150	150	
Enlarged	18(17)	3(4)	21
Not Enlarged	39(40)	10 (9)	49
TOTAL	57	13	70

All figures in brackets are expected values.

A Chi-Square test was done and was statistically not significant. Comparison was made between the results obtained on the blood slide and the study areas.

TABLE 19: Parasitaemia by area

BLOOD SLIDE	U.R.E. (1)	NYALENDA (2)	MKENDWA (3)	TOTALS
Positive	14(22)	45(25)	11 (23)	70
Negative	88(80)	73(93)	94(82)	255
Totals	102	118	105	325

(All expected values in brackets)

X_1^2 = 32.03; P < 0.005

This is statistically significant.

The table shows that there are less children with positive blood slides than expected in both Upper Railways Estate and Mkendwa, while there are more children observed with positive slides than expected in Nyalenda. The same was done for splenic enlargement and study area:-

TABLE 20: Splenomegaly by area

SPLENIC ENLARGMENT	U.R.E. (1)	NYALENDA (2)	MKENDWA (3)	TOTALS
PRESENT	6(14)	32(16)	7 (15)	45
ABSENT	95(88)	86(102)	98(90)	280
TOTALS	102	118	105	325

Expected values are given in brackets.

X_2^2 = 28.62; p < 0.005

Again, the observed splenic enlargement cases were much less than expected in both Upper Railways Estate and Mkendwa. Whereas in Nyalenda, the observed children with enlarged spleens were twice the expected number and those observed with no enlargement were fewer than expected.

The Chi-Square test here is statistically significant.

CHAPTER EIGHT

ENTOMOLOGICAL SURVEY

This survey included the collection of adult mosquitoes and their identification, and the collection of mosquito larvae and their identification. Pyrethrum spray-sheet catch (PSC) collections were done for the adult mosquitoes as already discussed in Chapter- IV Larvae were collected by spoon dips into the selected stations. Larvae collections were done as close to the adult collection stations as possible. As already stated in Chapter IV no suitable larvae collection areas were identified in Upper Railways Estate and so no larvae were collected.

A total of 14 adult mosquito collecting stations were selected. 6 were in Nyalenda, 4 in Mkendwa and 4 in Upper Railways Estate. In Nyalenda, a total of 118 adult mosquitoes were collected. Of these, 55(46.6%) were Anopheles gambiae s.1, 19(16.1%) were Anopheles funestus and 44(37.3%) were culicines. In the 6 houses there were a total number of 29 sleepers (17 children and 12 adults). The densities of each anopheline species per house were calculated.

These were: An. gambiae s.l. per house = 55 ÷ 6 =9.15;

An.funestus per house = 19 ÷ 6 =3.33

All female anophelines were recorded as to whether fed, unfed or gravid. These were then dissected to determine sporozoite infection in their Salivary glands. A total of 39 An. gambiae s.1. females were dissected. None

of them had sporozoites in the salivary glands. 15 female An. funestus were dissected. The salivary glands of these were also free of sporozoites. The same procedure was followed both in Mkendwa and in the Upper Railways Estate. In the latter, no anophelene mosquitoes were collected. However, a total of 55 culicines were collected.

In Mkendwa, a total of 21 mosquitoes were collected. Of these 2(9.5%) were Anopheles gambiae s.l., No Anopheles funestus were caught.
There were a total of 19 sleepers in the 4 households (8 adult and 11 children). The density of An. gambiae s.l. therefore was

$$2 \div 4 = 0.5$$

The density for An. funestus was 0.
These Anopheles were all female and on dissection, no sporozoites were found in the salivary glands. The average number of sleepers for both Nyalenda and Mkendwa per house was found to be 4.9 = 5 persons per house (Appendix 6).
All larvae collected were identified in the laboratory. In Mkendwa, larvae were collected in a pool in hoof prints. This pool dries up during the dry season. Numerous larvae of Anopheles gambiae s.l. were collected. All were in the fourth larval stage of development. In Nyalenda, larvae were collected in three different areas; along the Lake shore in cattle hoof prints, no larvae

were collected, away from the Lakeshore in cattle hoof prints, where culicine larvae were found, and from near homes in human foot prints. Numerous culicine larvae at various stages of development were collected. No anopheline larvae were collected.

CHAPTER NINE

DISCUSSION

9.1. Malaria Control in the Municipality

This was determined by a questionnaire, records review and by an informal interview with the Deputy Medical Officer of Health and the Chief Public Health Officer of the Council.

9.1.1. The Questionnaire to the Officer in-Charge of CDC

The results obtained are shown in Table 6 From the table, it is evident that 83.3% of the budget allocated for anti-malaria drugs was used for that purpose in 1975. In the same year only 6.7% of the personnel were actually involved in the treatment and prophylaxis of malaria. Although there was a total of 5 hospitals within the Municipality, none of them were directly under the Council.

During the same period, there were a total of 18 health centres and dispensaries. Of these, only 7 were directly under the Council.

The rest were run by non-governmental organisations (NGOs) like the Aga Khan Foundation and others. All health centres offer curative services, MCH and family planing services.

From the same table, it is evident that there was an over expenditure of £2742 of the budget allocated for antimalaria drugs in 1985. It is difficult to

explain why there was an over expenditure since there was no epidemic of malaria recorded during that year under which circumstances more drugs would be needed. In 1985, the total personnel involved in malaria control had increased by 8.4% out of which 7.0% were involved in malaria treatment and prophylaxis.

No money was received specifically for antimalaria drugs during the two periods. By the same year, the number of hospitals had increased to 7 and the health centres and dispensaries had increased to 34, a 30.8% increase. None of the 7 hospitals was directly under the Council. The current antimalaria activities were geared to the control of the mosquito vector and treatment of malaria cases to control the spread of the parasite. Health Education, an important aspect in changing peoples' knowledge and attitudes, with the hope of modifying their behaviour patterns, was not included as one of the current antimalaria activities. Chemoprophylaxis in children aged 1 day-6 years and pregnant mothers is an important aspect of malaria control in the Council. However, realising that chloroquine-resistant Plasmodium falciparum parasites are on the increase, the malaria Programme Committee of the Kenya Medical Research Institute has recent come up with some recommendations regarding the use of chloroquine as a first line drug in the treatment of malaria and also for chemoprophylaxis (unpublished, MRC Nairobi).

recommendation is that chloroquine remains the drug of choice in the treatment of malaria except in special defined cases. Secondly, Chemoprophylaxis should be given only to specific groups, which are:

a) Persons with underlying diseases making them susceptible to severe or complicated malaria e.g., sickle cell disease.

b) Pregnant women, especially in their first pregnancy.

c) Non-immune persons temporarily visiting malarious areas. (unpublished data, MRC Nairobi).

These groups exclude children under 6 years who live in malarious areas.

Should the Council adopt this new chemoprophylaxis scheme, it requires to have a record of all visitors and their places of origin, and a good medical history for those with other diseases that make them liable to infection with malaria.

With the above information, the Council will have to revise its chemoprophylaxis scheme.

Records Review

9.1.2 The Council makes practical recommendations during its annual general meetings. However, very few, if any, of these control measures recommended are actually carried out. One clear reason is lack of finance. Another reason could be that the personnel allocated to the various duties do not take them seriously and unless under strict

supervision, these do not reach their respective working stations. Most of the personnel are not trained on the job and so some lack the qualifications required for those jobs.

From the records, it was observed that only prior to presidential visits is any serious work done. Some recommendations are made over and over again and are never implemented. One such, is the destruction of floating Islands. Floating Islands comprise of papyrus reeds and mud. These come between April and August having travelled from as far as Tanzania or Uganda. Mosquitoes breed in these and are therefore brought to shore. To avoid this, the island should be destroyed before landing on the shore.

The grant from the DVBD ceased in 1980. There is no clear record to show how this money was spent as it was clearly designated for drain construction and maintenance.

A wall was also supposed to be built on the lakeshore to minimise swamps when the lake level rises during the rains. This wall to date has not been built. This may be due to both lack of funds and lack of engineering knowledge. Manpower development in the Council is poor. One reason is that the staff are relatively few and may not even be granted study leave. The other reason could be lack of motivation should the money be available for further training.

There is no research going on in the Council, but then the Council lacks the equipment and facilities. There is no laboratory belonging to the Council.

Although there is a "Malaria Eradication" Committee, the composition of the members leaves a lot to be desired. One would expect all governmental sectors relevant to the control, and possibly eradication, of diseases, to be included. This committee comprises only of medical personnel apart from the DC, who is the Chairman of the Committee. Malaria control, and possibly eradication, requires participation of all governmental sectors so that there is inter-sectoral collaboration as is outlined in the district focus for rural development. One would suggest here that the members be more or less like those on the DDC (District Development Committee). Considering that the Council has no external aid, the Ministry of Transport and Communication would fill up potholes on the roads while the Ministry of Housing and Physical Planning would rebuild the lake wall. The "Malaria Eradication" Committee, having formulated its objectives, should ensure their implementation as soon as possible and outline how these will be evaluated. A Surveillance System must be well defined right from the start.

9.1.3. Budget Review for 1976

It is evident here that from the budget for malaria control, only 12.3% of it was actually spent on malaria control. The rest went to the staff for various claims. This agrees well with what was observed in Mombasa Municipality that out of £100,000 set aside for malaria control, only £20,000 (20%) of it was actually used for that purpose. The rest were used for staff salaries and benefits. Similarly, in Kisumu Municipality, out of £23,677 allocated to malaria control in 1979, only £1,842 (7.8%) was actually spent on antimalaria activities. Again, the rest was spent on staff salaries and allowances.(7)

From this observation, it could be appropriate for the councils to set aside, in their budgets, separate allocations for staff salaries and malaria control. This is what was done in Mombasa in 1984. (6)

The total budget for the Council was £1,638,205 out of which £161,925 was allocated specifically for mosquito control.

9.1.4. The Informal Interview

Most of the information from the interviews conducted has already been discussed under the records review. Both the Deputy MOH to the

Council and the Chief Public Health Officer felt that they were unable to meet most of the expenses for malaria control because the revenue to the Council is inadequate since this co vers many other areas. They generally felt that they are succeeding in the control of malaria because school attendance by pre-primary school children is good and yet these have not developed immunity to malaria.

Another constraint that was stressed was lack of communication between the Council and other bodies carrying out malaria control measures. If there is no communication then the same work could be done by all bodies concerned. One would agree with the council here that communication is vital for the success of malaria control, so that if the DVBD was involved in research work, the district hospital could take on the curative services, while the council took on measures to control the mosquito vector-preventive measure s. The vector biology and control Research centre of the Kenya Medical Research Institute in Kisumu coul in turn find out, through research, the cheapest and most effective way of controlling the mosquisto vector. All methods recommended must be easy to apply.
The Council could also intensify Health Community Participation in malaria control.

9.1.5. Conclusion

All recommendatisons put down by the Council for malaria control are beneficial if implemented. These measures will go a long way towards controlling malaria. The Council is doing its best but the rate of population growth far exceeds the Council's staff growth and other essential resources. The population of the old town is growing at an alarming rate (Refer Chap. 4, p. 15). Although the Council's services have not expanded, the services are now extended to Manyatta and Nyalenda Sub-locations only, which are close to the old Municipality bordering the old town. Kisumu town is the most important centre for all activities in the Western region of Kenya. With migration in and out of the area, malaria control to a level that the disease is not transmissible is impossible. Infection control can be effected, however, with a little more effort in case finding and treatment.

In Brazil, a malaria control programme was set up in the Amazon Region and was later evaluated.(14) One major constraint in the Brazilian control Programme was found to be inaccessibility of some areas. This is also true of some areas within Kisumu Municipality notably in its extended areas. Another obstacle was found to be dispersion of the population and continuous migration of people all year round in search of work. Mosquitoes also developed resistance to the insecticide used.

The Brazilian Programme comprised of twice a year house sprays, treatment of all persons with fever, blood tests for malaria and health education. In the Kisumu Municipal Council, very little health education is given to the people. This would go a long way in educating the population, especially school children, to be responsible for their own health. This is the basis of community participation in attaining health for all by the year 2,000. The formation of the "Malaria Eradication" Committee was timely and called for. However, as already stated, membership to this committee should be revised so that all necessary departments are included. The recommendations made by the Committee are beneficial and one would hope that they will be implemented soon. One important aspect that the Committee has brought out, which the Council omitted is health education to the people. Adults are usually not ready to learn unless they are motivated. The target group here then, would be primary school children. Adults can, however, be taught about the Public Health Act[15] and the Malaria Prevention Ordinance (1962)[16], of the Kenya Laws. Most people seem ignorant about these laws and the sentences imposed should one break them. In the Public Health Act, residents are responsible for their own environmental sanitation, and premises should be kept free from anything that will cause the breeding of mosquitoes. Should such places occur, then the occupier of the premises shall be

liable to imprisonment or a fine.

9.2. The KAP Survey

In the analysis of this survey, variables pertaining to the knowledge, attitudes and practices of the respondents were compared by level of education of the respondent. The majority of the people had at least primary education as can be seen on Table 7 . 56.4% people out of 316 people had Primary education. This was true also for the three study areas taken separately.

9.2.1. Knowledge

In all areas, many respondents associated malaria with mosquitoes, 76.6% overall and 56.2% for Upper Railways Estate, 96.1% for Nyalenda, 90.5% for Mkendwa. In Upper Railways Estate, the majority of respondents were either house/girls or sub-tenants and this could explain the low figure of 82 persons associating malaria with mosquitoes.

A few people (4.8%) associated malaria with environmental factors such as "stagnant water", "change of climate" or "rains". The knowledge of the respondents on the association between malaria and mosquito was high. When the level of education was cross-tabulated with the

answers to "causes of malaria," the association is statistically significant. Similarly, 94.9% of all respondents were able to diagnose malaria by at least one symptom. All respondents in Nyalenda were able to give the correct symptoms for malaria.

There is a highly significant association between the level of education and the ability to diagnose malaria. The respondents' knowledge on prophylaxis against malaria was very poor. Although the majority (71.5%) said they take prophylaxis, only 10.8% of them knew that it is taken weekly. Only 24.7% took chloroquine for prophylaxis and still only in 112 did all family members take prophylaxis. The majority however, (52.8%) took medicine for prophylaxis only when sick.

It is clear here that the people do not know who should take prophylaxis and when. The majority of them also do not know what should be taken.

From the above, it appears that the knowledge of malaria in this population is high. The people here know that the mosquito is the vector and they are able to recognise the symptoms of malaria. It appears from the statistical analysis that the level of education influences the *knowledge of the people about malaria. They should,* however be taught about prophylaxis so that they know what to take and when.

9.2.2. Attitudes

Here, the people's attitude towards the government's efforts to control malaria were assessed. 60.4% of the respondents thought the government was taking some action. However, in Mkendwa 66.7% said the government was not taking any action to control malaria. In Nyalenda, half the respondents thought the government was not taking any action, while the other half thought in the affirmative. 80% of respondents in Upper Railways Estate thought the government was taking some action. The latter can be explained in that the Railways Corporation does clear bushes around their estates, maintain drains and occassionally spray the compounds. There was no statistical association between the level of education and the answers given to the question of whether there is any action being taken by the government to control malaria. The respondents were asked about the action the government took. Only 36.4% said the government provided free medical services. Only 20.3% said the government was controlling the spread of diseases. Only in Upper Railways Estate and in Nyalenda did respondents say that their compounds have been sprayed. In Nyalenda, the Council had held a malaria control week

in September where bushes were cleared, garbage collected, stagnant water drained and houses sprayed. This is likely to be the reason that 89% said the government had sprayed their compounds. In Mkendwa, 81% of the respondents had never had their compounds sprayed.

From the above, it is evident that the study population's attitude towards the government's efforts to control malaria is very poor. Very few of the respondents were aware that the government provides free medical care to all. This is supported by the answers given when the respondents are asked what they think the government could do to better protect them against malaria. The responses are given in Table 12, p.44. From this table, 40.8% of the respondents thought the government should improve their environmental sanitation. Here, answers like "improve drainage system", "drain stagnant water", "clear bushes", "spray compounds" and "bring clean water close to the people", were included. 76.6% of the respondents in Nyalenda gave the same answer. 36.3% of the respondents in Upper Railway Estate thought the government should provide enough drugs for treating malaria, and 69% of the respondents in Mkendwa thought the government should bring medical services close to the people or increase Mobile Clinic visits. A few respondents (11.7%) thought the government should intensify health education and Inspection Campaigns while others thought that all

possible methods should be used to control malaria- (2.5%). 16.8% of the respondents did not know what the government should do.

From the above, the attitude of the study population is that the government is responsible for their health and so should undertake all possible measures to better their health This is wrong and should be discouraged. Health education campaigns will go along way here in changing people's attitudes towards the maintenance of their own health.

9.2.3 Practices

93% of all respondents practised correct measures to protect themselves against mosquitoes. Correct measures here included, using bed nets, insecticides, mosquito coils, clearing bushes and draining stagnant water. All respondents in Nyalenda practised correct measures. 1.3% of the respondents took no action, and 4.7% used the wrong measures such as good diet, blankets, sheets and closing doors and windows early (Table 11).
When the level of education was cross-tabulated against these answers,there was no statistical association between the two. This means that the level of education did not influence what the respondents did to protect themselves against mosquitoes. When a member of the family was suspected to be suffering from malaria, 51.3% respondents either bought medicine from a shop

or went to hospital This was true for Nyalenda with 71.1% of the respondents doing so. In Mkendwa 62% went to hospital when ill and 51.4% in Upper Railways did the same.

9.2.4 Other Information obtained from the Questionnaire

The respondents were also asked about the presence of health workers in their areas. Only in Nyalenda did a significant number (84%) say there were. These health workers taught the people the health aspects of life and even did some health inspection. The respondents also thought that the health workers were effective. This explains why in Nyalenda all the respondents knew the symptoms of malaria and more than half the respondents gave prophylaxis to all family members. The knowledge of the respondents here as to what is taken was poor. The majority took analgesics for prophylaxis against malaria. The reason there are health workers in Nyalenda is that this area is a peri-urban slum and a number of non-governmental organisations have various projects here. Mkendwa is away from the main town. Transportation to this sublocation is therefore difficult.

The total number of sleeping rooms per household was dependent on the area as was shown by significant X^2. With the exception of areas where the full house was only one room, it was difficult to ascertain as to whether the reported number of

sleeping rooms were actually correct.

9.3. CLINICAL AND PARASITOLOGIAL SURVEY

Malaria is endemic in many parts of Kenya with the degree of transmission ranging from holo-endemic to no transmission. Vogel et al (1974)[17] described epidemiologically, transmission levels in some parts of Kenya. Kisumu District was classified under holo-endemic together with the Coast Province and Tana River District.

From Table 15 the parasite rate for all areas combined was found to be 21.5%. This agrees with a parasite rate of 22% from a study done in 1983 by the DVBD among nursery school children within the Municipality (ages less than 6 years). The parasite rate among school children during the same period was found to be 32.1% (unpublished DVBD date). The parasite rate for Mkendwa was 10.5% which agrees with the prevalence found in 1983 of 10%; 13.7% for Upper Railways Estate which had previously had a prevalence of 0.0%, and 38.1% for Nyalenda whose previous prevalence was 11%. The differences here could be due to the ages of the children studied. In this survey, the age 2-9 years was used. The DVBD staff studied pre-school children aged below 6 years. Immunity to malaria improves with age.

Another reason could be the timing of the study. This study was done shortly after the short rains.

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Another reason could be the timing of the study. This study was done shortly after the short rains.

The transmission of malaria is higher after the rains as there are more breeding places for A. gambiae.

All four species of human malaria have been reported in Kenya. The commonest species according to all reports is P. falciparum with a percentage frequency of up to 85%.(17)
In this study, P. falciparum accounted for 78.6% of all malaria infections. Mixed infections are excluded from this figure. In Mkendwa, P. falciparum accounted for 90.9% of the infections. This is shown in Table IX(d). There were no infections due to P.vivax; and P. ovale and P. malariae were responsible for very few infections, 1.4% and 11.4% respectively over all.

325 children aged 2-9 years were examined for splenomegaly. 13.85% of them were found to have enlarged spleens. The frequency distribution for spleen class by Hackett's Classification are shown in Table 16,a, b, c, d, for the three areas separately and for all areas combined. Vogel (17) and others described malaria in Nyanza Province as holo-endemic. This is equivalent to a spleen rate of 75% or greater in children aged 2-9 years. The spleen rate in this study population in children aged 2-9 years was only 13.85%. The reason here could be because of the lower transmission rates and the free drug use in the urban ecosystem. In Nyalenda, where half the sublocation is marsh and overgrown with reeds, the spleen rate was 27.1%. There was a significant association between the presence of malaria parasites

and splenomegaly. However, splenic enlargement was not influenced by parasite density.

There was also a significant difference in the observed prevalence of malaria by blood examination in the three study areas. There were far more children observed with positive slides in Nyalenda than in the other areas.

Comparisons were made between splenic enlargement in the three study areas. Highly significant differences were observed. Again, there were more children observed with splenic enlargement in Nyalenda than in the other two areas.

It can conclude then, that children in Nyalenda are more likely to be infected with malaria and to have their spleens enlarged than those in the same Municipality, living in Upper Railways Estate or Mkendwa.

The low spleen rate could be explained by the fact that most children in this area are treated with antimalaria drugs for many febrile illness as anti-malarials can be bought across the counter.

9.4 Entomological Survey

Human malaria is transmitted solely by anopheline mosquitoes. In addition to transmitting malaria, anophelines also transmit filariasis and some viral diseases.

In this survey, *An gambiae s.l.* and *An. funestus*,

the local transmitters of malaria, were studied.

9.4.1 Anopheles Gambiae

This is the most important malaria vector in Africa. It is a complex of at least six sibling species with marked differences in behaviour. Three of these sibling species are adapted to freshwater breeding sites; A.gambiae ss (species A), predominates in humid areas, is highly anthropophilic (preference for feeding on man) and an important vector of malaria; A. arabiensis (species B) found mainly in the savannah is also a good vector of malaria; the third A.quadriannulatus is mainly zoophilic and does not seem to be a vector.(15)
The two saltwater species A. meles of West African Coast and A. merus of East Africa coast, malaria vectors, depending on local conditions. They are mainly exophagic and zoophilic.

The Anopheles gambiae complex is widely distributed. It is robust and long lived, readily susceptible to infection and abundant. It commonly rests inside houses although it is easily driven out of doors. It bites at night in the houses but may bite outside in the cooler parts of Africa. During the cold season, it seems to disappear from its

limits of distribution.

The larvae are found in pools usually exposed to the sun. Larvae are more common in temporary pools than long standing ones. Breeding in rice fields and in swamps may occur. Owing to the nature of the breeding places, this species tends to be more numerous during the rainy season than in dry weather.

In this study, larvae of this species were collected in a temporary pool from human foot prints and animal hoof prints in one study area. Although larvae were collected from the swamps in Nyalenda, none of them belonged to this species.

9.4.2 Anopheles funestus

This vector is second only to An.gambiae s.l. as a vector of malaria in Africa. It is widely distributed and feeds mainly on man. It is also robust and long lived. It shelters almost exclusively in houses and is readily susceptible to infection.

This species also transmits filariasis and some viruses.

The larvae are commonly found in streams, preferably under shade; swamps; seepages, fallow rice fields and the grassy edges of rivers may be important breeding places. Whereas

A. gambiae s.l. is numerous following rains, A.funestus is numerous even during the dry season. Because of the variation in their breeding places, the one species takes over from the other as Chief vector when the season changes. A. funestus has a long flight range but its strong tendency to enter houses is less than that shown by A. gambiae s.l. A. funestus responds more readily to residual insecticides.

In this study, although adult A. funestus were collected in Nyalenda, no larvae were collected. Adult mosquitoes were found here owing to the presence of the lakeshore which is overgrown with reeds and weeds.

None of the adult mosquitoes collected had sporozoites in their salivary glands. This means that they were all non-infective. If oocysts had been looked for on the stomach wall, it would have been possible to tell which mosquitoes were infected. If the sporozoite rate is known and the average number of female anopheles found in a room or in a hut is known, the innoculation rate can be calculated. This is the proportion of the human population receiving an infective bite in a unit of time.

The adult mosquito densities found in this study are slightly higher than those found in a study done in Bandani Village in 1974.[19] In that study, the

densities were:

A. gambiae s.l. 3 per house

A. funestus 2 per house

In this study, the figures were 9 and 3 for A. gambiae s.l. and A.funestus respectively. These densities are for Nyalenda sub-location only. In Mkendwa sublocation, the density for A.gambiae s.l. was 0.5 mosquitoes per house. For Nyalenda, there was then a total of 12 mosquitoes per sleeping house. This density is influenced by rainfall, temperature and humidity. This survey was done following the short rainy season and this may account for the higher mosquito density in Nyalenda. Another factor here could be the relatively few houses that were selected for mosquito collection. Had these been more, the figure may have been different. In the houses selected there was an average of 5 sleepers per house. This agrees with what was observed from the KAP survey where the mode was 6 sleepers per house.

Ganharm (1928) found that for mosquitoes to be found in a house, the presence of people was necessary.(20) He noted that the entry time for male Anopheles into houses was between 5.00 a.m. and 6.00 a.m. and that the presence of fires in the houses kept mosquitoes away. Haddow (1941) found that the size of the human population had a profound effect on the mosquito population; the

the larger the human population, the larger the number of mosquitoes.[21] This means that large crowded communities in malarious areas are exposed to a high risk of infection. He observed too, that female Anopheles stayed indoors after feeding and males come in the early morning for shelter.

This may explain why the prevalence for malaria infection in Nyalenda is higher than in the other areas. Nyalenda is an over-crowded slum. This also explains why there were more mosquitoes collected here.

RECOMMENDATIONS

Malaria control programmes in most of Tropical Africa have been vertically oriented. These programmes are expensive as well as inefficient. These two factors have contributed greatly to the failure of controlling malaria transmission. New trends in agricultural exploitation and the distribution of rural populations are factors that have created new conditions for malaria transmission[22]. The migration of rural populations from the country side to cities has resulted in the growth of urban and peri-urban slum areas where makeshift housing favours malaria transmission. These areas develop a population density far greater than any rural areas, and this intensifies endemicity.

While mortality due to malaria may be declining, drug resistance is also developing and becoming widespread. The availability of drugs through commercial channels and the lack of adequate guidance on appropriate doses and treatment schedules favour the use of insufficient doses that relieve clinical sysmptoms but exert a high selection pressure for drug resistance. With this in mind, a few guidelines are given for the control of malaria in Kisumu Municipality, which are in conformity with the WHO recommendations.

1. Health Education

For any country to have provided health for all by the Year 2000, it was recommended in the Declaration of Alma-Ata in 1978, that the community must participate fully in the process of improving their own health[23]. For any community to participate, they must be provided with the education concerning the prevailing health problems and the methods of preventing and controlling them. It is usually difficult to change the attitudes of adults. Children, however, can be taught on health and its relating matters. This will not only give them knowledge on health matters but will shape their attitudes and provide the simple skills needed in taking care of their own health. Health Education should therefore be introduced in the school curriculum. Children tend to practice what they learn. Health education can also form part of the curriculum of adult literacy classes. With time, the adults will put into practice what they learn

The knowledge of the residents in Kisumu Municipality on malaria as a disease problem is high. However, their attitude towards maintaining their own health is poor Health education here will point out to them the importance of taking care of one's own health. This will also provide the necessary skills that are simple enough for this community to practice. Health education is also a tool which can be used to teach the community on Kenyan Laws governing health, such as the Public Health Act[15] and The Malaria Prevention Ordinance (1962).[16]

2. Community Participation

The Alma-Ata Declaration[23] defined community participation as "the process by which individuals and families assume responsibility for their own health and welfare and for those of the community and develop the capacity to contribute to their community development." Vector Control is an integral part of the prevention and control of some locally endemic diseases, in this case the mosquito and malaria. The bite of a mosquito is irritating and this can be used to motivate the community to participate in activities that will put an end to these bites.

To set up vector control activities the affected community must be involved in the decision making[24]. The activities must also conform with the community's life style, as usually, it is difficult to change the life styles of adults. Most urban communities are not homogenous. Informal group leaders should be recognised by the health authorities and be used in the planning, organizing and operating the control programmes. This will require the decentralization of many decisions to an intermediate level of the health services, as well as increased involvement of local and intermediate level administrations in planning at all levels.

To achieve malaria control within the Primary Health Care system the support of the health services will

be required. Short, medium-, and short-term objectives for malaria control must be clearly defined. A more collaborative relationship between the health service and the community will require major changes in the attitude and approach of health service workers to the community and to the individuals.

3. Inter-Sectoral cooperation

For antimalaria action to be implemented effectively within the context of Primary Health Care, support from health related sectors is necessary. The Primary Health Care strategy clearly identifies intersectoral cooperation for health as one of its major components. Community participation cannot be relaised with health education alone, but by incorporating health related activities into the individual's daily activities; so that a health education programme is introduced on the Voice of Kenya radio, therefore involving the Ministry of Information and Broadcasting. Health Education to school children and in adult literacy classes will involve the Ministries of Education and culture and social services. The Ministry of Agriculture will be involved when setting up Irrigation Schemes and Dams so that these are sited away from residential areas. The Ministry of Housing and Physical Planning will provide the technical knowledge and skills in constructing houses that do not encourage over-crowding, the planning of urban estates and can even assist in re-building the lake wall. The Ministry of Transport and Communication can be

consulted in the construction and maintenance of roads. This is the reason why the members of the Malaria Eradication Committee have to come from all sectors. Cooperation not only reduces expenses but also the need to employ or hire skilled labour for drain construction and maintenance, and other such activities.

4. A good Information system

In order that intersectorial cooperation works, a good information system is necessary. This will facilitate communication between the various sectors and also between the council and the community, and between individuals within the community.

An information system is also necessary in malaria control for both evaluation of the control programme and surveillance. Evaluation has been defined as "the process of collecting information and reaching a decision about the value of a project, course programme, book, etc[25]. It is a systematic way of learning from experience and using the lessons learned to improve current activities and promote better planning by careful selection of alternatives for future action. This involves a critical analysis of different aspects of the development and implementation of a programme and the activities that constitute the programme, its relevance, its formulation, its efficiency and effectiveness, its costs and its acceptance by all parties involved. The

purpose of evaluation in health development, therefore, is to improve health programmes and the services for delivering them, and to guide the allocation of human and financial resources in current and future programmes and services. Evaluation should therefore be used constructively as a tool for decision-making both at policy and the operational levels. It is therefore a continuous process. Indicators and criteria for evaluation should be clearly defined from the beginning as these are used throughout the process.

Surveillance in malaria eradication terminology, has been defined as "..... that part of the programme aimed at the discovery, investigation and elimination of continuing transmission, the prevention and cure of infections, and the final substantiation of claimed eradication. The individual functions of surveillance are antimalarial drug treatment, epidemiological investigation, entomological investigation, elimination of breeding foci, case follow-up and community follow-up."(8) Surveillance therefore, is putting a condition under observation.

In malaria control programmes, an efficient reporting system is necessary and should be tailored to meet the needs of the area. The information collected must be consistent and valid for both evaluation and surveillance.

5. Manpower Development

Manpower development must be encouraged so that research into new methods of controlling malaria and the mosquito vector in the local setting, can be undertaken. Collaboration between the council, the Ministry of Health and the centre for Vector Biology and control of the Kenya Medical Research Institute, is necessary for manpower development. Staff from the Council may go to DVBD or VBCR for training or to participate in Seminars and Workshop that enhance their knowledge and improve their skills.

It will also be necessary to train some informal leaders in simple skills which they can, in turn, teach individuals in the community. Manpower development may be very expensive at 'first but in the long run, malaria control will not be too expensive.

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APPENDIX I

A. QUESTIONNAIRE TO HEALTH AUTHORITY

NAME OF RESPONDENT.....

POSITION ..... QUALIFICATIONS.....

DATE: .....

1. List current anti malaria activities in your Municipality

(i) .....

(ii) .....

(iii) .....

(iv) .....

(v) .....

(vi) .....

(vii) .....

1. CHEMOTHERAPY

(1) What was your budget allocated for the purchase of Chemotherapeutic drugs?

(a) In 1974 - 5? .....

(b) In 1984 - 85? .....

(2) What were the total resources received for malaria Chemotherapeutic drugs in

(a) 1974 - 5? .....

(b) 1984 - 5? .....

(3) How much did you actually spend on malaria Chemotherapeutic drugs purchased in

(a) 1974 - 5? .....

(b) 1984 - 5? .....

11. PERSONNEL

(4) What was the total number of personnel involved in anti malaria activities in

(a) 1974 - 5? .....

(b) 1984 - 5? .....

(5) How many of your employees were actually involved in Chemotherapeutic activities in

(a) 1974 - 5? .....

(b) 1984 - 5? .....

111. ESTABLISHMENTS (in capital letters please).

(6) How many Health Centres and/or hospitals are within your Municipality? (include private and government).

	Hospitals	Health centre/dispensaries
(a) 1974 - 5	.....	.....
(b) 1984 - 5	.....	.....

(7) How many of these were under your Municipality

(a) 1974 - 5?

(b) 1984 - 5?

1V. CHEMOPROPHYLAXIS

(8) Do you give Chemoprophylaxis against malaria in your health units?

Yes ...____...

No ...____...

Don't know ...____...

(9) To whom do you give chemoprophylaxis?

(10) Do you think you are succeeding in controlling malaria?

Yes ...___...

No ...___...

Don't Know ...___...

(11) Why do you think so? .....

APPENDIX 2

HOUSEHOLD QUESTIONNAIRE

B: AREA: .....

Household No.

Interviewer: .....

Date: .....

Head of household .....

1. Age: 2. Sex: M F

3. Education:

a) None ...___...

b) Primary ...___...

c) Incomplete Secondary ...___...

d) Complete Secondary ...___...

e) Post Secondary (other training) ...___...

f) University ...___...

4. Occupation:

a)

b) Total Annual Income Kshs. or K£ .....

5. What are the main problems you experience as a

a) Family

b) Community

6. What are the main health problems you experience in this area?

a) Diarrhoeal diseases ...___.. .

b) Malaria ...___...

c) Measles ...___...

d) Intestinal worms ...___...

e) Fever ...___...

f) Other (specify) ...___...

7. What do you think causes malaria?

8. How would you know when a member of your family is suffering from malaria?

9. What do you do to protect yourself from mosquitoes?

10. What do you do when you suspect a member of your family to have malaria?

a) Go to hospital ...___...

b) Go to herbalist ...___...

c) Buy medicine from shop ...___...

d) Consult a friend ...___...

e) Other (specify) ...___...

11. Is the government doing anything about the problem of malaria?

a) Yes ...___...

b) No ...___...

c) Don't Know ...___...

12. If yes, what is the government doing?

13. a) Has the Urban Council ever sprayed your house or compound?

a) Yes ...___...

b) No ...___...

c) Don't Know ...___...

b) How often if ever?

14. (a) Do any of your family members take prophylaxis against malaria?

Yes ...___...

No ...___...

Don't Know ...___...

(b) If yes, how many of you?

15. a) What do they take?

b) Where do they get it from?

c) Who gives it to them, if children?

16. How often do they take prophylaxis?

17. What do you think the government or council could do to better protect you and your family from malaria?

18. Do you have community health workers in your area?

Yes ...___...

No ...___...

Don't Know ...___...

19. What do they do?

20. How effective do you think they are?

a) Very effective ...___...

b) Effective ...___...

c) Not effective ...___...

d) Don't Know ...___...

21. House

a) Permanent ...___...

b) Semi permanent ...___...

c) Temporary ...___...

d) Wooden ...___...

e) Other ...___...

22. Ceiling

a) Present ...___...

b) Absent ...___...

23. Total number of sleeping rooms

a) 2 ...___...

b) 3 ...___...

c) 1 ...___...

24. Total number of people in household .....

25. Record state of compound around house.

APPENDIX 3

SPLEEN SIZE: BLOOD SLIDES

AREA .....

Household No Interviewer No. .....

....._____.....

Head of household .....

Date .....

Child No. ....._____.....

1. Sex M....._____..... F ....._____.....

2. Age

3. Spleen size 0 ....____....

1 ....____....

2 ....____....

3 ....____....

4 ....____....

5 ....____....

4. Has the child been treated with chloroquine within the last two weeks?

Yes ...___...

No ...___...

Don't Know ...___...

5. Blood slide Positive ...___...

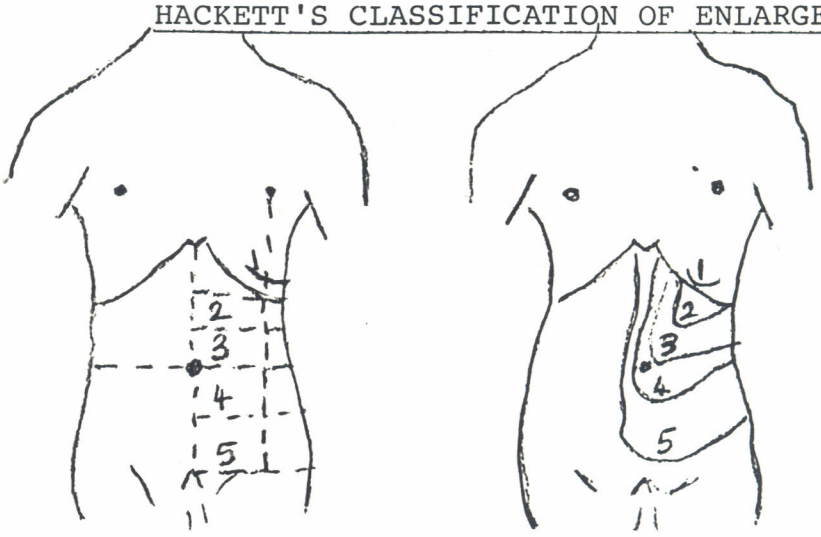
Negative ...___...

6. Parasite count/3000WBC

7. Parasite species a) P. falciparum ...___..
b) P. Malaria ...___..
c) P. Ovale ...___..
d) P. Vivax ...___..
e) Not identified ...___...

APPENDIX 4

HACKETT'S CLASSIFICATION OF ENLARGED SPLEENS



CLASS	DESCRIPTION
0	Normal spleen not palpable even on deep inspiration
1	Spleen palpable below the coastal margin on deep inspiration
2	Spleen palpable below the coastal margin, but not projected beyond a horizontal line half way between the coastal margin and the umblicus, measured along a line dropped vertically from the left nipple.
3	Spleen with lowest palpable point projected more than halfway to the umblicus but not below a line drawn horizontally through it.
4	Spleen with palpable point below the umblical level but not projected beyond a horizontal line situated half way between the u mblicus and the symphisis pubis.
5	Spleen with lowest point palpable beyond the lower limit of class 4.

APPENDIX 5

CODE BOOK FOR KAP SURVEY

	VARIABLE	VARIABLE NAME	NUMBER
2.	Sex	Sex: Male	1
		Female	2
3.	Education:	Education:	
		None	1
		Primary	2
		Secondary+	3
4.	Occupation	Occupation:	
		Unemployed/Housewife	1
		Employed	2
		Business	3
		Child	4
		Student	5
		Farmer	6
		No response	9
5.	(a) Family Problems	F'Problems:	
		Financial	1
		Diseases	2
		None	3
		Environmental	4
		Mosquitoes	6
		No response	9
	(b) Community Problems	Com. Problems:	
		None	1

VARIABLE	VARIABLE NAME	NUMBER
	Diseases	2
	Environmental	3
	Mosquitoes	4
	No response	9
6. Main Health Problems	Mhprobp	
	Diarrhoeal disease	1
	Malaria and fever	2
	Measles	3
	Other	
7. Malaria causes	MalCause:	
	Mosquitoes	1
	Environmental factors	2
	Other	3
	Don't Know	
8. Malaria diagnosis	KnMal:	
	Correct symptom	1
	Wrong symptom	2
	Don't Know	9
9. Protection Against Mosquito	Protmos:	
	Correct measures	1
	Wrong measures	2
	Nothing	3
10 Action Against Malaria	Action:	
	a) Go to hospital	1
	b) Buy medicine	2
	c) a § b	3
	d) Others	4
	e) No response	9

VARIABLE	VARIABLE NAME	NUMBER
11. Government Action Against Malaria	G action	
	Yes	1
	No	2
	Don't Know	3
12. What Government Action	Y Action	
	Free medical services	1
	Control diseases	2
	Health education	3
	Don't Know	9
13. (a) Compound spray	Spray:	
	Yes	1
	No	2
	Don't Know	3
(b) How often	Often:	
	Occassionally	1
	During malaria outbreak	2
	Monthly	3
	Never	9
14.(a) Prophylaxis taken	Prophy:	
	Yes	1
	No	2
	Don't Know	9
(b) How many of you	Y Many:	
	Only the sick	1
	All family members	2
	Some members	3
	Children only	4
	None	9

VARIABLE	VARIABLE NAME	NUMBE
15. (a) What is taken	Take:	
	a) Chloroquine	1
	b) Painkillers	2
	c) Any medicines	3
	d) a and b	
	e) Don't know	9
15. (b) Where is medicine from?	Where:	
	a) Hospital	1
	b) Shop	2
	c) a and b	3
	d) Don't know	9
(c) Who gives medicine to children?	Who:	
	Parents	1
	Guardian	2
	Themselves	3
	No response	9
16. How often is prophylaxis taken?	Protaken:	
	As told by doctor	1
	When sick	2
	Weekly	3
	As desired	4
	Don't take	9
17. What Government protection against mosquitoes	G Protect:	
	Provide enough drugs	1
	Environmental intervention	2
	Medical services close	3
	Health edu. and inspection	4

VARIABLE	VARIABLE NAME	NUM
	All possible methods	5
	Don't Know	9
18. Health Workers' present in Area	H Workers:	
	Yes	1
	No	2
	Don't know	9
19. What do they do	What do:	
	Health edu. § Inspection	1
	Clean § spray compound	2
	Provide treatment	3
	Don't Know	9
20. How effective are they	Effect:	
	Very effective	1
	Effective	2
	Not effective	3
	Don't Know	9
21. House structure	HStruct:	
	Permanent	1
	Semi permanent	2
	Temporary	3
	Not recorded	9
22. House Ceiling	HCeil:	
	Present	1
	Absent	2
	Not recorded	9
23. Total sleeping rooms	Sleep:	
	One	1
	Two	2
	Three	3
	Four+	4

VARIABLE	VARIABLE NAME	NUMBE
24. Total number of sleepers in house	P House:	
	1 - 5	1
	6 - 10	2
	11 - 16	3
25. State of compound	STA Comp:	
	Clean	1
	Unclean	2
	Not recorded	9

APPENDIX 6

PYRETHRUM SPRAY-SHEET COLLECTION

LOCATION..... AREA .....

DATE OF COLLECTION .....

NO. OF HOUSES	NO. OF SLEEPERS		AN. GAMBIAE S.L					AN. FUNESTUS					CULICINES		
	ADULT	CHILD	MALE	UNFED	FED	GRAVID	TOTALS	MALE	UNFED	FED	GRAVID	TOTAL	MALE	FEMALE	TC
1															
2															
3															
4															
5															
6															
7															
8															
9															

Densities: An. gambiae per house .....
An. funestus per house .....

SALIVARY GLAND DISSECTION TO DETERMINE SPOROZOITE INFECTION

ANOPHELES SPECIES	NUMBER DISSECTED	NUMBER +VE	NUMBER -VE	% +VE
AN. GAMBIAE				
AN. FUNESTUS				

APPENDIX 7

CLASSIFICATION OF ENDEMICITY OF MALARIA

1. Hypoendemic Malaria: Spleen rate in children (2-9 years) not exceeding 10%.
2. Mesoendemic Malaria: Spleen rate in children 2-9 years) between 11% and 50%.
3. Hyperendemic Malaria: Spleen rate in children (2-9 years) constantly over 50%. Spleen rates in adults also high (over 25%).
4. Holoendemic Malaria: Spleen rate in children (2-9 years) constantly over 75%, but spleen rates in adults low.