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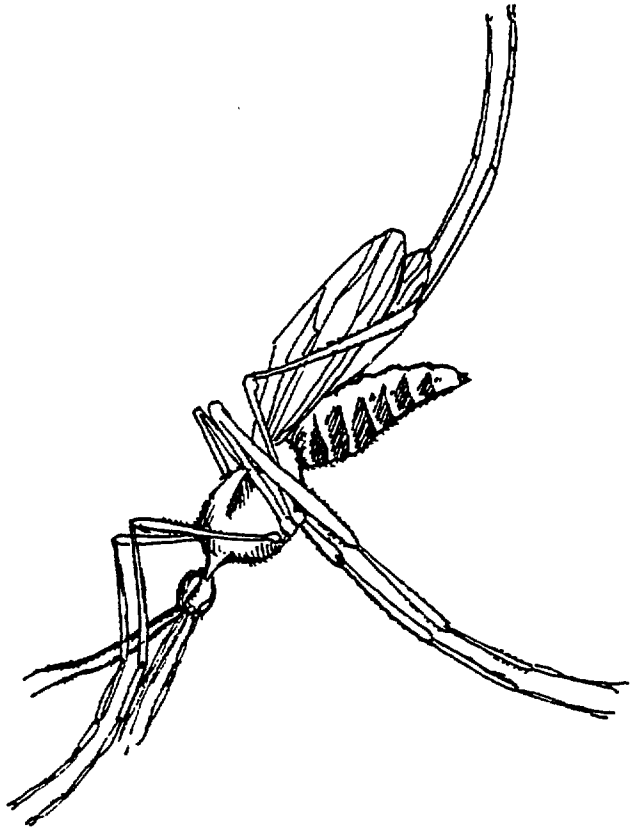
BAGAMOYO BEDNET PROJECT



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ANNUAL REPORT OCT 1990-SEPT 1991.

BAGAMOYO BEDNET PROJECT.

EXECUTIVE SUMMARY

The Bagamoyo Bednet Project was initiated by AID/AFR on 1 October 1990 and approved for four years at an initial level of $2 million. It is a joint collaborative effort on the part of Johns Hopkins University, School of Hygiene and Public Health, Baltimore and the Muhimbili Medical University, Insitutute of Public Health, Dar es Salaam to introduce insecticide impregnated bed nets to a community of about 25,000 people in coastal Tanzania to reduce malaria transmission.

The project has procured vehicles, office and laboratory space as well as laboratory equipment and supplies and has employed a number of staff who have now been trained. It has carried out local public relations work so that the project personnel are locally known and accepted, and social science studies to determine local perceptions of malaria and other similar diseases. It has completed mapping and census taking of all 13 villages so that proper malaria measurements can be carried out and that the actual requirements for nets is known. It has completed a malaria prevalence survey in primary school children which shows that malaria infection ranges from 50-82%. The mosquito population is being studied and shows high infectivity rates.

Processes of communication at the grassroots level are being developed and will be used to inform people about the importance of treated mosquito nets, and their role in malaria prevention. Following this nets will be sold to the public and conditions for local sustainability will be assessed. Presently the indications are that the intervention will be well received even if people have to pay.

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BAGAMOYO BEDNET PROJECT.

1. Introduction:

Malaria continues to be the most serious public health problem in Tanzania. This disease has a wide range of health impacts, especially on women and children. The last decade has seen further deterioration in the malaria situation in Tanzania as a result of spreading resistance to chloroquine, a drug which has been the foundation of malaria control efforts at the village level. It continues to be a major cause of infant mortality, particularly in the costal hyperendemic areas. In addition it is an important cause of stillbirth and spontaneous abortion and a contributing factor to Tanzania's high rate of maternal mortality. A recent UNICEF report (Women and Health in Tanzania, 1990) states "women in Dar es Salaam show an extremely high rate of anaemia, rising over the past few years with increasing problems of malaria" and that "there is increasing evidence that nutritional anaemia is much less of a problem than malaria related conditions" (MOH Report: Maternal Health in Tanzania, July 1990). Although malaria takes its severe toll on adults, attacks of malaria are even more serious for young children than for adults. The number of malaria cases admitted to the paediatric ward of the Muhimbili Medical Centre rose from 750-900 in 1976-77 to over 2,800 in 1987/8.

The use of insecticide impregnated bednets appears to be the only realistic intervention to control malaria and prevent serious illness where chloroquine resistant Plasmodium falciparum is endemic. Evidence from small scale or experimental projects continues to be favorable, but the Bagamoyo bednet project is the only major community based intervention which realistically looks at the major problems of local distribution of nets and sustainability of the intervention, as well as measuring the direct impact of bednet use on transmission and incidence of infection.

The Bagamoyo Bed Net project has had considerable achievements over the past year. The foundation had now been laid for the intervention to start. Almost all the work being done now is innovative without any models to follow. We are, however, proceeding with caution and carefully examining data as it is collected so that the necessary adjustments can be made to the implementation plan. The staff are well motivated, hard working and have excellent supervision in the field

2. Initiation.

The project was initiated on 25 Sept 1990, and recruitment of staff and procurement of supplies was started soon after that date. In spite of the crisis in the Persian Gulf and the war which ensued it was possible to procure, load and ship to Dar es Salaam a container load of supplies to that filed operations could commence by March 1991. Local staff were recruited, and in November the project was initiated by a workshop held in Dar es Salaam which was opened by the USAID Mission Director, Mr. Joseph Stepanek. The workshop was organized by Drs. Japhet Minjas and George Lwihula from the Muhimbili University College in collaboration with project staff Drs. Pros Lubega and Peter Winch. (Background paper for workshop: Annex 1A; Workshop Report: Annex 1B).

The workshop was an opportunity for researchers with different disciplinary perspectives to share their views, as well as to clarify the objectives and methodology of the social science/health communication component of the project.

3. Management

Initially the project was managed jointly by the Institute for International Programs and the Department of Immunology and Infectious Diseases at Johns Hopkins University, however in order to simplify administrative procedures, management of the project was consolidated within the Department of Immunology and Infectious Diseases. This also ensured greater accountability to the principal investigator. Monthly expenditure statements are on hand and a good analysis of financial obligations are available on request.

Management of the Muhimbili Medical Centre sub-contract is in the hands of the Muhimbili accounts department. All work is manual and slow, however, the accounts are well managed and full expenditure reports are submitted quarterly to the Johns Hopkins University. Now that the majority of the staff have been employed, monthly pay sheets and estimates of expenditure are developed by Dr. Lubega, submitted for approval to Prof. Minjas and one check is drawn. The project has a bank account in Bagamoyo which is then used to pay local salaries and costs. All expenditure is reconciled against signed receipts.

Communication with Tanzania is difficult and time consuming. The Medical Centre has a FAX machine, but it is difficult to transmit messages due to poor telephone lines. Telephone calls are used when possible, Dr. Lubega, Prof Minjas and the Project house in Dar have phones and sometimes one can get a clear line. All material is sent by DHL, which takes about a week and is expensive but reliable. Telephoning from Tanzania to the United States is prohibitively expensive and is used as little as possible.

4. Procurement of commodities and start of field activities

Vehicles were imported and arrived during late February and early March. The vehicle and the container full of supplies were cleared through customs by Muhimbili Medical Centre staff with reasonable efficiency. As per the project agreement, all items were landed duty free and are in air conditioned storage until required for the project. A laboratory, a suite of offices and a store room are being constructed by Muhimbili and are now almost ready for occupation. In the interim, project staff have been operating from adequate if cramped facilities in the Department of Medical Entomology.

As from 1 April the project took up its field accommodation in Bagamoyo and commenced field work. The facilities are at the Bagamoyo Training Unit and are rented from the Department of Community Medicine. These consist of a staff house, a seminar room used as an office and radio communication center, and a small laboratory for the processing of field specimens. There is also temporary accommodation for part time staff and occasional visits from US or Muhimbili principals. The project also rents one room in Bagamoyo town as additional office space for the social science personnel. It is negotiating to rent another house to provide permanent quarters for senior staff, both in residence or visiting.

5. Start up Activities:

During March and May 20 staff members were recruited (see Annex 2). Additionally an entomologist, Mr Majala and two malariologists (Drs. Z. Premji and Tarimo) were employed on a part time basis. All three are on the Muhimbili Faculty and are available for short term activities, although Mr Majala may be available for up to 50% involvement in future.

5.1 Geographical Reconnaissance:

Mapping based on sound geographical reconnaissance is an essential part of any vector control program, and necessary for planning good longitudinal studies on malaria incidence as well as studying transmission dynamics. Although good 1:50,000 maps are available, there are no detailed maps of villages, access roads, paths or other prominent features. The project area covers approximately 360 km^2 with a population of some 25,000 persons. Houses in each village are dispersed over a wide area, so the exercise was hours of walking as well as frequent verification with village leaders to see that no households had been missed. The process also provided valuable information on social and ecological conditions within the study area. With the arrival of the vehicles in March, visits were paid to all 13 villages in the project area and meetings were held with local administrators, party officials and village elders to explain the objectives of the project and what was to be done. Following this, early in April villages were visited one by one, mobilized for geographical reconnaissance (GR) and finally mapped. The sketch maps were drawn to show location of houses/buildings, responsible 10-cell leader (balozi) for each cluster of houses, roads, paths and prominent features. This information is entered into the data base after comparing with the recent census data and demographic information available from the GTZ Maternal and Child Health project in the Bagamoyo area.

The maps have been traced on mapping paper and duplicated for general field use. Data as entered in the project data base are included in annex 3. The average size of each village is 400 houses/homesteads. All houses were observed, mapped and entered into a data base during this GR activity.

5.2 Initial Malariometric Studies:

A malaria prevalence survey was undertaken in all schools within the project area to get some idea of the extent of the disease and its distribution. Children in Standards 1 and 2 were the study group. A total of 1224 blood films were examined (age range 6-16 median age 10, sex ratio 1:1). As well as a blood film, 100μl of finger prick blood was taken from each child and blotted on filter paper for serological examination at a later date. The mean slide positivity rate was 60.6% for all schools, but ranging from 50% to 82% positive. A summary of the prevalence survey data is given in Annex 4. The survey confirms the importance of malaria as a disease in the area and justifies the predictions made in the original proposal that coastal Tanzania represents one of the most intense zones of malaria transmission in the African continent.

Following the examination of the blood films, all schools were visited and arrangements made to meet the parents of the children and provide chloroquine for routine treatment of those found to be infected. At these meetings which were addressed by the social science team, a report back to the parents, teachers and children was made to help establish the credibility of the project and its goals in the eyes of the community. A question and answer session always followed these meetings which have been extremely popular and well attended.

5.3 Study Design:

The original proposal was based on a division of the study area into intervention and control villages, where baseline data would be collected from a series of core villages situated within the intervention area, and from a series of villages on the periphery of the intervention sites. Longitudinal studies in these sets of villages would provide information for comparison and analysis. Consideration of the issues involved, and examination of the village locations, ecology and accessibility lead us to consider and accept the step wedge design for implementation and data collection. Briefly the plan is to divide the project villages into four groups based on their location as well as their ecological and social characteristics. Group I villages (3) are on the coastal extremity, Group II villages (3) are on the Dar-

Bagamoyo main road, Group III villages (3) are at the apex just south of Bagamoyo town and in between the Dar and Chalinze access roads and Group IV villages (4) are along the Bagamoyo Chalinze road. (see map annex 5.

The intervention would be implemented stepwise starting with Group I in March 1992, Group II in Sept 1992, Group III in March 1993 and Group IV in Sept 1993. Each group would provide before/after information as well as acting as intervention and comparable control. Core villages for longitudinal study of both entomological parameters and malariometrics would be those of Group II and Group IV.

The rationale for the step wedge design and implementation plan are in annex 6.

6. Project Implementation

6.1 Social Science and Health Communication.

Field investigators for the social science component of the project were hired in March. During March and April they participated in the geographical reconnaissance and the establishment of contact with the study communities.

Dr. Peter Winch visited Tanzania in May, June and July and, in conjunction with Dr. George Lwihula, the field investigators were provided basic training in the concepts and methods of applied medical anthropology as well as the clinical and entomological aspects of malaria and their relevance to social science work. In May and early June a series of 13 focus group discussions, one in each village, were conducted in order to gather social, cultural and economic information about the communities in the study site. These discussions, in addition to providing an opportunity to further explain the project to local leaders and health workers, produced information which was used to in the development of detailed implementation plans for the social science, malariometrics and entomology components of the projects.

During the focus group discussions persons were identified who would be good key informants about illnesses and their treatment, beliefs about mosquitoes and the transmission of malaria as well as community structure and organization (See Annex 7A). This information is fundamental to our development of a health communication program to promote the proper use of insecticide impregnated bednets. Data collection techniques used included unstructured and semi-structured interviews as well as systematic techniques (free listing, pile sorts and paired comparisons). Using the computer program ANTHROPAC, pile sorts of illness terms were converted to proximity matrices and then hierarchical clustering, non-metric multi-dimensional scaling and consensus analysis were performed (See Annex 7B).

The major finding was that, although people know the word malaria, that it is caused by mosquitoes and that it can be treated with bitter medicine (chloroquine), they only apply the word to a small fraction of what is known to be malaria on the basis of clinical and parasitological studies. Illness episodes are often only referred to as malaria if they occur at a time when mosquito densities are at their maximum, involve fever and are of mild to moderate severity. Here are two examples of what biomedical scientists call malaria, but not villagers in Bagamoyo District:

1) For pregnant women, fever is seen as a sign of pregnancy like morning sickness rather than as a symptom of infection with malaria parasites during pregnancy. Numerous studies have shown that infection of the placenta with malaria parasites is most common and severe during a woman's first pregnancy, and this results in higher rates of spontaneous abortion, stillbirth and infants born with low birth weight. This situation is attributed to the youth of women during their first pregnancy, rather than to the presence of malaria infection.

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2) According to data gathered by the GTZ Family Health Program in Bagamoyo, the annual peak of mortality is from mid-June to mid-August. This is also the time of peak malaria transmission. Paradoxically this is a time when the mosquito population is declining rapidly, although a large percentage are infected. Because of the lower mosquito population, informants attribute fevers, especially fatal ones, that occur at this time to a variety of causes other than malaria such as spirits (shetani).

The implications of these findings are of great import, both to this project and to malaria control efforts in other parts of Africa:

1) The fact that the importance of malaria is underestimated affects the sustainability of the project. People will be unwilling to invest even a small sum of money in something that they do not perceive as a priority.

2) Entomological studies have shown that the greatest risk of malaria comes after the mosquito population has peaked and is declining. A significant amount of risk may be present even after mosquito population have declined to undetectable levels. The fact that people think that the malaria is chiefly a concern when the mosquito population is at its peak means that they may abandon the use of bed nets when there are few mosquitoes, which would make bed nets an ineffective control measure.

It is clear then that a comprehensive health communication strategy is needed if impregnated bed nets are to be both an effective and sustainable control measure. A necessary prerequisite to cost recovery will be make people aware of the true dimensions of the malaria problem.

To this end, communication about malaria and the project started early and is continuing. When results from the malaria prevalence survey available, meetings were arranged with village leaders, teachers, parent, children and health workers to explain the meaning of the high prevalence rates (Annex 8).

A workshop in late September will bring together project staff and Tanzanians with experience in health communication in order to put together a preliminary communication plan (Annex 9). The potential use of communication channels such as theater in Bagamoyo District will be reviewed. A knowledge, beliefs and practices survey will be conducted in November to provide additional baseline data so that the mobilization phase of project can start in the Group I villages in December. It is expected that many elements of this comprehensive communication plan will be applicable throughout Africa.

6.2 Malariometrics.

The necessary prerequisite for this work is the GR and a detailed demographic census of the core villages. This has been completed and the data are currently being entered into our data base program. The census is far more intensive than the GR, but is based on the latter as start up data. For each village a core of workers recommended by the village health workers has been recruited and asked to visit each household and record demographic details of the inhabitants. The number of infants and children under 5 are noted. These data were be checked against the GR information to determine validity and when found to be acceptable were entered into the data base. Those census takers found to be reliable are being trained to assist with other tasks associated with malariometric and entomological studies.

The main malariometric assessment of this project will be based on <u>incidence</u> of parasitic infection in infants between six and 36 months old. The group is susceptible to infection and parasitemia will be accompanied by fever in nearly all cases. It is proposed to identify families living in

the core villages who have children in this age group and recruit them into the study. They will then be kept under regular observation by village health workers and blood films taken if they become febrile. If infected with malaria parasites, the children will be treated radically with Fansidar under our direct supervision and readmitted into the longitudinal study.

A second measurement will be cataloguing mortality of children under 5. The Gambian work (Alonso et al 1991, see annex 9) has demonstrated that use of IBN by the community will significantly reduce the mortality of children of this age group. Village health workers in all villages will be asked to visit all families in the village who sustain a death, and arrange for a verbal postmortem to be taken. Those deaths which can be ascribed to malaria by a panel of Tanzanian pediatricians will be entered in the data base.

6.3 Entomology

Initially, the entomological staff were involved in the GR work, and required information from this in order to design the program of field work. Time was spent in recruitment and training of local mosquito collectors, setting up the field laboratory and developing sampling techniques.

Following the July visit of Dr. Beier a major innovation in the sampling methodology was contemplated. This entailed the use of CDC light traps for sampling the vector populations instead of doing man-biting collections. Data published recently from Tanzania (Lines et al 1991) indicate that light traps can be used in lieu of human baits (Annex 10). This has prompted the change in proposed methodology. Light traps have been procured and will be evaluated according to the new protocol. Pyrethrum spray collections (PSC) samples were made during July/Aug from all 13 villages. Mosquito specimens were identified and vector species dissected to remove ovaries from half gravid specimens for future chromosome examination, gut contents removed for blood meal analysis and the thorax removed for future ELISA testing for sporozoite antigen determination.

A sampling procedure was worked out which could be implemented to cover the core villages once fortnightly or else the entire study area once fortnightly depending on the availability of additional staff, transport and logistics for this work.

In the meantime, 12 houses (10 for regular survey and two as standby) have been selected from each of the core villages. Early in October a sampling procedure will be implemented using the light traps when they arrive. (see annex 11)

7. Issues and Concerns.

7.1 Timing and life of project.

The project was approved for 4 years and the implementation plan designed for three years in the field with some 6 months at the end to complete the analysis and write up the results. However as the work proceeds it is clear that these predictions were inadequate. The project needs four full years in the field. Even with the rapid start up which we achieved, we were only able to collect background information from July 1991. It will be 18 months after start up that we will be able to field the first stage of the intervention.

7.2 Increased salaries and local wages.

The original budget was drawn up in 1989. Since then local salaries have increased, particularly for trained and professional personnel. We have already lost a highly skilled social scientist to AMREF, a medical research organization in Dar es Salaam, at a salary three times higher than we were paying. It will be necessary to remain competitive in the local market if we are to maintain good staff relationships.

7.3 Transport costs.

The roads in our project area are some of the worst imaginable. Excessive damage to vehicles results and it is essential to obtain additional vehicle as standby. When routine entomological and malariometric measurements are in progress, a tight schedule of activities is necessary and any breakdown would be disastrous. As the vehicles age, the problem of transport and breakdowns will become very acute.

7.4 Lack of full time entomologist in the field.

The project will suffer from the fact that we do not have a qualified, full time entomologist/professional officer in the field. Dr. Lubega is also in need of reliable support staff. A professional entomologist would be able to conduct the necessary field work and operational research and provide her with quality support.

7.5 Need for additional equipment.

Since the initiation of this project, published information has indicated that light traps can be used to sample the mosquito population instead of making collections on human bait. This innovation requires us to invest about $10,000 on the purchase and shipping of 50 traps.
Equipment for electrophoresis is requested for year 2 in order to carry out mosquito identification and determine any likely selection for insecticide resistance.

ANNEX #1A

Factors affecting the acceptance and usage of insecticide impregnated bed nets to control malaria: Current knowledge and plans for research in Bagamoyo District, Tanzania.

Background paper prepared for the Bagamoyo Bed Net Project, Workshop on Issues Relevant to the Promotion of Impregnated Bed Nets in Bagamoyo District, December 3 and 4, 1990, Tanzania Episcopal Centre, Kurasini, Dar es Salaam, Tanzania.

Paper prepared by: Peter Winch

Funding for the Bagamoyo Bed Net Project is provided by the United States Agency for International Development.

10

Factors affecting the acceptance and usage of insecticide impregnated bed nets to control malaria: Current knowledge and plans for research in Bagamoyo District, Tanzania.

Introduction

In Tanzania malaria is the leading cause of outpatient hospital attendances, often the leading cause of hospital admissions, and one of the top causes of mortality in hospitals[1]. Malaria control programmes in the country have, unfortunately, encountered serious setbacks in recent years. Resistance to chloroquine, the drug most suitable for the treatment and prophylaxis of malaria in primary health care programmes, has become widespread[2]. The spraying of houses with residually acting insecticides, although it can be a highly effective means of control, has proven difficult to implement due to organizational problems and the high cost of insecticides and equipment[3].

Given this situation, a significant effort has been put into investigating the efficacy of, and the operational problems associated with, insecticide impregnated bed nets **(IBNs)** in Tanzania. A three year trial has been conducted in Muheza District, Tanga by investigators from the Amani Medical Research Centre of the National Institute for Medical Research and the London School of Hygiene and Tropical Medicine[4] which compared the effect of bednets impregnated with permethrin, bednets impregnated with lambdacyhalothrin and residual spraying with DDT, and examined the acceptability and operational difficulties associated with the implementation of this type of intervention at the community level. The same group collaborated with the Tropical Pesticides Research Institute (TPRI) to conduct experimental hut trials to examine the effect of treated nets and curtains on mosquito house-entering and feeding behaviour[5]. A trial of IBNs has also been conducted by the TPRI at the Usa River settlement in Arusha[6]. A group at the Swiss Tropical Institute Field Laboratory (STIFL) in Ifakara is in the early stages of a further trial of IBNs. In addition, the UNICEF/WHO Joint Nutrition Support Programme (JNSP) has been distributing impregnated bednets for use by pregnant mothers and young children in Zanzibar, and there are plans to extend this programme to Pawaga District, Iringa.

From the perspective of the programme planner, IBNs are attractive for several reasons. First, it is an intervention which corresponds to a felt need of many Tanzanians, that of protection from biting insects. Secondly, the technology used is much less complex than that required for the spraying of houses with insecticides. Much of the responsibility for distribution of the nets and their reimpregnation could conceivably be transferred to community organizations or village health workers. Finally, there is the potential for cost recovery through the sale of the nets and insecticides.

There are, however, several disadvantages to the use of IBNs which may limit their effectiveness. Although vector control experts have not yet arrived at specific recommendations, it is felt that a high rate of usage may be necessary for IBNs to have significant impact on transmission. In other words, instead of some people using nets some of the time, it may be necessary for most people to use IBNs most of the time for an effect to be seen on malaria morbidity and mortality. This is particularly true in sub-Saharan Africa where the principal vector of malaria is Anopheles gambiae s.l. Species in this complex, because of their biting and resting behaviour, life expectancy and efficiency in acquiring and transmitting the parasites which cause malaria, may continue to transmit malaria even after measures are taken which often eliminate malaria transmission in Latin America or Asia where others species of Anopheles are found. For example, in the Garki project in northern Nigeria, even the combination of mass drug administration and residual spraying, implemented under optimal administrative conditions, failed to interrupt transmission for any length of time, although there was a significant decrease in the prevalence of parasitemia[7]. Establishing and maintaining a high rate of usage of IBNs may be difficult. In addition, there are a number of operational details related to the importation and/or local production of nets and insecticides and the distribution and reimpregnation of the nets and community participation

which, if not attended to, could make the difference between programme success and failure.

This paper will attempt to review the social, cultural, economic and organizational factors which will need to be considered both for the design and implementation of the trial of IBNs planned for Bagamoyo District and for future malaria control programmes of the Ministry of Health of Tanzania. This review is in no way complete. It is hoped that participants in the workshop will point out important factors which are not mentioned here. The topics to be covered are shown schematically in figure one.

Part I: Perceived benefits of the use of bed nets: The role of local models of health and illness and disease transmission by insects.

The effects of local or folk explanatory models of health and illness on acceptance of IBNs can be very important, but often go unnoticed. Operational problems such as a non- functional distribution system for nets lead to direct and obvious results: no nets are present. On the other hand, most people have difficulty articulating the models they use to explain the occurrence, causes and recommended treatments for different illnesses. When these models clash with biomedical explanations of disease and disease transmission, the effects are most often indirect. For example, a patient may state that he or she does not want to take a prescribed drug because it is too expensive, rather than stating that he or she does not feel the drug will attack 'the real cause' of the illness.

The effects of these different explanatory models may not be apparent during the lifetime of a well-funded project as the cost and inconvenience of using IBNs is minimized. When the project ends, however, people weigh the benefits of investment of time and money in using IBNs against their other priorities. The assessment of what these benefits are is based on the models they use to explain health and illness, the perceived severity of the problem (malaria or mosquitoes) and the perceived benefits of the IBNs. It is at this point that usage of IBNs may show a significant drop.

Perception of the types of malaria and their causes

Both entomologists and parasitologists who study malaria and the people who suffer from malaria have had to develop complex models to explain why, on the one hand, there seems to be a relationship between mosquitoes and malaria and yet, on the other hand, one can not predict based on the mere presence or absence of mosquitoes when clinical cases of malaria will occur. In the biomedical model, distinctions are made between the causative agents of malaria which are the four species of Plasmodium parasites, the vectors of malaria which are various species of Anopheles mosquitoes and factors which affect the dynamics of transmission. The latter include humidity and high temperature which increase mosquito longevity and the immunity the human population has to malaria as a result of previous exposure and current nutritional status.

People living in malarious areas often have noticed that more cases of malaria occur for example when there is high humidity or heavy rain, when people are weak from hard work and insufficient food or when there are large numbers of mosquitoes present. The usual result of such observations is that humidity, rain, hard work and malnutrition, instead of being seen as factors which modify the dynamics of transmission, are seen as distinct causes of malaria. Further explanations are invoked to explain the cases that seem to occur 'for no other reason'.

Helitzer-Allen in Malawi[8] examined factors affecting the use of prophylactic chloroquine among pregnant women in Malawi. The term malungo which literally means fever and represents the concept of malaria was found to have seven separate subcategories, each with its own etiology, symptoms and treatment. They included, by etiology, malungo due to mosquitoes, contamination of food by flies or coughing, rain and weather changes, hard work, spirits or witchcraft, dirty water or food, and kulipuka, a

form of malungo in children associated with blisters. An important feature of this classification is that only malungo caused by mosquitoes or contamination of food by flies or the cough of malaria patients was thought to be treatable with chloroquine, and this was one factor which lessened compliance with regimes of prophylactic chloroquine. Similarly Fivawo[9], in a study of the social and cultural aspects of malaria in Muheza District, Tanga, found that people could name eight distinct causes of homa ya mbu.

The significance of classifications of malaria and malaria-like illnesses such as those found by Fivawo and Helitzer-Allen is that IBNs may only be thought to useful for preventing one 'type' of malaria. Therefore, even if people recognize that malaria is caused by mosquitoes, and that IBNs will prevent exposure to mosquitoes, they may not feel that malaria is preventable as exposure to other causes of malaria such as rain is inevitable. In the study of Helitzer-Allen, a subsequent health education intervention stressed that chloroquine is beneficial for all forms of malungo, not just those attibutable to mosquitoes, contamination of food by flies or the cough of malaria patients, resulting in a statistically significant increase in compliance with an antenatal prophylactic chloroquine regimen.

Recognition of different types of insects and their role in transmission

When health professionals design health education messages they often assume that, once people are told what the dominant mode of transmission of a given disease is, they will realize automatically that other modes of transmission are unimportant. For example, in education about mosquito-borne diseases, people are usually expected to assume without being told that they are not transmitted sexually or by the faecal-oral route. Folk understandings of transmission, however, usually do not assume that, because one mode of transmission is dominant, others are insignificant. This point was illustrated in a recent study by Mzirarubi et al.[10] of knowledge and practices with respect to AIDS among truck drivers in Tanzania. Although almost every person interviewed stated correctly that AIDS is sexually transmitted, 61% of the women and 53% of the men interviewed stated that AIDS can also be transmitted by mosquitoes. The point here is not that people fail to distinguish between diseases such as AIDS and malaria, which is probably a rare occurrence. This example is meant to illustrate that 1) information about the transmission and prevention of one communicable disease may be thought to be relevant to other communicable diseases; and 2) people think communicable diseases can have many different modes of transmission. This may lead them to conclude that control measures are inefficacious, because they only aim to block one mode of transmission.

The perceived relationship between different categories of insects by the community may be different from that of the entomologist. In Mexico, we have found that although flies and mosquitoes are clearly recognized as distinct entities, they are often thought of as the male and female of the same species (like bull and cow) rather than as two distinct species[11]. Health education messages about the transmission of typhoid fever by flies were thought to apply to mosquitoes, and messages about the transmission of malaria and dengue by mosquitoes were thought to apply to flies. Preventive measures directed only against mosquitoes were thought by some people, accordingly, to be unlikely to completely eliminate the transmission of malaria and dengue.

The role mosquitoes play in causing malaria may be explained in a number of ways. In Honduras it was found that there were at least five explanatory models[12]. In the 'fly model', mosquitoes are seen as carrying microbes or germs mechanically from contaminated water. This is reinforced by the fact that Anopheles mosquitoes commonly breed in swamps which are considered to be full of 'germs'. In the 'bee model', mosquitoes cause illness by injecting venom. In the 'trigger model', the causative agents of malaria are always in the body. Mosquito bites are seen as 'activating' these dormant microbes.

In the 'debilitation model', anaemia results from the cumulative effect of hundreds of mosquito bites. The body is in a weakened state which leaves the person susceptible to malaria. Some people

feel that the causative agents of malaria are always in the body, and that it is only when one is debilitated that illness appears. This model appears to be common, and is supported by the fact that people often receive a diagnosis or anaemia and malaria at the same time in the clinic.

Finally, in the 'mosquito model', mosquitoes are seen as extracting microbes from one person and passing them on to another. The significance of these different ways of understanding transmission is that, according to some, the volume of bites received will determine the risk of disease while, according to others, even one bite can cause disease. The perceived efficacy of IBNs, which will decrease may not eliminate mosquito biting, may be affected by how people understand the role of the mosquito.

Perceived benefits of using bednets

A large number of factors will affect the assessment people make of the benefits of using bednets. It is important to examine not only whether they are considered to be beneficial or not, but exactly how beneficial they are compared to other methods of treatment and prevention. As mentioned above, some people may feel that they are not effective against all the causes of malaria, or do not prevent some forms of transmission. The perceived benefits will also be affected by how serious an illness malaria is thought to be and the amount of annoyance caused by mosquitoes. Adults often have enough immunity that attacks of malaria are mild and rare. In this case the benefits of IBNs for their children might need to be stressed. In addition, some individuals do not seem to be bothered much by mosquitoes, while others are unable to sleep if mosquitoes are present.

Several investigators have noted that IBNs also provide protection from cockroaches, bedbugs and rodents[13,14]. People may notice dead cockroaches and bedbugs in the vicinity of the nets, providing direct proof of their efficacy. It has been suggested that this effect of the IBNs be stressed when their use is being promoted. A possible disadvantage of this approach could appear if cockroaches and or/bedbugs become resistant to the insecticide, but mosquitoes are still susceptible. Seeing cockroaches and bed begs once again flourishing, people may conclude that the IBNs have lost much of their efficacy.

In summary, people are likely to conclude that IBNs are an efficacious technology, based on the fact that they provide a barrier from mosquitoes, cockroaches, bedbugs and rodents. Local explanatory models about the causes, transmission and prevention of malaria and other communicable illnesses may lead people to conclude that their efficacy as a malaria prevention measure is limited, and to underestimate the potential benefits of using IBNs. Prevention of malaria is not usually mentioned as a benefit of using IBNs. For example,the following reasons for the purchase of nets were given in The Gambia, in descending order of preference: protection from mosquitoes and other biting insects; protection from rats, lizards and their droppings; gives privacy in bed and protection from dust[15]. Somewhat different results were obtained by Alilio[16] in a survey in Pawaga Region, Iringa. Of those who used nets, 69% stated that they used them to decrease malaria, 30% for protection from mosquitoes and .5% for protection from other biting arthropods.

Part II: Acceptability and Proper Usage of Impregnated Bed Nets

In this section we will review issues of acceptability and proper usage of IBNs, as well as ways in which an assessment can be made of the level of usage in the community.

Acceptability of IBNs

The major factors affecting acceptability of IBNs are migration patterns, beliefs about and practices in relation to bed nets or similar-looking objects, design (shape, size and material) of the nets and side effects (lack of ventilation, symptoms from exposure to insecticides).

Differences between ethnic groups in migration patterns and beliefs about bed nets are well documented. Bradley et al.[17] report that, in the Farafenni area of The Gambia, 99% of the Mandinka, 64% of the Wolof and 58% of the Fula use bed nets. This data was confirmed by MacCormack and Snow. They found that the reasons for these differences were more cultural than economic, including "Mandinka sleeping habits and the need for privacy, the provision by Mandinka husbands of bed linen including a net as part of marriage exchanges, and Fula preferences for being unencumbered with goods so that they might move with their herds whenever necessary"[18]. It has been reported that some coastal peoples in Tanzania feel that bed nets are similar to shrouds used to cover dead people, and that they, therefore, are not willing to use them.

In Bagamoyo District, those who grow rice typically spend part of the months of April, May and June in their fields protecting the growing plants from birds. It will be important to find out both how much exposure they have to mosquitoes during this time, and whether they would be willing to take IBNs with them to the fields.

There are many issues to be considered in the actual design of bed nets. Njunwa et al.[19] found that nylon nets were too flimsy, and soon developed holes. After six months many had to be replaced. They were, however, easier to reimpregnate because they could be wrung out. Polyethylene fibre nets were very durable and only slightly more expensive, but had to be left to drip instead of wrung out during impregnation. Both kinds were found to burn slowly when they caught fire. Cotton nets have been found to be more flammable and to absorb more insecticide (making higher doses necessary for reimpregnation) than nets made of artificial materials[20]. The shape and size of the nets should be adapted to local needs, as determined during the baseline research.

The major side effects of using bed nets reported in Tanzania are lack of ventilation and cold-like symptoms from the insecticide. Alilio[21] in his study in Pawaga District, Iringa, found that 62% of the people interviewed never use bed nets, 16% sometimes used them, 21% always used them. Of those who sometimes used them, all did not use them in the hot, dry season before the long rains, and all did use them during the 'mosquito season'. Such a variation in usage will probably also occur in Bagamoyo District. Entomological studies will need to address whether we should encourage people to use nets every month of the year, or whether the risk of transmission is low enough during the hot, dry season that suspension of the use of nets during this period does not jeopardize the control of malaria.

Njunwa et al.[22] found that several members of the impregnation team experienced running eyes and noses and, in two cases swollen faces, when impregnation was carried out with lambdacyhalothrin. Members of the community also experienced these symptoms during the first few days after they received their nets. There were preliminary indications that hanging a net for a few days after impregnation to dry would eliminate this problem. This would be feasible when new nets are being given out, but inconvenient for reimpregnation.

Proper Usage of Bed Nets

Rozendaal[23] lists the following factors to consider in the evaluation of whether bed nets are being properly used:

1. Time spent at night per age group: (a) outdoors; (b) indoors for other purposes than sleeping; (c) sleeping. Patterns of nighttime activity can have a large impact on the efficacy of IBNs. Leake and Hii[24] in East Malaysia found that many adults watched battery-operated televisions until late at night, at a time when feeding by malaria vectors was at a maximum. This was thought to be one of the main reasons why, in a previous trial of IBNs, prolonged suppression of malaria transmission had not been achieved.

2. Proper use of the mosquito net before sleeping: tucking in under a mattress or sleeping mat to close all openings. When people sleep on bamboo floors or in beds with string mattresses, special mats should be used to prevent mosquitoes from entering the net or feeding from beneath. For non-impregnated bed nets whose efficacy is based solely on their ability to function as a barrier to mosquitoes, proper use of the net before sleeping is very important. For IBNs this will be less important, and a decision will have to be made about whether it needs to be stressed. Lines, Myamba and Curtis[25] found that an IBN in which holes had been cut, to simulate a torn net, reduced the number of mosquitoes which fed and survived approximately as well as an intact IBN.

3. How many people sleep under one net and what is the relation between occupancy rate and proper use of nets.

4. What happens to the nets at daytime, are they rolled up or left hanging down?

An additional aspect of proper usage which needs to be examined in trials of IBNs is whether people are washing their nets. Njunwa et al.[26] in their trial of IBNs in Muheza District, Tanga, marked nets with both an indelible marker and a washable marker. Disappearance of the latter was evidence that the net had been washed. Washing of permethrin-treated nets at a dose of .2g/m^2 was found to greatly decrease the mortality of mosquitoes exposed to the net, while 100% kill of mosquitoes exposed to nets impregnated with lambdacyhalothrin at a dosage of 30 mg/m^2 was obtained even when the nets had been washed.

Measurement of Usage of IBNs

If malaria transmission is not suppressed in a trial of IBNs, there are several possible explanations: 1) transmission is so intense that IBNs alone can not significantly decrease it; 2) due to characteristics (e.g. feeding before people go to bed) of the local malaria vector(s), IBNs are not an appropriate method of control in this setting; or 3) too few people are using the nets, or they are being used improperly. The first two explanations can be explored through entomological and malariometric studies.

There are four ways in which levels of usage of IBNs can be assessed: (Sample data collection forms are shown in figures 2 & 3)

1) SURVEYS WITH CLOSED-ENDED QUESTIONS. Questions about whether a household owns bed nets, whether they are being used and whether they are being washed can be included in multi-purpose surveys, or in surveys which only examine usage of IBNs. The validity of this method may be low if the communities have been exposed to health education messages and, therefore, know that they are supposed to be using IBNs. A good example of this is described by Leake and Hii in two villages in

East Malaysia[27]. In one village (Telupid) where health education had recently been carried out, 31.4% of people were found to be using nets by direct observation, compared to 47.4% who stated that they had used nets on the previous night in a survey conducted the next morning. This difference was statistically significant. In another village (Kudat) where no health education had been carried out, 52.5% of people were found to be using nets by direct observation, compared to 58.1% who reported that they had used nets in a survey conducted the next morning. This difference was not statistically significant. Despite the limited validity that this method can have, it is the most common method for assessing bed net usage because it is easy to conduct and leads to less resistance from the community than more intrusive observational methods.

2) DAYTIME OBSERVATIONS. In this method, houses are visited during the day. All nets are examined, and their serial number, condition (presence of holes, presence of washable ink indicating that they have not been washed) and position (beside bed, over bed, elsewhere) are noted. Questions are then asked about how many people slept under each net on the previous net and how many people did not sleep under any net. These observations were included in the survey instrument administered used by Leake and Hii in East Malaysia. This method does provide direct confirmation of whether nets are present, but still does not provide direct evidence of the actual usage of the nets. It is the best way to determine how often nets are being washed. These observations might be conducted periodically by mabalozi or community health workers.

3) NIGHTTIME OBSERVATIONS. Observations are not made when everyone is in bed, as this is too intrusive. Leake and Hii made observations between 9 pm and 12 pm, when all children and some adults had gone to bed. Observations could also be made in the early morning, when women are up fetching water or preparing food but men and children are still in bed. Observations are quick and consist of counting the number of nets in use, the number of people sleeping in them and the number of people awake outside of the nets. If necessary, the procedure can be simplified so that only a count of the number of nets in use is made. This is obviously the most intrusive method. During the pre-intervention research, an assessment will need to be made as to whether this method is acceptable to the community, and if so, when observations could be made.

4) INFORMAL CONVERSATIONS AND OBSERVATIONS. This method is an adjunct to, but not a replacement for, the above methods. As a result of daily contact with community members, project staff should be able to get an impression of whether most people are using the nets or not. This method will be more valid (less likely to yield wrong results), but less precise than the above methods. For example, if through informal contacts it appears that nobody is using the nets, but direct observation reveals a high rate of usage, it may be that people are using their nets much more when they know that the evaluation team will be in the village.

Part III: Cost recovery

Despite Tanzania's goal of self-reliance as stated in the Arusha Declaration, the health sector is heavily dependent on foreign aid both for the establishment of new facilities and programmes, and also for long-term recurring costs[28]. This has been particularly the case for vector control programmes, since necessary insecticides and equipment mostly have to be imported. Many vector-control programmes end as soon as funding stops. Furthermore, as many of the insecticides are manufactured from petroleum by-products, their cost can be expected to rise when petroleum prices rise, in other words at a time when the country is already short of foreign currency.

It seems unlikely that the Ministry of Health of Tanzania could cover much of the costs of an IBN programme. Current spending has been estimated to be less than US $2 per annum[29]. As there appears, nevertheless, to be a strong demand for bed nets already among Tanzanians, a malaria control

programme based on IBNs has the potential to include a cost recovery component. In Pawaga District, Iringa, Alilio[30] found that of those who owned bed nets already, 42% had paid from 100 to 1000 Tanzanian Shillings, 35% had paid from 1001 to 2000 and 24% had paid more than 2001. When respondents were asked whether they would purchase nets if the government were to supply them at a price of 1000 Tanzanian Shillings, 55% of all the people (current users and non-users) said they would buy one, 28% said no and 17% said maybe. If taxes on imported bed nets are waived, their market price will probably still be more than 1000 Shillings.

A key question must be whether coverage of 55 +/- 17% of the population would be sufficient to have any effect on malaria. It is also crucial to know whether the 28% who said that they would not buy a net are in fact those at greatest risk of malaria due to their low economic status and sub-standard housing. In Muheza District, Tanga, an attempt is being made to set up a revolving fund administered by the wenyekiti (village chairmen). Token payments collected for the nets are going to be used to pay for the replacement of damaged nets[31].

Another concern is seasonal availability of the nets. In Bagamoyo District the highest mortality every year occurs during the months of April to June[32]. These are the months of heavy rain, food shortage as it is just before the rice harvest, and shortage of money. This is also a time when many people are living in the fields to protect the rice crop from birds. It is, accordingly, the time when there is perhaps the greatest need for IBNs, and yet people have the least capacity to purchase them. In addition, their distribution during this season would be very difficult due to the bad condition of the roads. A successful malaria control programme based on IBNs would need to have the nets available for distribution in August and September when people have spending money available from their harvest. This would be less important for those people who make their living through fishing or growing coconuts, as the income from these activities is more evenly spread throughout the year.

MacCormack, Snow and Greenwood[33] review the economic aspects of the use of IBNs in primary health care in The Gambia, and conclude that, given the high cost of imported nets and problems in distribution, the best chance for a successful programme lies in local production of the nets. They see it as an income-generating activity involving the grass roots of the rural economy. They state their case as follows: "Tailors, responding to consumers' preferences, are providing the kind of nets people want to buy, including those that will fit the different sizes and shapes of beds in use. However, primary health care workers have a role in advising villagers on such matters as ensuring sufficient overlap on the net's opening side, and adequate length to allow the net to be tucked under the mattress. Permethrin treatment of nets can also be done locally, with primary health care workers assisting village women."

Part IV: Implementation at the community level

Communities need to be involved in the distribution and regular reimpregnation of IBN so that the intervention is acceptable and locally sustainable with minimum input from government agencies. This entails issues of relations between project staff and community, community participation, information, education and communication (IEC) and supervision and monitoring.

Relations between project staff and communities

Although the project will bring many benefits to the community, many of the activities may be perceived as time-wasting or annoying. Collection of insects will take place in and around people's houses, repeated blood samples will be taken from children, children may have to take curative doses of malaria medication even if they do not feel sick and people will be asked many questions. Time will need to be invested in the establishment of solid contacts with communities at the outset. An honest appraisal should be given of the advantages and inconveniences which will result from the project.

Community Participation

Active community participation in the design and implementation of health and development programmes is crucial to their success. Communities are rarely involved in real decision-making, and therefore feel they have little stake in programme outcome. Nichter[34] points out that assumptions regarding what a community wants, needs, or will support, are usually made by programme planners rather than the community. Rajagopalan and Panicker[35] state that "Many times such plans are forced upon the villagers and the latter acquiesce passively to their implementation, without participating in them. Their acquiescence is often mistaken for cooperation/participation." The fact that the initiative for the use of impregnated bed nets has not originated among the people of Bagamoyo District already raises some controversial issues. On one hand important decisions have already been made without the input of the people the programme is meant to benefit which may make community participation more difficult to achieve. On the other hand, if no intervention is specified, it is impossible to draw up a budget and difficult to obtain funding from governments or aid agencies. Ways to involve the community actively in other aspects of the planning, implementation and evaluation of the project need to be pursued vigorously.

The role of Community Health Workers (CHWs), which have been the backbone of rural health services in Tanzania, must be well thought out. A number of difficulties have been identified with the current CHW programme[36,37], many of which are related to their job descriptions. It is anticipated that the addition of this intervention (distribution of nets, reimpregnation) to their responsibilities has the potential to strengthen and further define their roles. It may, on the other hand, be one more responsibility for which they have neither the time, nor training, nor administrative support necessary for it to be carried out well.

Alternatives to the involvement of CHWs include the involvement of mabalozi (10-cell leaders), wenyekiti (village chairmen), religious officials or even special purpose workers. In the IBN study in Muheza District, wenyekiti distributed the nets, had people sign for them, and are collecting the token payments which are going to be used to start a revolving fund to replace damaged nets. In the Kongwa Trachoma Project[38], a special class of worker was created. For the application of tetracycline ointment daily to the eyes of children, Village Treatment Assistants (VTAs) were nominated, each of whom was responsible for the administration of the ointment in five households, or to about 25 children. The system apparently worked very well. Good records were kept, and the VTAs were enthusiastic about their work. Creation of a special class of worker rather than using existing resources usually makes programmes less sustainable due to higher staff costs and duplication of resources.

Information, Education and Communication (IEC)

Nguma[39] reviews the current status of IEC for behaviour change in health in Tanzania. He notes that many of the difficulties of the Health Education Unit (HEU) of the Ministry of Health have much to do with problems of organisation, coordination and planning. These problems are not well recognised, as attention is usually focussed on the content of the messages and the medium used to convey them to their target audience. Nguma notes that there are a large number of organisations producing health education materials, and little coordination of the wide variety of messages which are being propagated.

I mentioned in part I that people may apply information about the transmission and prevention of one communicable disease to communicable diseases in general. This means that there should be a coordination of health education materials among past, present and future communicable disease programmes in any given country. If terminology used in the different programmes overlaps, as is common with communicable disease, the problems are even greater.

An example of the consequences of lack of coordination was encountered recently in a dengue haemorrhagic fever control programme in Honduras[40]. The Spanish word bicho can refer to bacteria, intestinal worms, insects and even spirit companions of men and animals. As a result of health education campaigns promoting the use of oral rehydration solution (ORS) in the early 1980s, bichos came to be associated by many people with diarrhoeal diseases. In a community-based dengue control programme that started in 1988 which attempted to encourage people to control the breeding sites of the larvae of the mosquito Aedes aegypti, the larvae were commonly identified as the cause of diarrhoea. A great deal of difficulty was encountered in trying to convince people there there is a connection between mosquito larvae and adult mosquitoes, and that controlling the former would have an effect on the latter.

In kiswahili many words have a wide range of meanings. Health educators, in attempting to use the most understandable language, often use the most simple and common words, which may also have the most potential for ambiguity. As noted earlier, a recent study among truck drivers in Tanzania found that the majority thought that AIDS could be transmitted by mosquitoes. One reason for this may be the use of words such as mdudu which has a range of meanings similar to bicho. For example, I observed that following message on an AIDS prevention poster on display at the Tanzania Public Health Association conference:

"Tusaidiane kujikinga na mdudu kiini cha ukimwi"
(Let us help each other to protect ourselves from the AIDS virus)

Health personnel quickly recognise that mdudu kiini means AIDS virus. It may be however that ordinary people reading this think that there is some relation between the mdudu kiini cha ukimwi and wadudu like flies and mosquitoes which transmit diseases, wadudu which cause intestinal infections and wadudu which make their cattle sick. In addition, the verb kukinga is likely to be used in explaining how bed nets work or why they should be used. In view of the fact that IEC about both AIDS and malaria is likely to intensify in the coming years, it would make sense to make sure that the messages are mutually reinforcing.

Another issue will be the delivery of the health education. Nguma points out that there is a severe shortage of health educators in the country, and that there is also the belief that 'anyone can do health education'. The choice of who will deliver the education and when it will be delivered is an important one. If people who already have other roles such as CHWs or wenyekiti are used, the programme should be more sustainable. These people, however, are more likely to stick to previously memorized messages instead of entering into a real dialogue with the community about their concerns about the nets. The use of fewer, more highly trained health education personnel, on the other hand, may lead to a more expensive programme with less frequent health education. A key factor in the decision will be training of those who will do the education: how it is done, who does it and who gets it. One outcome of this research project should be the production of a training manual for use in health education in IBN programmes.

Finally, Nguma points out that the audience must be in a receptive mood for the education they are going to get. He gives the example of ten minutes of health education that is done every morning in health centres in Tanzania. The topic to be covered is determined by the health workers, not by the current concerns of the patients. The talk may be on malaria even if all the patients have diarrhoea that day. In a IBN intervention, seasonal variation in work schedules will be important. If everybody is out in the fields protecting the rice from birds or harvesting rice they will probably not be in the mood for a talk on how to reimpregnate bed nets. Baseline research should look at when people are most likely to be receptive to educational activities.

Supervision and Monitoring

Finally, an IBN intervention may fail because of lack of supervision and monitoring. MacCormack and Lwihula[41] showed how a programme aimed at controlling malaria in children through the use of prophylactic chloroquine failed because attention was not paid to a wide variety of small problems which arose. These included the exclusion of socially marginal families from programmes and irregular supplies at the local level. Each of these 'details' was small in itself, but the accumulation of many of them threatened the success of an otherwise sound programme. This study should determine what type of long-term supervision is necessary for the programme to function effectively.

Conclusions

This paper is an attempt to summarize the social, cultural and economic issues which will be relevant to the development of an IBN intervention in Bagamoyo District, Tanzania. Any comments, criticisms or additions are more than welcome.

Figure One:
Factors affecting acceptance and usage of insecticide impregnated bed nets to control malaria.

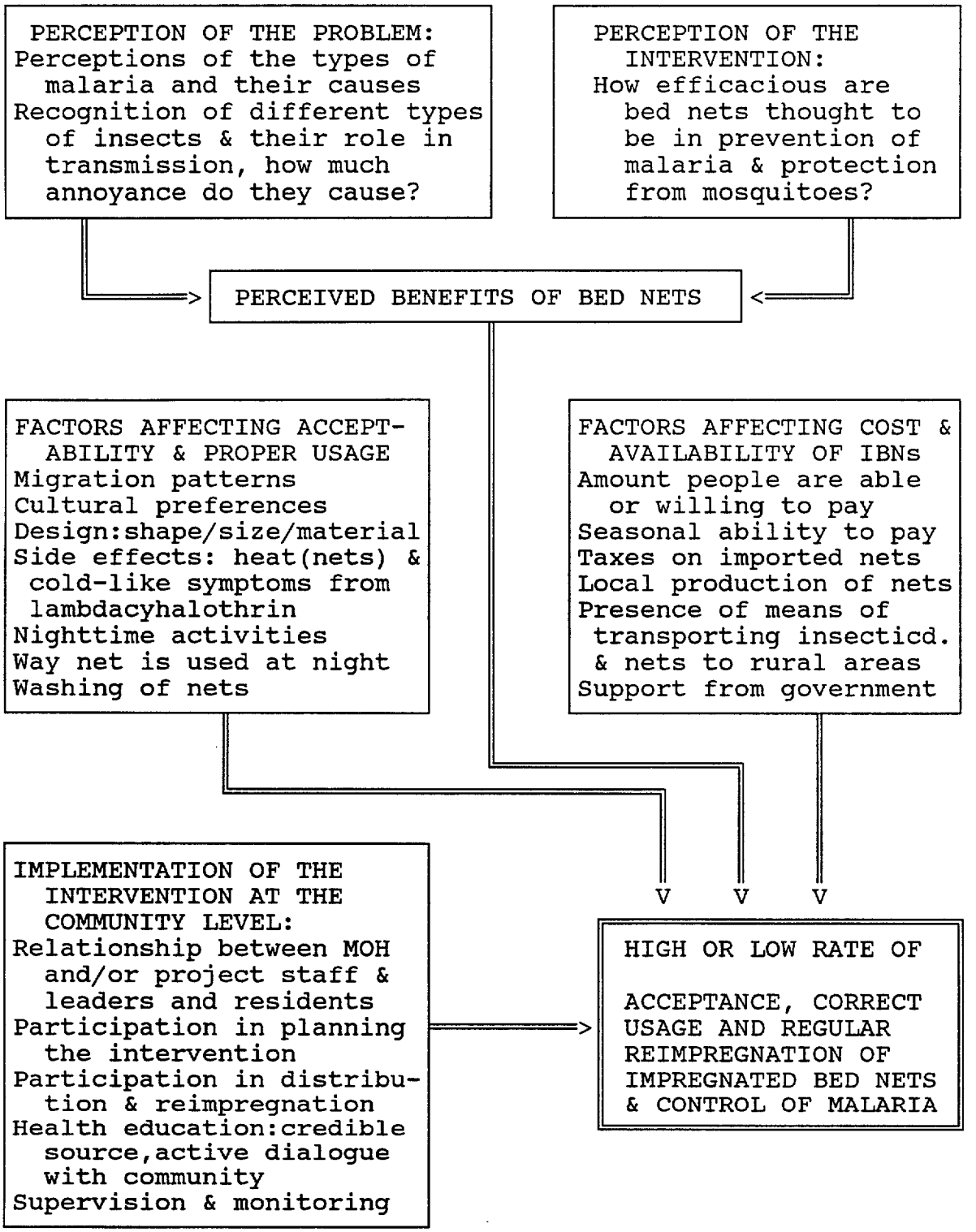

Figure Two:

Example of a form that might be used to collect data on use on IBNs (Similar to form used by Leake and Hii)
Form 1: Daytime Visit

Date:_____ Time:_____

Community:_____ House number:_____

Interviewer:_____ Person interviewed:_____

Does your family have any mosquito nets? [ ]yes [ ]no

If 'yes', who used them last night? (Specify number of people and bed net condition and serial number)

Serial number of net	Type of net: M= med,L=lg	# child. using last ngt	# adults using last ngt	Condition		Position	
				Holes	No holes	Over bed	Elsewhere

Comments: _____

_____

No. of people not using a net last night: _____ children; _____ adults

Reasons for not using net:
1. [ ] Net was sold 2. [ ] It was too hot 3. [ ] Came back late

4. [ ] Other (specify):_____

Figure Three:

Example of a form that might be used to collect data on use on IBNs
Form 2: Nighttime visit

Date:_____ Time:_____

Community:_____ House number:_____

Interviewer:_____ Person interviewed:_____

	Adults	Children
Number asleep or in bed		
Number under nets		
Number not under nets		
Number awake and out of bed		

Activities of adults who are out of bed: _____

_____

Activities of children who are out of bed: _____

_____

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ANNEX 1B: WORKSHOP REPORT

Bagamoyo Bed Net Project

Workshop on Issues Relevant to the Promotion of Impregnated Bed Nets in Bagamoyo District

December 3 and 4, 1990

Tanzania Episcopal Centre, Kurasini, Dar es Salaam, Tanzania.

Workshop Participants

Mr. J. Stepanek, Mission Director, Agency for International Development, Luther House, Dar es Salaam

Professor W.L. Kilama, Director General, National Institute for Medical Research, P.O. Box 9653, Dar es Salaam

Dr. G.P. Temu, Department of Epidemiology and Communicable Diseases, Ministry of Health, Dar es Salaam (representing the Director of Preventive Services)

Dr. B.G.I. Mligo, District Medical Officer, Bagamoyo District

Mrs. S.M.L. Laver, Department of Community Medicine, University of Zimbabwe, Harare

Prof. J.N. Minjas, Chairman, Department of Entomology and Parasitology, Muhimbili Medical Centre, P.O. Box 65011, Dar es Salaam

Dr. G.P.Y. Muhondwa, Chairman, Department of Behavioural Sciences, Muhimbili Medical Centre, P.O. Box 65015, Dar es Salaam

Dr. G.K. Lwihula, Department of Behavioural Sciences, MMC

Dr. M.T. Leshabari, Department of Behavioural Sciences, MMC

Dr. E.F. Ndyetabura, Bagamoyo Teaching Unit, Department of Community Medicine, MMC

Dr. P. Mujinja, Department of Behavioural Sciences, MMC

Dr. Z.A. Premji, Department of Entomology and Parasitology, MMC

Mr. A.R. Majala, Department of Entomology and Parasitology, MMC

Mr. F.K. Nyange, Department of Psychiatry, MMC

Mr. M. Alilio, Amani Medical Research Centre, National Institute for Medical Research, P.O. Box 4, Amani, Tanga (currently at the Swiss Tropical Institute Field Laboratory, Ifakara, Morogoro)

Dr. P. Lubega, Department of Entomology and Parasitology, MMC and Johns Hopkins University, School of Hygiene and Public Health, Department of Immunology and Infectious Diseases, Baltimore USA

Dr. P.Winch, Johns Hopkins University, School of Hygiene and Public Health, Center for International Community-Based Health Research, Baltimore USA (Editor of Workshop Report)

Bagamoyo Bed Net Project
Agenda for workshop at Tanzania Episcopal Centre, Kurasini

Monday December 3, Morning: Introduction to Project
Chairperson: J.N.Minjas
Rapporteurs: F.Nyange, P.Winch

9:15 - 9:30	Welcome, introduction of USAID representative: J.N.Minjas
9:30 - 9:45	Opening remarks: J.Stepanek, Mission Director, USAID/Tanzania
9:45 - 10:05	Current status of malaria and IBN research in Tanzania: W.L.Kilama, Director General, National Institute for Medical Research
10:05 - 10:25	Overview of entomology: J.N.Minjas
10:45 - 11:10	Overview of malariometrics: P.Lubega
11:10 - 11:30	Overview of social science component: G.K.Lwihula
11:30 - 12:00	Summary of morning session; overview of issues to be discussed during remainder of the workshop: J.N.Minjas

Monday December 3, Afternoon: Beliefs about malaria and insects
Chairperson: G.K.Lwihula
Rapporteurs: A.Majala, M.T.Leshabari

1:30 - 2:10	Biomedical understandings of malaria: occurrence of clinical cases, types of immunity, conditions necessary for transmission to take place: P.Lubega
2:10 - 3:00	Folk understandings of febrile illness including malaria, transmission of vector-borne disease, treatment and prevention of malaria and protection from mosquitoes; assessment of efficacy of these methods of treatment and control: P.Winch
3:15 - 5:00	Discussion of plans for data collection on beliefs about malaria and insects relevant for Bagamoyo, suggestions for questions to concentrate on and ways of improving instruments

Bagamoyo Bed Net Project
Agenda for workshop at Tanzania Episcopal Centre, Kurasini

Tuesday December 4, Morning: Acceptance & Use of Bed Nets
Chairperson: M.T.Leshabari
Rapporteurs: P.Mujinja

9:00 - 9:30	The impregnated bed net intervention: why it was chosen, description of the technology, how it will be applied, expected results, description of the study site, workplan (timetable) for entomology/malariology component: J.N.Minjas
9:30 - 10:00	The impregnated bed net intervention: plans for distribution, reimpregnation and promotion of proper use, plans for measurement of usage, anticipated problems (causes of non-acceptance and difficulties in measuring usage), workplan for social science component: G.K.Lwihula
10:15 - 11:15	Sustainability and cost recovery: P.Winch
11:15 - 11:45	Discussion of implementation of bed net intervention, especially factors influencing acceptance and ways to investigate them, discussion of how to measure usage
11:45 - 12:00	Summary of morning session

Tuesday December 4, Afternoon: Community participation and health education
Chairperson: E.P.Y.Muhondwa
Rapporteurs: Z.A.Premji, P.Lubega

1:30 - 2:45	Issues in health education/promotion: who will do education/promotion, channels (radio, print materials etc.) to be used, how will messages be developed: S.Laver
3:15 - 3:30	Introduction to issues in community participation in Bagamoyo District: P. Winch
3:30 - 4:00	Discussion on community participation in Bagamoyo District
4:00 - 4:40	Discussion of data collection instruments
4:40 - 5:00	Conclusions and recommendations

Monday December 3, Morning: Introduction to Project

Chairperson: J.N.Minjas
Rapporteurs: F.Nyange, P.Winch

Opening remarks: J.Stepanek, Mission Director, USAID/Tanzania

* USAID has been in Tanzania for 30 years, has developed strong relationship with the country

* Zanzibar project was a managerial nightmare: had to be on a war footing which was exhausting; the administrative burden on both the government of Zanzibar and USAID was great

* a big problem was the science of malaria control was changing right at the time when the project was being approved: resistance to DDT and to chloroquine was being documented in Tanzania

* result of the war was mosquito 1, man 0

* when decision was made to end the Zanzibar programme, there was no reply (no criticism, comments etc.) which indicates the low level of concern that exists for this important disease

* impregnated bed nets are a different approach, both in the technology being used and in the way responsibility is being shared between government, individuals and the community

* individuals must take responsibility for their health, in this framework government involvement is more effective

* US health system has similar problems, could use a similar approach

* pleased that USAID is working with such fine organisations as Muhimbili Medical Centre and Johns Hopkins University

Current status of malaria and IBN research in Tanzania: W.L.Kilama, Director General, National Institute for Medical Research

* Speaking to this audience is like being a priest, priests always talk to the converted, this audience is already convinced of the need for bed nets

* Tanzanian is a sea of intense transmission with a few (disappearing) islands where malaria is slightly absent. Urban areas were islands, people used to think that they could live in urban areas and escape from malaria, but this no longer is true

* Amani had anophelism without malaria, but now malaria is the number one cause of clinic visits

* epidemics are even taking place in Dodoma and other inland areas that previously were not that much affected

* malaria is consolidating its position as the number 1 cause of hospital admissions and deaths

* in the country disease summary, made from compiling 15 million reports from districts, malaria accounts for 29.08% of the cases reported, and diarrhoeal diseases 8.81%

* there is a trend of increasing morbidity and mortality over the period 1970-1989, especially since 1984

CHEMOTHERAPY

* multi-drug resistance is the leading technical problem
* 30% of school children have chloroquine resistant parasites
* 70% of <5s do not have full parasite clearance with chloroquine
* measuring, mapping and monitoring of resistance needs constant attention
* amodiaquine is promising, there has only been one report of resistance
* baseline studies are being done on new drugs, and one drug combinations

CHEMOPROPHYLAXIS

* there is a need to develop guidelines
* which group: pregnant women (which pregnancy); children (<5 only?)

VECTOR CONTROL

* biological control methods such as Bacillus thuringiensis H-14, Bacillus sphaericus, larvivorous fish (N. palmquist) are being tested in Tanzania
* the efficacy of intradomiciliary spraying with ICON (lambdacyhalothrin) has been compared to DDT
* once ICI is finished developed a new microencapsulated form of ICON which will not be adsorbed onto mud walls, intradomiciliary spraying will again be a viable alternative control method
* work is being done with larvicides: temephos, fenitrothion

BED NETS

* were recommended by Ross in 1910
* Nevill in Kenya in 1988 found that they protect against malaria
* many problems are overcome by impregnation with pyrethroids: impregnation protect the sleeper, insecticide is better targeted
* trials have been done in Gambia, Burkina Faso, Tanzania; Gambia and BF were not holoendemic areas like Tanzania
* in Tanzania (Muheza District, Tanga Region) there was a decrease in mosquito population densities, decrease in parity, age and sporozoite rates, however low sporozoite rates were still enough to allow transmission; slight decrease in malaria parasite rates; significant decline in %age of children with high parasitaemia, more noticeable in less traditional villages (with slightly better housing conditions)
* impregnation is cheap, simple and can be community based
* in a follow-up study in Muheza we are looking at whether villagers would buy the nets who already know they work
* UNICEF Zanzibar bed net programme for pregnant women and young children is being extended to Iringa
* a good net cost $3 and lasts for 5 years. Annual cost including impregnation is less than $1
* we should aim at integrated control
* one study showed that a combination of IBNs and chemotherapy with Fansidar of all children at beginning of study controlled malaria for a significant length of time
* need to integrate IBNs, chemotherapy and housing improvement

Introductory talks by project staff

Overview of entomology: J.N.Minjas
Overview of malariometrics: P.Lubega
Overview of social science component: G.K.Lwihula
[These talks largely presented what is in the proposal.

Discussion

Kilama
* waiving of tax on nets has been suggested to government. Nets should be like prescription drugs
* nets should not be included in the essential drugs programme if that means that they will be given out free. It is important that there be a charge for the nets, even if it does not cover the whole cost

Temu
* other measures are needed, IBNs are not enough to control malaria

Mligo
* malaria is increasing in the District according to reports
* confirmation is difficult
* malaria is #1 outpatient diagnosis
* no doubt as to its importance

Nyange
* some problem with validity of GTZ mortality data as staff were paid for each death reported, leads to inaccuracies

Muhondwa
* need to look at the perceptions of the community, how they define disease and what they consider to be the most important health problems according to their own definitions

Premji
* filariasis is the sister disease to malaria, we should look for an effect on filariasis in this study
* instead of just disease-specific mortality rate, we should also look at the infant mortality rate and the maternal mortality rate, look at the effect on the whole health environment

Minjas
* the area is endemic for Bancroftian filariasis

Mligo
* GTZ set up vital records system because deaths occurring in the villages were being underreported

Alilio
* need to look at biting by mosquitoes from under the bed; local production of bed nets; community participation
* can not recommend giving away nets free, this has caused problems in other studies
* how will fishermen be protected

Mujinja
* must look at the ability to pay, not just the absolute cost. A very low cost may be still too high if the family has no money, no ability to pay

Monday December 3, Afternoon: Beliefs about malaria and insects

Chairperson: G.K.Lwihula
Rapporteurs: A.Majala, M.T.Leshabari

Biomedical understandings of malaria: occurrence of clinical cases, types of immunity, conditions necessary for transmission to take place: P.Lubega

Folk understandings of febrile illness including malaria, transmission of vector-borne disease, treatment and prevention of malaria and protection from mosquitoes; assessment of efficacy of these methods of treatment and control: P.Winch

[Note: the material from both these talks is largely contained in the background paper]

Discussion:

Muhondwa
* The project is a type of 'action research'. This is an advantage because many things will become apparent that are not in other forms of research
* In a filariasis study he had been involved in, people had thought it funny that grown men (the entomology field workers) were spending time chasing mosquitoes. This was considered to be a sign of madness, and one way of stating in Swahili that someone is mad is to say that he/she is 'chasing mosquitoes'
* The involvement of village leaders is important. In the filariasis project there was a big impact when the study was explained to village leaders and they were shown the larvae or worms with the microscope
* It was not clear to him what the link was between explanatory models for malaria and its transmission and the promotion of IBNs. How were we going to link one to the other?
* Bed nets may be a sign of status. Commonly they are only owned by the 'dukawala' or shopowner. It must be remembered that bed nets are an aspect of material culture. We can not give out nets and say 'if you use it, it helps' and expect other changes in the community. People may wonder whether it is not appropriate for them also to gain access to other household items/features that are found with bed nets such as screening or cement floors. 'We want a modern house', it is a package. We need to ask 'what goes with possession of a bed net?' or 'a good modern house is.....?' For example, beds go with bed nets. We need to broaden the scope of the research.
* Proper use is difficult. Old-time malariologists in London considered bed nets to be a good way of trapping mosquitoes, because people invariably used them improperly. Has this changed? Also, children are very active during sleep. A child rarely wakes up where he/she went to sleep. How will this affect the efficacy of bed nets?

Winch
* According to experimental hut trials, impregnated nets with holes work about as well as nets without holes. In other words, impregnation will lessen some of the problems associated with improper use.

Minjas
* torn net is still a good trap for mosquitoes

Leshabari
* Many aspects of the study may be perceived as an invasion of privacy: asking people where they sleep and with whom, coming into the house during the middle of the night to catch mosquitoes, going into parts of the house where normally even the children are not allowed to enter. This may affect community participation.

Lwihula
* In other studies these problems have not proven to be insurmountable, provided it is explained to the community in advance what is planned. For example, in filariasis studies blood samples have been collected at midnight with no problems.

Premji
* Clinical picture of malaria in adults is changing. Pregnant women and young children are no longer the only ones at risk. At Muhimbili Hospital there have been cases of adults with severe cerebral malaria

Ndyetabura
* Most kids have no bed, they sleep on the floor. Where and how are we going to suggest that they hang up their nets? Can mattresses also be provided to go with the nets. It might even be possible to impregnate them.

Laver
* We have to remember community participation. People will tell us how to design the nets. We should ask them, instead of making the decisions ourselves.

Alilio
* The study in Muheza showed that people sleeping on the floor were actually better protected than people sleeping on mattresses.
* A big problem in Muheza was the great expectations people had of the intervention. People expected malaria and mosquitoes to disappear with the intervention. When they did not, there was disappointment. We must avoid creating unrealistic expectations.

Muhondwa
* Many projects have the 'wrong employees'. The locals are only employed as insect catchers, not in the higher more responsible positions. If an effort is made to recruit local people, acceptance of the project can be much higher. 'That is my son doing that'. He gave the example of a person in Tanga who asked him his name and then said: 'you are a Christian, why do you not hire Moslems, why are our people never hired? You are in this for yourselves.'

Minjas
* An effort is being made to recruit several experienced people from Bagamoyo District for the entomology work.

Discussion question: What is the balance between simple messages with little explanatory power and more complex messages with greater explanatory power?

Winch
* One reason for the decreasing number of cigarette smokers in USA may be that messages are now more complex. Instead of stating 'if you smoke, you will get cancer and die', they state 'if you smoke a pack of cigarettes a day for twenty years you will have ___ probability of getting lung cancer'. Vector control messages are all very simple 'no mosquitoes, no malaria', so much so that they have little explanatory power.

Leshabari
* The effectiveness of a message in bringing about behavioural change is dependent upon the source, the type of medium and the content. With some mediums you can not transmit very complex messages. You can not be transmitting complex messages with probabilities etc. at a time when people are too busy to think about them.

Laver
* Channels should facilitate dialogue. We need to get away from the one way transmission of simple messages.

Alilio
* In a survey on health education messages and people's understanding of them in Morogoro, people often stated "this is what we are told in the dispensaries", and then proceed to state what they themselves believe. There is a contradiction between the 'dispensary knowledge' and the local knowledge.

Winch
* Similarly in Mexico we have found that people preface statements about malaria, dengue with 'they say', for example 'they say malaria is caused by mosquitoes'.

Discussion question: Models of malaria for complex, relation between malaria and mosquitoes in often unclear. Is it better to ignore malaria and focus on the efficacy of nets in protection from mosquitoes and bed bugs, which are the more observable effects?

Laver
* We need to find out which the community feels is more of a problem, malaria or mosquitoes, and concentrate on that.

Winch
* If we concentrate on mosquitoes, people may not use nets when there are less mosquitoes, although malaria risk is still present then.

Minjas
* Mosquitoes are a year round phenomenon in many places such as Dar where they are breeding in septic tanks etc.

Majala
* Mosquitoes may be associated with malaria, or they may be associated with fever in general. This will make a difference.

Muhondwa
* At first pit latrines were promoted in Tanzania entirely on the basis of the health benefits to be gained from using them regularly. Their use was said to prevent 'safura' or hookworm. This had little effect on their use. Later the convenience and aesthetic qualities of latrines were stressed, and use started to increase. In some places an emphasis on mosquitoes will be appropriate, in other places an emphasis on malaria.

Lubega
* We can not say nothing about malaria, because if we do, it will be hard to explain why we want so many blood samples. We need to explain why we are measuring disease.

Minjas
* The relative importance of malaria and mosquitoes should be ranked.

Muhondwa
* The experience with pit latrines is that both need to be promoted. One or the other is not enough.

Winch
* Different messages will appeal to different people. We can not say 'the people think malaria is more important', because some will think that way, and others will think mosquitoes are more important. For this reason multiple messages will be more effective.

Discussion question: What claims should be made with respect to the effect of the bed nets on malaria morbidity and mortality?

Alilio
* We should start by emphasizing the decrease in man-mosquito contact and decrease in nuisance that results from use of the nets. Once people have heard and understood this we can proceed to more complex claims.
* People like things they can see and observe. For this the barrier effect of bed nets will be more impressive than the disease control effect of bed nets.
* We have to avoid overexpectations. In Muheza, people said at the end of the study 'they have been here for two years and we still have mosquitoes'.

Laver
* It depends on what they think malaria is and what they think causes it. Some ideas are false or counterproductive and should not be incorporated into our health education. Other ideas are true, are more compatible with what we are trying to get across, and can be incorporated into our health education.

Lubega
* The changes we are looking for may be so small that they will not notice them. We therefore should be careful about making claims regarding noticeable changes.

Temu
* We need to know what the baseline health status is, what the school attendance, and then measure changes. We need to explain these results and changes to the people

Nyange
* We need to know the general level of mortality, the infant mortality rate etc. The mortality rates of the group to whom we are making the claims will influence the sort of claims we want to make.

Discussion question: What claims should be made with respect to mosquitoes, bed bugs, cockroaches etc ?

Winch
* We need to careful making these claims. With DDT spraying of houses, early on it was noticed that cockroaches were killed. when they became resistant (often before the mosquitoes) it was thought that the spraying did not work any more.

Muhondwa
* You can demonstrate effects to scientists with the [statistical] results of the studies. You also want to take the communities on board. You need to think where you want to put your emphasis

Alilio
* In the study in Muheza where ICON (lambdacyhalothrin) was used, the biggest perceived benefit was protection from nuisance mosquitoes, followed by protection from malaria, reduced bed bugs and cockroaches, and not needing to use bed sheets.
* If bed bugs, cockroaches etc. are indeed affected, we need to make these claims in our promotion

Discussion question: Should transmission be mentioned, and if so, how should it be explained?

Minjas
* We must give some education. We can not have a three year study and at the end leave communities as ignorant as they were at the beginning.

Ndyetabura
* We can not ignore malaria, they know we are measuring it. They need the link and the explanation.

Laver
* It is an ethical issue. We have no right to withhold information. It is their right to know about transmission.

Temu
* All positive cases should be treated and followed up.

Minjas
* We will do incidence studies on cohorts of children, but we are not treating the whole population.

Muhondwa
* We are coming back to earlier questions about an integrated approach. We are not in the business of controlling malaria. We want to test the technology.

Discussion question: How can entomology and malariometry data be shared with the community?

Lubega
* GTZ has a health newsletter that they have used to communicate to the communities some of the results of their studies

Ndyetabura
* I have talked to people who work in malaria control in Nepal where there is epidemic/unstable malaria. There is quick feedback of results to the people through community health workers

Laver
* In Zimbabwe simple bar charts and pie charts have been displayed at clinics showing the results of studies we have carried out

Alilio
* In Tanzania neither CHWs nor clinics may be a good way to feed results back to the people. CHWs often are not trusted. 'They are as bad as we are'. In addition, CHWs are overburdened with a number of other responsibilities.
* In a study in Morogoro there have been a number of negative comments about clinics. 'They make us stay too long with of all this [health education] nonsense'. 'We must boil syringes'.
* Posters and calendars may not be that informative.
* In Iringa UNICEF used videos. This seemed to be very successful. People were interested in seeing themselves and their community in the video, it made it more relevant.

Muhondwa
* Feeding back information to the family and to the community will be different. It is straightforward to inform a family of results: 'you have ten children in the family, none have got malaria this year'.
* At the community level it is different. In Kagera the community was given the prevalence rates for AIDS in the community instead of individual results. They were told 'be careful, you can't tell who has AIDS'.

Winch
* People may not only be interested in personally relevant clinical malaria results, but also in when the mosquitoes are biting, how many kinds they are, where they live etc. We can not assume that people are not interested in the more 'abstract' results too.

Leshabari
* It is clear that baseline data must be gathered before we can answer any of these questions.

Tuesday December 4, Morning: Acceptance & Use of Bed Nets
Chairperson: M.T.Leshabari
Rapporteurs: P.Mujinja

The impregnated bed net intervention: why it was chosen, description of the technology, how it will be applied, expected results, description of the study site, workplan (timetable) for entomology/malariology component: J.N.Minjas

Introductory comments:

The impregnation of bed nets with insecticides has been an important advance. Many factors limited the effectiveness of non-impregnated materials: nets were often torn or not properly tucked in; mosquitoes fed on limbs that were sticking out; feeding occurred from underneath the bed, especially with beds made from maize stalks; people got bitten before bedtime; people woke up before dawn and mosquitoes were waiting for them.

Impregnated bed nets significantly improve personal protection: mosquitoes don't feed even if a limb is sticking out; lifespan of mosquitoes is shortened even if they pick up a sub-lethal dose of the insecticide (mosquitoes need to live approximately 10 days for the malaria parasites to complete their cycle in the mosquito); the insecticide is delivered more efficiently - the net is like a baited trap, it is the most likely site for the mosquito to land.

As Culex mosquitoes do not land on walls, residual wall spraying has little effect on them. IBNs, however, may have an effect on Culex. The quantity of insecticide used for IBNs is smaller than the amount used for residual wall spraying. IBNs are thought to be safer than spraying, as the spraymen receive much exposure when they are spraying walls.

Impregnation can be done by communities, this has been done in Muheza, Arusha and Zanzibar. Less supervision is needed than with vertical (residual wall spraying) programmes. There are advantages to 'impregnation en masse', although some people do not want their clean nets to be mixed with other people's dirty nets.

Nets can be identified by various colours and codes. This is so that we can see that all the nets are reimpregnated and monitor the loss of nets. In Zanzibar UNICEF used blue nets, while non-UNICEF nets were white. In Muheza a washable marker was put on the nets to monitor washing. In additions, bioassays should be done periodically on a sample of the nets to detect loss of efficacy with time and to detect insecticide resistance.

We aim to cover 10 to 20,000 families with this intervention. We want blanket coverage of a region, not isolated villages or areas. Logistics problems are in large part determining the study site. The proposed study areas is bounded by the Ruvu River and the Ruvu North Forest Reserve on the North and West, by the Mpiji River on the South and by the Indian Ocean.

Laver: Why this area?

Minjas
* some want the coastal region
* movement is unidirectional: either across the Ruvu River on the ferry or towards Dar es Salaam, less movement that in other areas

Leshabari
* if aim is to test IBNs, criteria for choosing the study site should be based on malaria prevalence/epidemiology, and the presence of mosquitoes. Logistics should be a secondary consideration.

Minjas
* the whole district has the same types of mosquitoes, there is not significant variation, except that salt-water mosquitoes are found along the coast

Leshabari
* information should be available on the district, and we should use it, e.g. the number of patients with malaria coming in from each area

Minjas
* we are open to advice

Laver
* are there schools in this area? This problem affects children, and a logical place to start would therefore be in schools.

Minjas
* there are schools throughout the district

Winch (to chairman)
* we should prolong this discussion on study sites as it is important

Mligo
* we must be careful with the behaviour of people - there are many practices common in this area which will limit the effectiveness of nets. Commonly along the coast people sleep outside during the hot season, and in town people often do not go to bed until very late

* Communication problems: the north-east corner of Bagamoyo District in inaccessible from March to June; the Ruvu River ferry often does not work during the long rains, so it is necessary to return via Chalinze; the north-west corner (Kibandu) is also difficult to reach during the long rains; the Chalinze area (immediately West of Dar es Salaam, away from the coast) would be a good study site
* malaria is the #1 problem in the whole District

Muhondwa
* there are two major factors to consider in the choice of a study site: 1) the mosquito and how its numbers vary with different environments and different types of economic activities; 2) the people, social and cultural differences between different areas; 3) trade centres - they are very distinctive
* the coast is a specific cultural zone
* although a small district may appear homogeneous, there can be important variations
* in my work with the promotion of latrines in Bagamoyo District the following variations were important: 1) the Mwinyi (descendants of Arab and Swahili traders) refused to dig latrines, they felt it was beneath them; 2) the Wakwavi are a cattle-owning semi-nomadic people who live inland; 3) near Tanga District people were more settled, accepted new ideas more readily, were very different; 4) people in the trade centres were very different from those living off the main roads
* different groups should be represented in the study area, or, if not, excluded on purpose

Leshabari
* There seem to be four factors here that need to be taken into consideration: 1) social class - higher (Mwinyi) versus lower (Wakwavi); 2) ethnic differences; 3) whether a settlement is a trade centre or not, rural/urban differences; and 4) logistics

Muhondwa
* categorisation can be difficult. For example, the Mwinyi may think of themselves as being of high socio-economic status because they have an overrun estate of 20 coconut trees that belonged to the greatgrandfather and some Arabic heritage. They do what they consider a gentleman should do. They may, however, be extremely poor. People in the trade centres are very different, and are materially well off. The Wakwavi have riches in the form of cattle, but this is not reflected in their material possessions.

Lwihula
* GTZ is operating in many villages in the District. Do we include or exclude those villages from the study?
* in the rotations of the fourth year medical students, they concentrate on the south-east corner, for that reason there will be little cooperation from people in the south-east corner

Leshabari
* ability to buy nets will vary between urban and rural areas

Alilio
* heterogeneity makes the study interesting, this heterogeneity should be sought out, not avoided

Nyange
* the different ecological, topographic and economic zones should be samples, e.g. trade centres, forest etc.
* if we pick only one type of zone there can be bias

Leshabari
* whose definition of town are we using? What may be rural to you may be urban to them.

Winch
* the study site needs to be a block and needs to be accessible. That means we have two choices: the block between the Ruvu and the Mpiji shown by Minjas or a block around Chalinze.

Minjas
* the study site must be a solid continuous block

Muhondwa
* do not rule out inaccessible areas. If resources are not the issue, we should take the good with the bad, take blocks which are scattered throughout the District

Lwihula
* we should take a block from each type of cultural region. We might take three well-separated blocks which would represent the heterogeneity in the District

Muhondwa
* if we take blocks, the villages (in between) not picked may still have access to the intervention

Mujinja
* the villages immediately outside of the study area may have more mosquitoes if they are repelled there by the presence of nets in the intervention villages

Minjas
* in the original plan there are natural boundaries such as the Ruvu North Forest Reserve, the Ruvu River and the Indian Ocean so this will not happen

Premji
* the proposed control are along the south bank of the Ruvu River is different from the proposed intervention area. It is low-lying and prone to floods.

Leshabari
* the proposed study size of 20,000 would mean that we can only study 3 villages

Minjas
* the villages are small, 20,000 will mean many more than 3 villages

Laver
* we have an overstudied area used by the Department of Community Medicine at the University of Zimbabwe. I have reservations about working in such an overstudied area here.

Muhondwa
* it is bad to work in an 'overstudied' area, but the bonus is that it is an intervention activity. We can say to the communities "in the past we have only done studies. This time we will work with you on a problem you think is important".
* in 'unstudied areas' it may be hard to get husbands to let you talk to their wives - in Bagamoyo this is not a problem.

Ndyetabura
* is it possible to have an intervention block only? We could measure the pre and post-intervention parameters in the intervention block and compare them.
* the idea of a control is new to me. If we have one it should be farther away.

Leshabari
* I do not recommend having a control area. It is better to have a 'sharp epidemiologic knife'.

Alilio
* there may be areas of resistance to intervention implementation within the intervention area. This happened in Muheza
* problems with logistics may be exaggerated. In Morogoro they told me that one village in inaccessible during the rainy season. I had no trouble getting to it. We need concrete evidence of logistics problems, not just reports of them.

Muhondwa
* this project is not out to prove that IBNs work. We have baseline data, it is shown that they work.

Winch
* this is an efficacy trial: we are trying to show that, under optimal conditions, the intervention has a significant effect. This is not an effectiveness trial, in which we put a proven intervention into the hands of the Ministry of Health and seem how effective it is given common administrative and operational problems.
* Although other trials have shown that IBNs are efficacious we must keep in mind that: 1) any trial of any type will have an impact on health, just because of the presence of vehicles and trained personnel to transport and help people; and 2) the trials in Tanzania have shown an effect, but it was small. It such a small effect large enough that we would recommend to the Ministry of Health and they invest scarce resources into an IBN programme? In this trial we want to see if the magnitude of the effect is greater and is significant when a large contiguous area is covered.

Mligo
* will Bagamoyo town be excluded? People in the town will want nets.

Winch
* urban malaria is a problem in Tanzania. Control programmes in Dar es Salaam have not been very successful. Maybe we want to include an urban area (Bagamoyo town) as part of the study, and seek extra funding if this is necessary.

Leshabari
* the limit is 20,000 houses. We can not go over it.

Lubega
* The efficacy of IBNs is not proven in Africa, only in China.

The impregnated bed net intervention: plans for distribution, reimpregnation and promotion of proper use, plans for measurement of usage, anticipated problems (causes of non-acceptance and difficulties in measuring usage), workplan for social science component: G.K.Lwihula

Introductory comments:

* the study site has a mixture of ethnic groups including Zaramo and Kwere

* the applied social science investigations carried out as part of this project will have the following general objectives:

1) PRE-IMPLEMENTATION STUDIES: To determine how the intervention should be implemented. This encompasses such questions as what type of bed net (individual or family size, shape etc.) people prefer, how should bed net distribution be organized (through community organizations, clinics etc.), what channels (radio, flyers, house-to-house visits etc.) should be used for health education and how best to communicate to the community about the purpose and use of the nets.

2) ASSESSMENT OF USE OF NETS: To determine what percentage of people use the nets, and if they are used appropriately.

3) COMPARISON OF USERS AND NON-USERS: To examine barriers to adoption of the intervention by comparing the characteristics of the users and non-users of the nets.

4) ASSESSMENT OF SUSTAINABILITY: To assess long-term sustainability of the project.

* during the pre-implementation studies contacts will be established between project personnel and residents of the study site, information will be gathered about the villages in which the study will be conducted, knowledge and beliefs about malaria and other febrile illnesses and disease transmission will be investigated and different methods of distributing and impregnating the nets will be considered

* objectives 2, 3 and 4 involve the study of migration patterns both within and out of the district, beliefs with respect to bed nets, sleeping patterns, outdoor and indoor activities which expose people to mosquito bites and the willingness of people to NOT wash nets for at least six months

Discussion:

Muhondwa
* does the study of migration exclude 'visiting', for example when guests stay at the house or children stay with their uncles?

Leshabari
* people may have no choice but to wash their nets because the nets will smell from sweat and dirt

Laver
* we need to explore the potential for community participation during the pre-implementation stage. If we leave it until the implementation stage, it is too late

Leshabari
* what is community participation? We need to be clear about how we use this term

More comments by Lwihula:

* An accurate assessment of compliance with net usage during the intervention will be crucial for this study. Without this assessment, no conclusions about the efficacy of impregnated bed nets can be made. There are four ways in which levels of usage of IBNs can be assessed:

1) SURVEYS WITH CLOSED-ENDED QUESTIONS. Questions about whether a household owns bed nets, whether they are being used and whether they are being washed can be included in multi-purpose surveys, or in surveys which only examine usage of IBNs.
2) DAYTIME OBSERVATIONS. In this method, houses are visited during the day. All nets are examined, and their serial number, condition (presence of holes, presence of washable ink indicating that they have not been washed) and position (beside bed, over bed, elsewhere) are noted. Questions are then asked about how many people slept under each net on the previous net and how many people did not sleep under any net.
3) NIGHTTIME OBSERVATIONS. Observations are not made when everyone is in bed, as this is too intrusive. Leake and Hii made observations between 9 pm and 12 pm, when all children and some adults had gone to bed. Observations could also be made in the early morning, when women are up fetching water or preparing food but men and children are still in bed.
4) INFORMAL CONVERSATIONS AND OBSERVATIONS. This method is an adjunct to, but not a replacement for, the above methods. As a result of daily contact with community members, project staff should be able to get an impression of whether most people are using the nets or not.

* it is planned to assemble the following team to carry out the social science research: 2 full-time social scientists, 1 data clerk, 4-8 part-time research assistants (to be used during surveys) and 2 principal investigators (Lwihula, Winch)

* it is planned to acquire the following equipment for the social science investigations: 1 4-wheel drive vehicle, 2 motorcycles, 1 computer

* the timetable for the social science investigations is:

Month	Weather	Activities
Nov 90	Light Rain	Recruit social science graduates Protocol development Development of instruments (English)
Dec 3-4 90	Light Rain	Workshop at Kurasini: Revision of protocol Review and modification of instruments
Jan - early Feb 91	Light Rain	Translation of instruments Eng -> Swa Pre-testing of instruments Hire and training of 2 social science graduates Mapping: soc sci & ento field staff, Establish contacts in community
Late Feb - Apr 91	Heavy Rain (Ramadan Apr)	Initial round of interviews in more accessible areas of district
May - July 91	Rain ends, then dry	Second round of interviews in less accessible areas of district
Aug - Sept 91	Dry, then light rains	Analysis of interviews Decisions on objectives of educational/promotional materials
Oct 91	Light rain	Design of educational materials Design of pre-intervention survey to test effect of ed/prom materials, Workshop to review plans & educ mat.
Nov - Dec 91	Light rain	Conduct pre-intervention survey Preparation in communities of system for distribution of nets Training of personnel to monitor use
Jan 92	Light rain	Distribution of nets
Feb 92-94		Promotion and monitoring of net usage
Mar - Apr 94		Initial Data Analysis, Workshop to discuss results

Discussion:

Muhondwa
* the research plan looks great. The major defect is that there is no distinction between data collection at the household level and data collection at the community level
* I recommend the use of focus groups for data collection at the community level - it is ideal for learning about definitions and perceptions of problems by the community
* you should consider the use of participatory research methods in which you make community members part of the research team. Much of the participatory research methodology was developed right in Bagamoyo District
* sharing data with the community will be much easier if they have taken part in the data collection

Lwihula
* I agree with all four points

Laver
* I am worried about the late placement of the health communication materials development in the timetable. The community can be involved in defining the problem right at the beginning using picture codes and 'stories with a gap'. They can then work with you in the development of health communication materials to be used in the intervention

Sustainability and cost recovery: P.Winch

Introductory comments by Winch

* Self-reliance in general is difficult, and is especially difficult for vector control programmes as most of the insecticides and equipment are imported. For this reason many programmes end as soon as external funding ends.

* There are already indications that many Tanzanians are willing to pay for nets. There are two important questions, however:
1) Will enough people buy nets for there to be a significant impact on malaria transmission?
2) Those who do not pay were probably at greater risk for malaria before the intervention due to their lower socio-economic status. Will their risk of malaria be increased as mosquitoes are diverted from the houses of those with nets to houses without nets?

* Seasonal availability of the nets will be important. In Bagamoyo District people have very little money during March, April and May, yet this is a time of the year when transmission is perhaps greatest.

* There may have to trade-offs between efficacy and sustainability. Cotton nets could more easily be produced in Tanzania, possibly even at the local level. Cotton nets, however, are more absorbent of insecticide and therefore will not be as efficacious. Nets made of artificial materials will be more difficult to product in Tanzania and therefore make the intervention less sustainable, but they absorb less insecticide.

Discussion:

Minjas
* There is no problem making nets here in Tanzania
* There are groups working on insecticide formulation that would be more appropriate for cotton nets
* At present more insecticide is needed to impregnate a cotton net which increases the cost
* The textile industry is thinking of getting into the production of synthetic nets

Mujinja
* These questions are all very difficult: if someone has a net, that does not mean that they will have no malaria or no mosquito bites, and so the willingness of people to pay for nets is not guaranteed
* It is hard to know who will pay for the nets until the population is familiar with the technology

Leshabari
* Payment for nets does not necessarily have to be in cash

Alilio
* people are interested in cash transactions, not payment in kind
* sustainability of the intervention will mean selling nets in shops
* there is great competition for resources: people also want to buy kangas, food etc.
* McCormack in the Gambia reports that nets were sold successfully during the harvest season

Lwihula
* we need to create the demand for nets. We start by giving nets out free, and hope that once people see their utility there will be a demand for them

Nyange
* when we set prices we need to take into account that those who are selling the nets will want to make some profit
* there is the danger of people selling the nets if we give them out free

Leshabari
* selling always goes on - we see people wearing military uniforms on the street

Nyange
* when condoms were distributed free in Bagamoyo District, soon we found that they were being sold by the roadside

Ndyetabura
* I am concerned about the sustainability of the insecticide. How is the insecticide going to be made available to people?

Minjas
* pyrethroids will be registered and marketable
* this 'market' is not yet apparent to businessmen

Premji
* the observations on the toxicity of pyrethroids have all been over a short term. The long term effects, say after someone has used an impregnated nets regularly for 25 years, may be greater
* consideration should be given to analyzing serum for levels of toxin

Minjas
* pyrethroids are considered to be very safe, although the long-term effects are unknown

Alilio
* one person impregnating bed nets in Muheza with deltacyhalothrin got a very swollen face and hands. A number of people had cold-like symptoms such as stuffed-up nose.

Open discussion

Winch
* how important is proper usage? If a person is using a nets, but is 90% out of it, does that count as usage?

Leshabari
* social scientists will need to define proper usage, and then measure it

Winch
* people will tend to not use nets during the hot, dry season. Should we push them to use nets during the hot season, even though they will probably not continue this after we leave, or should we devise a more feasible alternative behavior, such as hanging the net as a curtain beside the bed during the hot season?

Minjas
* there is no option. We must aim to have people use nets properly throughout the whole year.

Premji
* an opaque net would not be used during the hot season, but a transparent one will be used as it provides more ventilation

Leshabari
* we should not change the rules just because it is hot

Premji
* I did not see a timetable for the entomology studies

Minjas
* it is essentially the same as for the social science studies. Mapping will take place from January to March, followed by collection of background data and the intervention will start in January 1992.

Alilio
* a mix of methods is needed. Focus groups may be better for women, and one-on-one interviews better for men. It is also good to have a mix of formal and informal methods. Flexibility is important.
* we try to avoid imposition, avoid imposing our ideas on people, but sometimes we need to state our ideas forcefully.

Leshabari
* there needs to be a balance between democracy and imposition

Premji
* nets should be used by health workers and hospitals to set an example

Mligo
* the functioning of the GTZ village health worker programme in Bagamoyo was sustained by the allowances given to CHWs, the reliable supply of essential drugs and the presence of supervisors with motorcycles. All of these things cost money, and therefore when funding is withdrawn sustainability is difficult.
* the GTZ and DMO systems were operating in parallel, there was little coordination between them
* there should be close coordination between this programme and the DMO at every stage

Tuesday December 4, Afternoon: Community participation and health education

Chairperson: E.P.Y.Muhondwa
Rapporteurs: Z.A.Premji, P.Lubega

Health Communication and Community Participation - Sue Laver

Introductory comments:

There have been both successes and failures among health care programmes. Successes have been related to technologies such as smallpox vaccine. The failures, for instance many smoking cessation programmes, have been related to human behaviour. The gap between technology and people that leads to these failures is often information. We need to look at past approaches and learn from them. Some of the common barriers to communication are:

1) Dependency on Didactics. There is the feeling that we must always tell someone what to do. I do not like the term 'health education' because it sounds 'top-down', implies a one-way flow of information from the educated to the uneducated.

2) Top-down vertical programmes. Important decisions are made at the top and people are not involved in planning and decision-making from the start.

3) "Telling - not selling". We assume it will be obvious why what we want people to do is the right thing to do.

4) Poor perception of social and traditional forms of communication. Traditional forms of communication are thought of as 'unprofessional'.

5) Messages and outdated and Westernized. Messages are designed in Europe or North America and used unmodified from country to country and are not brought up to date.

6) Objectives are fragmented. Many agencies and donors result in contradictory messages/priorities/recommendations.

7) Feeling that communities should be grateful recipients of scientific endeavours and research.

8) Poor utilization of communities as a resource. There are artists, poets etc. within communities who can help with health communication.

9) Unquestionable belief in the institution (carrying out the programme or study) - whatever the institution prescribes must be right.

10) Communication starts too late in the project

Other problems can be categorised into:
- planning
- organisational barriers (including planning)
- communication barriers
- evaluation

Do these points apply to the situation in Tanzania?

Muhondwa
* Tanzania is not too different
* GTZ has utilized traditional methods of communication. This was demonstrated in the Tanzania Public Health Association conference where a 'choir' of primary health care workers who are part of a GTZ programme sang songs about family planning. It is true that traditional forms of communication are thought of as 'unprofessional'.

Laver
Some of the ethical issues in health communication are:

1) Credibility of the communicator. Who does the communication, and how they behave is critical. In this programme we should be sure that communicators use nets themselves, that they are good 'role models'.

2) The justification for the intervention should be medically and technically sound. This justification should be explained to the communicator.

3) Personal opinion versus social responsibility. Should nurses who do not want to promote contraception have to resign?

4) Preferences versus societal norms.

5) Control groups. What are the ethics of testing nets versus no nets within households or between communities?

What is an effective method of health communication at one stage may not be effective at another stage. The communicator must both be sure of the information and also be sure of the method which will permit change to take place and the stage it should be used. Dialogue, rather than a one-way flow of information, is conducive to change.

The chart below summarises the different types of communication strategies or channels that are available. The difference between a poster and a picture code should be noted. a poster poses the solution, for example by showing a bed net. A picture code poses the problem, for example by showing a child shivering, lying in bed (with malaria). In a 'story with a gap', two pictures are shown, for example a healthy baby and a baby with kwashiorkor. People are asked 'what happened?'. In other words they think through what the conditions were that lead to the baby's ill health.

Communication strategies and where each is most effective:

Communication Strategy	Cognitive (Knowledge)	Affective (Attitude)	Behavioural (Skills)
Lecture	✓		
Group Discussion		✓	
Demonstration			✓
Drama		✓	
Role playing			✓
Print Media	✓		
Pamphlets	✓		
Poster	✓		
Picture Code	✓	✓	
Video	✓	✓	✓
Radio	✓	✓	

Phases of a community-based public health intervention and appropriate communication strategies for each phase

PHASE	KEY ISSUES	OPPORTUNITY FOR PARTICIPATION	COMMUNICATION STRATEGY	RESEARCH ISSUES
PLANNING	* key leaders *introduction of concept	* data gathering (disease summaries) * action plans * clarification of beliefs	* focus group discussions * picture codes * stories with a gap	* perception studies * literacy * channels of communication
MOBILIZATION	* adoption * attitude change	* trial of IBNs * design/make IBNs * malaria action committees	* drama * posters * open meetings * demonstrations * video	
IMPLEMENTATION	* usage * promote sustainable behaviour		* print media (instructional support)	* measurement of usage
EVALUATION	* monitoring * review	* data gathering * maintenance 'team' * review progress	* video * focus group discussion	

Based on the above, some guidelines for health communication are:

1) See where people are at.
2) Build on existing knowledge bases.
3) Involve community at every phase.
4) Be sensitive to cultural issues.
5) Prepare thoroughly for the intervention.
6) Promote perceived benefits.
7) Only provide information that people can act on.
8) Be sensitive to project phases and utilize appropriate strategies.
9) Utilise experiences from other 'successful' programmes (EPI etc).
10) Adopt a truly participatory approach.

Discussion:

Muhondwa
* I hate to play the devil's advocate, but this sounds like a third research project - communication research. How do you integrate the knowledge of mosquitoes and of people with good communication? This is not a Ministry of Health project, but rather a research project with limited goals and objectives.

Laver
* you need to have a communication support team on the ground from the very first stage of the research. The team can contribute to the social science research by doing Freire-type disease summaries. It can contribute to the entomology by explaining the purpose of the entomology studies to the community and feeding them back results. The team is very important in community mobilization.

Muhondwa
* Freirian methods are open ended - other concerns not related to malaria and mosquitoes will be brought up which we do not have the time, money or expertise to deal with. Can we deliver?

Laver
* when I was working in a remote community in Zimbabwe on a water and sanitation project, people said they wanted a beer hall, not a well. Obviously working with the community will be a long process. We must find creative ways to feed back our results to the community. In Zimbabwe we use huge bar graphs and pie charts outside clinics to show what the results of our studies have been.

Premji
* People may go to sleep very late. What can we do about this?

Laver
* again there is an issue of credibility here. If we are walking around in the middle of the night collecting mosquitoes, our suggestions that people go to bed early and stay under nets will not be very credible.

Minjas
* the peak biting hours are between 10 pm and 3 am. If everyone is up during these hours, IBNs will not work. If only some people are out they still should work.

Leshabari
* a more frequent behaviour can be used to prop a less frequent one

Muhondwa
* if we work normal working hours, 7:30 am to 2:30 pm, only, we will miss much valuable information. It will be necessary for project staff to work irregular hours much of the time.

Minjas
* we will not have all the information right at the beginning. If I had the facts, I would go out and start discussing things with the community right at the beginning.

Laver
* you can't leave communication as a haphazard and unplanned activity. Even without all the facts, you can start the communication process at the beginning by telling people what data you are collecting and why.

Implementation of the intervention at the community level: Peter Winch

Introductory comments

Communities need to be involved in the distribution and regular reimpregnation of IBN so that the intervention is acceptable and locally sustainable with minimum input from government agencies. Although the project will bring many benefits to the community, many of the activities may be perceived as time-wasting or annoying. Collection of insects will take place in and around people's houses, repeated blood samples will be taken from children, children may have to take curative doses of malaria medication even if they do not feel sick and people will be asked many questions. Time will need to be invested in the establishment of solid contacts with communities at the outset. We need to consider how the community can be involved in planning, implementation and evaluation. Finally, it is necessary to consider the relative advantages of involving community health workers, village chairmen, 10 cell leaders or special purpose workers in our programme.

Laver
* the intervention is a package, not little boxes. The components interact at every phase of the project. The community needs to see us as one team, not a series of groups each with their own interests.

Minjas
* I agree that we all need to act as one team.
* as far as implementation of the intervention is concerned, the support of the government and party structures is indispensable. Although the government has cleared the idea, we need to see the regional administration, the party and government officials at the District level and the District Medical Officer. At the village level the chairmen and balozi are indispensable.
* I do not know how much time the GTZ village health workers will have.

Laver
* this is a three year project. At the beginning there is the need to establish a consistent team. Maybe considerable time will need to be spent creating this team.
* we can not be too dependent on government agencies, as they have other responsibilities which may call them away from their commitments to us.

Minjas
* the core team in the field will consist of Pros Lubega, and at least 3 field workers (social science, malariometrics and entomology).
Alilio

* sometimes the CCM (Chama cha Mapinduzi - the national political party of Tanzania) structure is not trusted - in Muheza we found that the katibu was actually selling the nets.
* there have been many government vertical programmes in the past. If you make use of the village chairman and 10 cell leaders you run the risk of perpetuating this vertical approach
* I would be skeptical about using the CCM structure, it is necessary to spot pitfalls early on.

Leshabari
* problems with the CCM are isolated incidents. Even if the local CCM structure is bad, you need to use the system because officials such as the village chairman have dual roles, as individuals and as bureaucrats.
* we need to be cautious with community health workers. We do not know what kind of respect they enjoy.

Muhondwa
* if we are going to do multidisciplinary research we need to be explicit about how it will occur. We should be able to see the interlinkages between the different disciplines.
* mobilization usually takes place through the community leaders. The CCM officials act as conduits, and we try to accomplish our goals with minimum discussion. We need to consider at what point we can say "thanks mwenyekiti, I can work on my own now". We should also consider going directly to the community members under some circumstances.
* I like special purpose workers. They enable projects to get going, but they create unnecessary compartments.

Leshabari
* It may be better to assume that other workers (community health workers etc.) already have their time fully booked

Mligo
* there are already two CHWs in each village. As the CHWs are in the villages, they should be used.
* the net issue will not take much of the time of a CHW compared to other duties
* it is not proper to put another worker in a village if a CHW is already there

Muhondwa
* the CHWs may become involved in nets and abandon other duties

Alilio
* the problem with CHWs is that every project wants to use them, so they get overburdened
* you can use local people or people recruited from other areas. An example of the use of local people was in Muheza where we had 'village coordinators' for the bed net project there. These people did observations on net usage, and because they were related to the people they were observing, they were unobtrusive. The problem with local workers is that they can be hard to supervise. there are many other activities going on in the village which tend to divert their attention.

Majala
* if this is a 'health' project, we must involve the community health workers. Why have two people doing the same thing?

Laver
* this is a research project. Some of the tasks which will need to be done will be more related to research than to health, and for this reason a community health worker might not be the appropriate person for the task.

* we should consider training workers in the project who could later train others to replicate the intervention so that it can be expanded after the project is over.

Lubega
* for malariometrics the CHW is the obvious link. We might have the CHW choose a special purpose worker to assist him or her.

Laver
* I would also like to see a communications person be hired and integrated into the team right from the beginning of the project

Lwihula/Minjas
* the communications person would be part of the social science team and would participate in some of the social science data collection responsibilities. Regular meetings will be held of the entomology, malariometry and social science field staff to facilitate communication and team work.

Conclusions and Recommendations

1) The workshop was successful in presenting the whole range of issues which would have to be faced in implementing an effective intervention. There was some concern expressed that many questions were raised, but few decisions reached. It is thought to be critical that the following issues be resolved as soon as possible:

i. A final decision should be made on the study site, including the number of families to be covered and the location of the intervention and control areas.

ii. The objectives of the social science, entomology and malariometry components should be reviewed again in light of recently published bed net studies and more detailed information about the field site. A firm consensus should be reached among all the project staff on these objectives.

iii. Workplans for the social science, entomology and malariometry components should be finalized.

2) It was felt that there was too little time at the workshop to adequately review and discuss the data collection instruments. It was recommended that people send their suggestions to Dr. Lwihula, and that a working group be convened, primarily from among the faculty of the Department of Behavioural Sciences, to review the instruments in detail.

3) Following the suggestion of Mrs. Laver, it was decided that a communications person should be hired to work with the field staff throughout the project. The ideal candidate would have several years of field experience, willingness to learn and take initiative, and familiarity with the primary health care philosophy. The person would not necessarily have to have a university degree, but a good working knowledge of English would be a requirement. Mrs. Laver will investigate the possibility of having this person travel to Zambia to observe the health communication and community participation component of a water and sanitation project there.

4) It was recommended that the entire budget be reviewed. As there were indications that a larger sample size and a more intensive health communication component are advisable, it was felt that additional funds may need to be sought so that the project can done as well as possible.

5) Coordination with government agencies was unanimously seen as a priority. It was noted that in some project little effort is made to explain the objectives in detail to the District Medical Officer or local government officials until the end of the project, when there is suddenly interest in sustainability. To ensure sustainability, local officials should be involved in planning and evaluation right from the beginning.

6) Finally, it was felt that the 'confusion' created by considering all of the social, cultural and economic factors the affect the implementation of intervention is healthy. Usually these factors are not considered until the project is over, at which point it is too late to make changes. By considering these factors now, a better intervention can be mounted.

Annex 2.

BAGAMOYO BED NET PROJECT

STAFF LIST

	NAME	POSITION	DATE OF EMPLOYMENT
1	Switbert Kamazima	Social Scientist	March 1991
2.	Ahmed Makemba	Social Scientist	March 1991
3	Naomy Mashauri	Administrative Secretary	March 1991
4.	Yuna Hamisi	Medical Assist.	May 1991
5.	Ali Mtengwa	Snr. Mosquito Collector	March 1991
6.	Ali Saidi	Mosquito collector	May 1992
7.	Juma Athumani	" "	May 1991
8.	Mrisho Kibaya	" "	May 1991
9.	Kassim Mwamba	" "	May 1991
10	Bakari Halfani	" "	May 1991
11.	Gabriel Jackson	" "	May 1991
12.	Michael Amani	" "	May 1991
13.	Ramadani Hassani	" "	May 1991
14	Mzee Abdullah	Watchman at project house in Dar.	
15.	Jinah Lile	Part time Social Scientist	
16.	Z. Premji	Part-time researcher - Malariometrics.	
17.	Ahmed Majala	Part time researcher Entomology.	

BAGAMOYO BED NET PROJECT **ANNEX 3**

SUMMARY OF THE GR DATA WITH COMPARISONS
TO THE GTZ AND NATIONAL CENSUS

VILLAGE NAME	CENSUS 1988	GTZ 1989	BBNP 1991
Kerege	503	366	485
Mapinga	518	171	479
Zinga	465	-	443
Pande	360	-	332
Kondo	282	317	340
Mlingotini	386	387	458
Yombo	328	-	304
Chasimba	386	218	482
Kongo	236	199	336
Matimbwa	252	246	375
Kiromo	576	649	599
Mataya	106	236	232
Buma	221	208	203
Total			

*note
1. Census and GTZ counted households yet BBNP counted houses in which people are living.

2. GTZ data is collected by VHW and the coverage depends on the VHW. Some households are very far from the rest of the village and may not have been covered.

ANNEX #4

SUMMARY OF PREVALENCE SURVEY DATA: BAGAMOYO DISTRICT, JUNE 1991

PART I: RATES OF SLIDE POSITIVITY FOR MALARIA

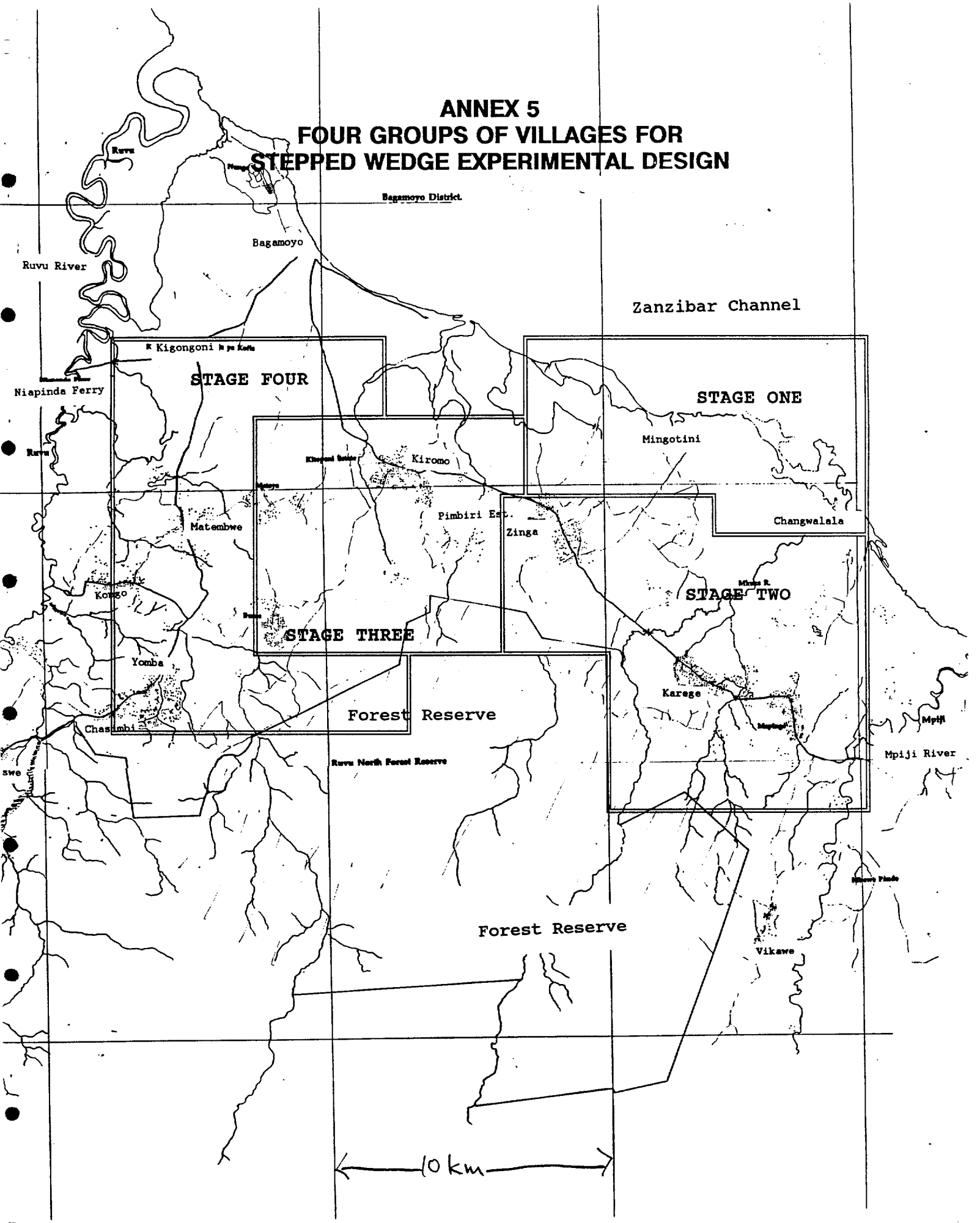
			Proportion Positive	No. Tested
For Entire Population			.6095	1224
Rates by sex				
SEX	0	Female	.6003	613
SEX	1	Male	.6190	609
Rates by age				
AGE	6		.4286	7
AGE	7		.5714	14
AGE	8		.6582	79
AGE	9		.6910	178
AGE	10		.6079	329
AGE	11		.5618	251
AGE	12		.6120	183
AGE	13		.6355	107
AGE	14		.4528	53
AGE	15		.6667	18
AGE	16		1.0000	3
Rates by school				
SCHOOL	1	Buma	.5625	64
SCHOOL	2	Kerege	.8194	72
SCHOOL	3	Kerege-Mapinga	.5000	52
SCHOOL	4	Mapinga-Mtambani	.7838	148
SCHOOL	5	Kiromo	.5797	69
SCHOOL	6	Kongo	.4925	67
SCHOOL	7	Mataya	.6301	73
SCHOOL	8	Matimbwa-Miembe Saba	.5556	81
SCHOOL	9	Mlingotini	.6757	111
SCHOOL	10	Pande	.5538	65
SCHOOL	11	Yombo	.5479	146
SCHOOL	12	Zinga	.7051	78
SCHOOL	13	Mwanamakuka-Bagamoyo	.5000	198

PART II: AVERAGE PARASITE DENSITIES FOR POSITIVE CASES (742 children)

(Number of malaria parasites seen per 200 White Blood Cells)

			Density	Number Tested
For Entire Population			29.4407	742
Parasite densities by sex				
SEX	0	Female	27.4768	367
SEX	1	Male	31.4332	374
Parasite densities by age				
AGE	6		106.0000	3
AGE	7		28.1250	8
AGE	8		33.9423	52
AGE	9		34.7355	121
AGE	10		30.3065	199
AGE	11		25.9078	141
AGE	12		23.9459	111
AGE	13		32.3971	68
AGE	14		11.5000	24
AGE	15		27.7500	12
AGE	16		60.0000	3
Parasite densities by school				
SCHOOL	1	Buma	47.4722	36
SCHOOL	2	Kerege	37.0508	59
SCHOOL	3	Kerege-Mapinga	23.9615	26
SCHOOL	4	Mapinga-Mtambani	43.6552	116
SCHOOL	5	Kiromo	22.5500	40
SCHOOL	6	Kongo	29.8485	33
SCHOOL	7	Mataya	24.6304	46
SCHOOL	8	Matimbwa-Miembe Saba	27.4667	45
SCHOOL	9	Mlingotini	22.0548	73
SCHOOL	10	Pande	21.6286	35
SCHOOL	11	Yombo	24.8250	80
SCHOOL	12	Zinga	30.1091	55
SCHOOL	13	Mwanamakuka-Bagamoyo	20.3878	98

ANNEX 5
FOUR GROUPS OF VILLAGES FOR STEPPED WEDGE EXPERIMENTAL DESIGN



ANNEX 6: THE STEPPED WEDGE EXPERIMENTAL DESIGN

Background

The Stepped Wedge experimental design was first used in The Gambia to assess the effectiveness of Hepatitis B vaccination. This vaccine was proven effective in controlled clinical trials, so it was known to be of benefit. It was uncertain, however, how effective it would be under field conditions. The vaccine was introduced into the regular programme of vaccination of children (EPI) one District at a time at three month intervals. The trial compared the districts where the vaccine had been introduced with the ones where it had not been introduced.

The Stepped Wedge Design is used where the following two conditions exist:

a) The intervention being tested in known to be of benefit, but it is unclear how great the benefit is. With impregnated bed nets, we know that they provide protection against biting insects, and in some trials they have appeared to provide protection against malaria. We are not sure how great the effect on malaria transmission and mosquito densities and longevity will be in an area of holoendemic malaria.

   As the intervention is of known benefit, it is unethical to deprive any group of it. For that reason, all parts of the study area must eventually receive the intervention.

b) The intervention is being implemented over a large area. It is logistically impossible to implement it over the whole area at one time.

Proposed Use of the Design in the IBN project

The study area would be divided into four areas corresponding to Mapinga, Kerege and Zinga (A-Kerege Ward); Mlingotini, Pande and Kondo (B-Kerege Ward); Kiromo, Buma and Mataya (C-Kiromo Ward) and Yombo, Chasimba, Kongo and Matimbwa (D-Yombo Ward). The intervention would be introduced into one area at a time at three to four month intervals. No groups would be labelled "control" and "intervention". Instead, the groups would be labelled stage 1, stage 2, stage 3 and stage 4. Such a design would be understandable to the villagers as they have experience with projects such as the DANIDA water project being implemented in stages.

Malariometrics and Entomology in a Stepped Wedge Design

Assessment of the effect of the intervention would be confined almost entirely to stage 2 and stage 4 villages. Three types of comparisons would be made:

1) Stage 2 before nets versus stage 2 after nets.
2) Stage 2 versus stage 4 during the period starting when nets are distributed in stage 2 and ending when nets are distributed in stage 4. This period should be at least of twelve months in duration.
3) Stage 4 before nets versus stage 4 after nets.

Starting in July 1991, a cohort of children (ages???) would be identified in stage 2 and stage 4 villages. These children would be followed on a prospective basis for the duration of the project.

Measurements of mosquito densities, age structure of mosquito populations and the types and proportions of anophelines infected with malaria parasites would take place in stage 2 and stage 4 villages. There would be two stations for human bait captures and other measurements in each village. Yombo and Chasimba would be counted as one village.

Some malariometric and entomological assessment might be conducted outside of the stage 2 and stage 4 villages if they are found to have some special characteristic that might change as a result of the intervention. For example, if 50% of the anophelines in Mlingotini are found to An. merus, which can breed in salt water, measurements might be conducted to see if this proportion changes as a result of the intervention.

Social Science (including economics) and Health Communication in a Stepped Wedge Design

Several major problems have been identified in the initial social science research which will need to be addressed in the project:

1) The word "malaria" is used be villagers in a more restricted way than it is used by biomedical scientists. "Malaria" seems to refer primarily to relatively minor episodes of fever. Many episodes of fever are attributed to supernatural and personalistic causes. "Dege dege" which seems to correspond to cerebral malaria in many cases does not seem to be not generally recognized as a type of malaria. The consequence of this "splitting up" of what is malaria in biomedical terms is that the true importance of malaria may be underestimated.

2) Mosquitoes are thought to be a problem primarily during one three month period of the year. There may be a tendency to only use nets at this time.

3) During the months of April, May and June, many people sleep outside near or in the middle of their fields of rice and cassava to protect these crops from wild pigs.

4) As few house have electricity, fire is commonly used for light, for warmth and also for chasing away pigs. This increases the risk of both small holes in nets which allow in mosquitoes, and nets catching fire and houses burning down.

There is a need for both more information on social and cultural factors, and for an early and comprehensive programme of health communication. The social science activities would be divided into three phases: planning, mobilization and implementation.

PLANNING PHASE:

All villages are now in this phase. One group of villages at a time will move into the mobilization phase. The chief activities in the planning phase are:

1) Communication of prevalence survey results in July 1991. This will be an opportunity to establish a relationship based on honesty and trust with the communities, to introduce the project to the villagers who have so far only heard about it indirectly from their leaders, and to start the process of enlarging and deepening people's concept of malaria and its consequences for the community.

2) Collection of information on community characteristics through focus group discussions and individual interviews.

3) Collection of information about understandings of health and illness, patterns of use of health services, and beliefs about biting insects and the prevention of malaria and other fevers.

4) Collection of information about sleeping patterns and the feasibility of using nets under various conditions.

5) A baseline survey to collect data on the number of nets needed, social and economic characteristics and risk factors for malaria (September 1991?)

6) A programme of health education focussed on malaria as an illnesses and its consequences.

MOBILIZATION PHASE:

The first group of villages to receive the intervention will move into the mobilization phase about October 1991. This phase will last from two to three months. The following activities will occur in this phase:

1) Formation of a group or committee in each village which would be involved in the distribution and reimpregnation of the nets and assist in the promotion and measurement of their use.

2) Health communication, probably using theatrical techniques to a large degree, to introduce the concept of bed nets and their impregnation, explain how they work (that if your neighbour uses them, this helps to protect you from malaria), explain the dangers of fire, and emphasize the importance of using them all year.

IMPLEMENTATION PHASE:

The first group of villages might move into this phase in January or February of 1992. Activities would be:

1) Distribution of nets and creation of a fund to pay for the replacement of damaged nets and insecticide for reimpregnation.

2) Setting up of nets. A team may need to circulate to set up nets in difficult conditions (very high ceilings, very small houses, beds placed outside when people are guarding crops).

3) Promotion of the proper use of the nets.

4) Monitoring of the rate of use of the nets through survey and observational techniques.

5) Collecting feedback from people on their reactions to nets and the benefits/disadvantages they perceive in their use.

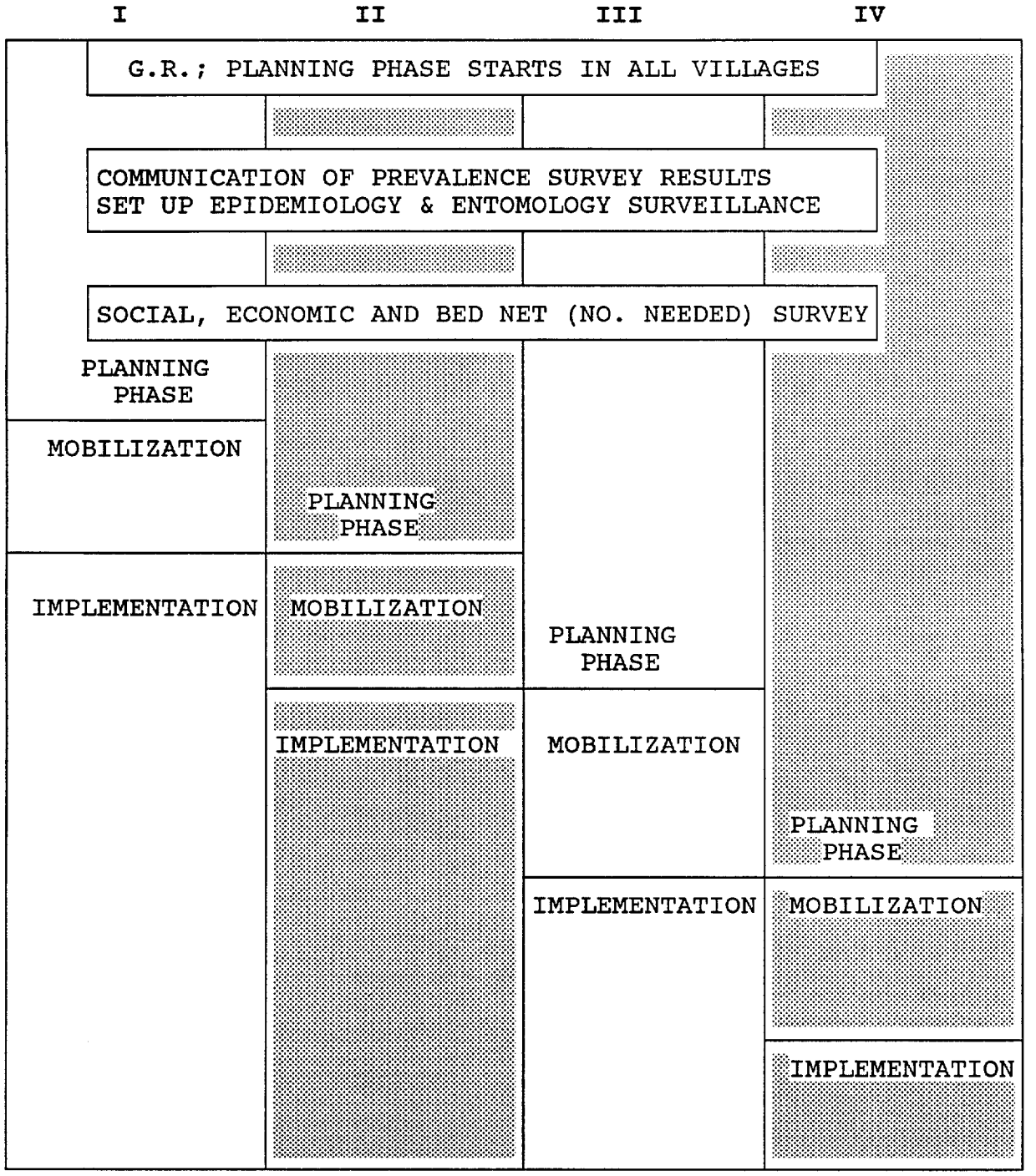
<u>Assignment of Villages to Different Stages</u>

1) Mlingotini, Kondo and Pande probably should not be in stage 2 or 4 because of strong winds coming off the ocean, and the presence of salt water breeding sites.

2) Epidemiology surveillance would be hard in Kiromo, Buma and Mataya as their is no dispensary in Kiromo ward and people go to a variety of places (Yombo, Chalinze, Mbegani, Zinga, Bagamoyo) to seek medical care.

3) Due to ward divisions, the order should probably be ABCD or DCBA.

STEPPED WEDGE



A	B	C	D
Kondo	Mapinga	Kiromo	Chasimba
Mlingotini	Kerege	Buma	Yombo
Pande	Zinga	Mataya	Matimbwa
			Kongo

ANNEX 7A: REPORT ON STATUS OF SOCIAL SCIENCE/HEALTH COMMUNICATION COMPONENT OF BAGAMOYO BED NET PROJECT: Peter Winch, July 13/91

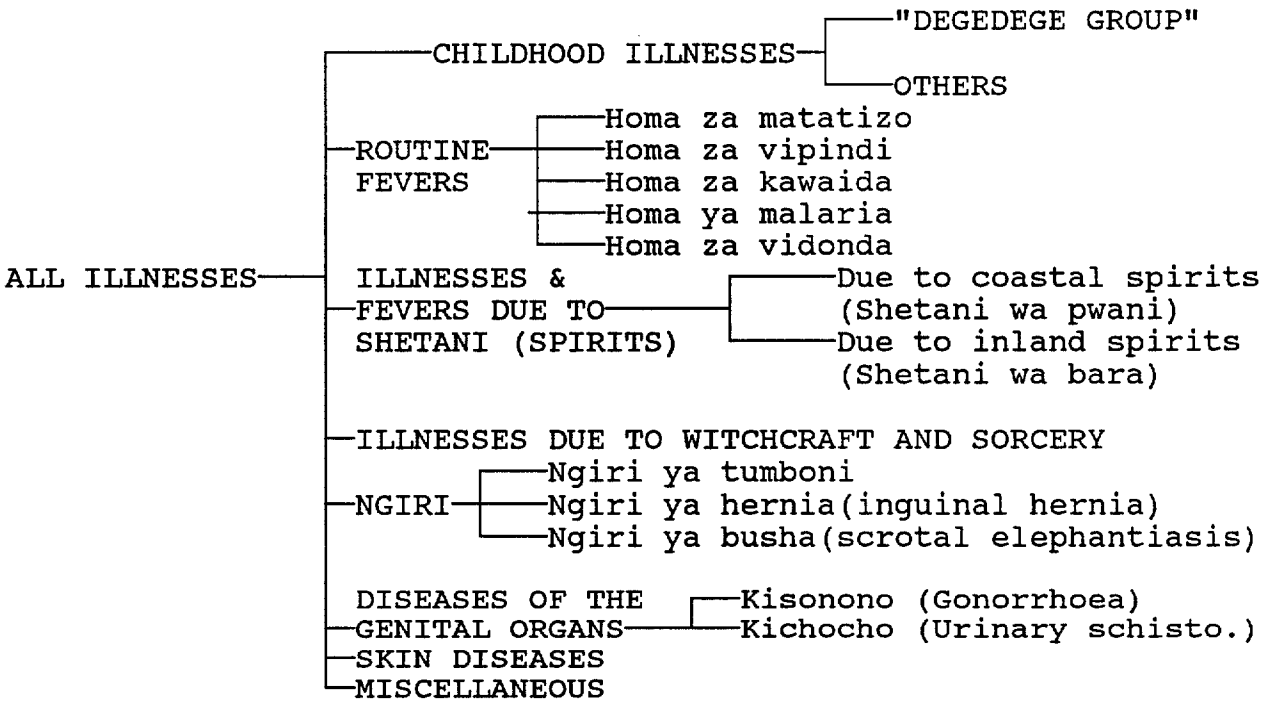
I. Local Perceptions of Malaria, Other Febrile Illnesses, Seasonality of Illnesses and Insects of Malaria, Other Illnesses and Insects

The word malaria appears to be universally recognized in Bagamoyo District as a common febrile illness which is caused by mosquitoes. Nevertheless, the importance of malaria seems to be underestimated by villagers. Several informants stated outright that malaria is not an important problem. To understand the reasons for this situation, it is necessary to understand the local taxonomy of illnesses.

Major groupings of illnesses

A list of 41 illness terms was compiled from the 13 focus group interviews. Each of these terms was written onto a card, and eight informants were asked to put the cards into piles of illnesses which were similar. Informants were then asked to justify the groupings they had made and talk about the illnesses in each group. This procedure took about two hours per informant. Another nine informants, many of whom were unable to perform pile sorting due to illiteracy, were asked to talk about the different illnesses one by one. Hierarchical clustering was performed using the computer programme ANTHROPAC.

Eight major groupings of illnesses were identified. Approximate English equivalents are in brackets.



1) Magonjwa ya watoto/Childhood illnesses:

"Degedege group"	
Kifafa (seizures)	Mkulumkulu
Degedege=ugonjwa wa kitoto	Vichango, kichango
Others	
Pepo punda (tetanus)	Utapia mlo (malnutrition, marasmus)
Pumu (asthma)	Sarua/bunduga (measles)

The meanings of and the relationships between the terms mkulumkulu, vichango, ugonjwa wa kitoto and degedege are complex and require further research. The prototype of the group is degedege. It is recognized by the sudden onset of severe fever, trembling and/or stiffness of the limbs, frothing at the mouth, babbling incomprehensibly (which is sometimes interpreted at speaking foreign languages) and a high mortality rate. This illness is greatly feared, especially because of its sudden onset. A few people stated that it was caused by malaria going to the brain, but most either did not know, or thought it was due to a shetani (spirit or devil) attacking the child. Two informants gave us a detailed description of how the shetani attacks: it is caused by mashetani wa pwani, in particular ibilisi. This spirit assumes the form of a bird and flies over houses. If there is a young child in the house, it may get degedege. Treatment is usually sought from a fundi or mganga wa kienyeji (traditional practitioner) rather than the dispensary or hospital. Any puncturing of the skin with needles is thought to be particularly dangerous, as this allows shetani to enter the child and kill him or her. Degedege is so feared that people hesitate to mention the illness by name. Ugonjwa wa kitoto (literally childhood illness) is commonly used as a euphemism for degedege, and may be a preferable way to ask about degedege in malaria surveillance activities.

Mkulumkulu and vichango are conditions related to degedege. The term mkulumkulu means "big-big" in Kizaramo and is almost exclusively used by the Zaramo. Some informants say that it is synonymous with degedege, others say that it is the name used for a group of illnesses which includes degedege and kiarusi/kiharusi, which is used for strokes in adults. Vichango is sometimes described as being the same as degedege, and other times as being similar to severe dehydration with complete absence of stool and urine output and drying out of the skin. It bears some simiarity to an illness category "empacho" described in Honduras by Kendall.

This group of illnesses is important as it appears to include what is recognized clinically as cerebral malaria in children. These conditions are thought to be unrelated to malaria, however, a fact which may lead informants to underestimate the importance of malaria as a cause of death in children. Furthermore, treatment is seldom sought, at least initially, from practitioners of cosmopolitan medicine.

In addition to cerebral malaria, the vichango-mkulumkulu-degedege group of illnesses may correspond clinically to febrile convulsions, severe pneumonia, dehydration or meningitis.

2) Routine fevers (Homa)

Fever is an important symptom and is mentioned as a symptom of almost every illness, both inside and outside of this group. One informant stated that "fever is the mother of all illnesses". Some informants make clear distinctions between different types of fevers, and have a taxonomy such as this:

Type of Fever	Cause	Seasonality
ROUTINE FEVERS:		
1. Homa za matatizo (Fever of problems)	Hard Work	February-May
2. Homa za vipindi (Fever that comes and goes)	Exposure to rain, wind or cold	Long rains (April-May)
3. Homa za kawaida (Regular everyday fever)	Light work, tiredness	Any time
4. Homa za malaria, Malaria (Malaria fever)	Mosquitoes	When there are many mosquitoes, esp in long rains
5. Homa za vidonda (Fever associated with boils)	Boils	Any time
FEVERS DUE TO SHETANI (SPIRITS)		
1. Homa zisizo za kawaida (Unusual fevers) or Homa zisizokubali tiba za hospitali (Fevers that are not treated at the hospital) Homa za kuchemka (Boiling hot fever)	Shetani	Mlao/rice harvest in June, July, August
Insufficient information: homa za mapafu, aimonia		

Other informants collapse several of these categories together. For example, some informants state that homa za kawaida, homa za vipindi and homa za malaria are all the same thing.

An illness is recognized as being malaria based on the following information:

a) It occurs at a time when large numbers of mosquitoes are present - typically during the long rains.
b) Fever is present, but not severe fever or fever accompanied by signs of cerebral involvement.
c) Chills.
d) Headache.
e) It gets better when treated with chloroquine.

Severe fevers, or fevers that occur at a time when there are few or no mosquitoes are not seen as being due to malaria. This is significant because, epidemiologically, the risk of malaria is actually higher when the mosquito population has peaked and is declining, because the fewer mosquitoes that are present are older and more likely to be carrying sporozites.

The last category of fevers, homa zisizo za kawaida, actually does not belong with this group, but rather with the group magonjwa ya shetani or illnesses caused by spirits.

3) Magonjwa ya shetani (Illnesses caused by spirits)

Shetani or spirits are thought to be the cause of most or all severe fevers. They are also called dudu. They are classified into two groups: mashetani wa pwani (coastal spirits) and mashetani wa bara (inland spirits). They are compared in the following chart:

	Mashetani wa pwani (Coastal spirits)	Mashetani wa bara (Inland spirits)
Synonyms	Jini	----
Characteristics	Clean, live in water or close to the coast	Dirty, hide in trees
Examples	Subiani, ibilisi	Kinyamkera, Mwenembago
Practitioner who treats	Fundi wa kitabu (Practitioner of "Coranic" medicine)	Fundi wa kishenzi ("Uncivilized" practitioner)
Types of treatment	Write appropriate verse of Coran, put in water and drink ink or put in amulet	Madogoli (ceremony with drums,dancing), herbs, offerings to trees

There are many types of shetani. One informant produced the following list:

Mashetani wa pwani: Chunusi, Makata, Subiani, Radhani, Tali
Mashetani wa bara: Kinyamkera/Mwenembago, Kinyonga, Simba, Mkwavi, Mdoe, Mbangubanu
Mashetani wa pwani au bara: Chunusi, kibwengo, kiarusi, kinyonga

Illnesses caused by mashetani do not generally seem to be distinguished from each other on the basis of symptoms, but only through traditional methods of diagnosis such as opening the Coran at a random page or using a ramli divining board. Kumbazi is a term used to describe the illness one can get after bumping into a shetani. Very high fever is a common symptom of magonjwa ya shetani. This fever is sometimes described as homa ya kuchemka (boiling hot fever).

These illnesses are said to be worst during the mlao or harvest period in June, July and August. Informants said that this is becasue the people have food, so it is a good time for the shetani to attack and "fill up". This period of time corresponds to the months when, according to the GTZ surveillance systme for deaths in children, there is a huge peak in deaths of yound children due to the combination of malaria, malnutrition (follwoing the food-scarce months of February to June) and pneumonia (in the months of June, July and August it is cold at night).

4) Magonjwa ya kulogwa (Illnesses due to witchcraft or sorcery)

We have not yet found a consistent classification for these illnesses. Some informants state that mawewe (mental illness or insanity) is a class of illnesses which can be caused by evil spells, by God or by smoking marijuana. Other informants state that magonjwa ya kulogwa is a class of illnesses which includes zimbu moto, mawewe and others.

5) Ngiri (Swellings)

There are three kinds of ngiri: ngiri ya mshipa wa kushuka or ngiri ya busha (filariasis of the scrotum) which is caused by water from the body sinking into the scrotum; ngiri ya hernia or ngiri ya kuvimba (inguinal hernia) which is caused by working hard without eating and ngiri ya tumboni (heartburn?). The later can be fatal if an attempt is made to treat it surgically, as it is accompanied by mshipa wa roho (unclear translation).

Matende (elephantiasis) is not connected with ngiri ya busha (filariasis of the scrotum) and is again related to hard work and dirty blood or water "sinking" from the body into the legs. One informant stated that "some people say it (matende) is caused by mosquitoes, but if that were true, everyone would have it."

6) Illnesses affecting the genital organs.

This group includes kisonono (often gonorrhoea) and kichocho (urinary schistosomiasis).

7) Skin diseases

These include vidonda (bumps and boils) and upele (scabies).

8) Miscellaneous

A variety of other illnesses are not put into groups such as kuumwa na nyoka (snakebite), msukumo wa damu kuwa mkubwa (high blood pressure), kifua kikuu (tuberculosis) and safura (hookworm).

Malaria and pregnancy

Malaria during pregnancy is an important cause of morbidity and mortality in the view of medical personnel. Consequences include an increased incidence of stillbirth, spontaneous abortion and low birthweight secondary to placental malaria, anaemia (which increases the risk of blood loss in childbirth), folic acid deficiency (which puts the neurological development of the fetus in jeopardy) and immunosuppression (which increases vulnerability to a variety of infectious diseases). This view does not seem to be shared by villagers.

The signs of pregnancy, from initial interviews, are thought to be: missed menstrual periods, weakness, dizziness, vomiting, rapid heartbeat, darkened nipples, fevers, trembling of the body and general aches and pains. It is significant that fevers, headaches and trembling (chills?) are not seen as symptoms of malaria, but rather as signs of pregnancy.

Special problems in the first pregnancy are said to be kifafa (seizures, toxaemia), headache, pains in the loins and stomach, safura (hookworm), swollen calves of legs, low blood, spontaneous abortions and high mortality among newborns. These problems are attributed to the mother being young, or it being the first time, even though headache, low blood and high mortality among newborns can be consequences of malaria in pregnancy, espcially the first pregnancy.

Very few women appear to be taking dawa chungu (bitter medicine or chloroquine) during pregnancy as chemoprophylaxis although it is supplied free of charge through the essential drugs programme and the GTZ Family Health Project. The reasons for this remain to be investigated.

Insects

Insects which are commonly considered to be harmful to man are:

Chawa	Louse	Mbu	Mosquito
Kunguni	Bedbug?	Mbung'o	Tsetse fly
Kiroboto	Flea	Inzi	Fly
Papazi	Tick	Viroboto funza	Jigger

Very few people seem to recognize different types of mosquitoes. Several informants have noticed that there are many more mosquitoes in Bagamoyo Town than in the villages, and yet malaria is more common in the villages. One informant thought that the malaria in the villages must be due to the hali ya hewa (the type of air/climate found there).

People believe that mosquitoes transfer vijidudu (microbes) from one person to another. They think that a mosquito can infect a second person immediately after biting the first person. Some informants feel that any biting insect can transmit fever. Very few people relate elephantiasis to mosquitoes.

During the months of April, May and June, people remain in the rice fields on a continuous basis, staying in vibanda or small huts. During the day they guard the rice from birds, and at night from pigs, warthogs and hippopotamus. Some people sleep outside on a bed. Fire is commonly used to scare pigs and for warmth at night. The possibility of nets catching fire will need to be considered.

Implications of the Findings

Villagers who know that our project involves bednets are eager to get them as soon as possible. The main reason for this enthusiasm seems to be a desire to protect themselves from mosquito bites. Both mosquitoes and malaria, however, are thought to be an important problem only during certain times of the year. In addition, there does not seem to be much enthusiasm about the idea of paying for nets.

Proper and sustained use of nets, as well as cost recovery, will depend on two factors:

a) People must believe that malaria is extremely important. They must think of it not as just as cause of mild fevers during the long rains, but also as a cause of low birthweight among children, weakness in adults, poor school performance in children, cerebral malaria in children and fevers in pregnancy. This will increase the potential for cost recovery.
b) People must think of malaria as a risk at any time of the year, not just during the long rains.

II. Preliminary Report on Plans for Health Communication

The health communication activities would be divided into three phases: planning, mobilization and implementation.

PLANNING PHASE:

All villages are now in this phase. One group of villages at a time will move into the mobilization phase. The communication objectives of the planning phase are

1) Communication of prevalence survey results in July 1991. This will be an opportunity to establish a relationship based on honesty and trust with the communities, to introduce the project to the villagers who have so far only heard about it indirectly from their leaders, and to start the process of enlarging and deepening people's concept of malaria and its consequences for the community.

2) Introduce the idea of malaria as an illness which can take many forms, not just fever (malaria ina sura nyingi). Malaria will be presented as an illness which can act directly, or which can "help" (ugonjwa msaidizi) other illnesses such as malnutrition, weak blood or pneumonia. Malaria will also be presented as one cause of weakness and headaches.

3) Introduce the idea of malaria as an illness to which pregnant women, especially if it is their first pregnancy are vulnerable to. Explain that fever may be absent, and yet malaria can contribute to stillbirths, abortions and children with low birth weight.

Channels of communication that might be used include meetings with women's groups (Umoja wa Wanawake Tanzania), teachers, or all the people living in one or two ubalozi where a discussion of malaria and its consequences is stimulated using picture codes. Feedback of entomology and malariometrics results will often be used as a starting point for discussions.

MOBILIZATION PHASE:

The first group of villages to receive the intervention may move into the mobilization phase about November 1991. This phase will last from two to three months. In this phase a group or committee will be formed in each village which would be involved in the distribution and reimpregnation of the nets and assist in the promotion and measurement of their use. The communication objectives of the mobilization phase will be:

1) To discuss the concept of disease transmission by mosquitoes and to stress that mosquitoes can not immediately transmit malaria after biting an infected person, but that the infection takes seven to ten days to "develop". A comparison might be made with cooking rice: the rice is not immediately ready after being put in water, but requires some time to cook. If the fire is strong, it cooks more quickly. In the same way, mosquitoes can not transmit malaria immediately upon emergence. In addition, mosquitoes can transmit quicker when the weather is hot and humid.

2) To open a discussion on seasonal variation in the incidence of malarial fevers. It would stress that when the mosquito population peaks in the middle of the long rains, most of them are youngsters (vijana) who are not yet infected. On the other hand, after the long rains have ended and few mosquitoes are present, most of the mosquitoes are older adults (wazee) and are much more dangerous because they are more likely to be infected.

3) To open a discussion on the different types of mosquitoes, stressing that, just like snakes, some are very dangerous if they bite, and others are not. For this to have a lasting impact, a "personality" will have to be built around the different mosquitoes. One way to do this would be to compare the malaria mosquito (mbu ya malaria, An. gambiae gambiae) to the shetani wa pwani or coastal spirits and to pigs, and the matende/busha mosquito (mbu wa matende, mostly Culex quinquefasciatus) to the shetani wa bara or inland spirits and to birds as follows:

Mbu wa malaria Malaria mosquito	Mbu wa matende Elephantiasis mosquito
An aristocrat, likes clean water especially rice fields	A dirty, uncivilized mosquito
Highly educated (Mtaalam)	Uneducated
Hard working: infects many people even if they are few in number.	Lazy: there are many, but they only take the time to infect a few people.
Very intelligent and cunning: They have "akili" like pigs and hide until you are asleep, and then attack you, very hard to scare off (kufukuza).	Not too intelligent, they attack even if you are awake and can be scared off like birds.

4) To present impregnated bed nets as an intelligent way to deal with an intelligent mosquito, and to explain their dual effect: i.e. even though adult men do not suffer too much from malaria like children and pregnant women, they can protect their wives and children by using a net so that mosquitoes who bite men die before they can carry father's malaria parasites to the others in the family.

Communication channels that might by used are theater, videos and posters.

THEATER

Theater has been used successfully in health programmes in many parts of Tanzania. For example the Johns Hopkins/Wilmer Institute group studying trachoma control near Dodoma used theater to promote face washing as a means of trachoma control. People walked from miles around to see people dressed as giant flies.

To the potential for using theater in this project, we have made contact with Amandina Lihamba, Head of the Department of Art, Music & Theatre at the University of Dar es Salaam (see attached report of meeting) about where and when theater might be used. The two main options are 1) using a professional group from the Chuo cha Sanaa (College of Arts) in Bagamoyo or 2) forming a theatrical group in each community. Regarding the former, a theatrical group from the Chuo cha Sanaa has already toured performing a play about AIDS. The college has its own vehicles, so we would only need to pay for petrol. It would probably be relatively easy to get the college involved in the project.

If students and professionals from the college are doing most of the work, the communities will become involved in theater as spectators only. Another option, then, would be to involve community

members in writing scripts, making costumes, writing songs and acting. Although this takes more time, it probably will have a much more profound and long-lasting impact on perceptions of malaria and its control. If we space out the net distribution, as envisaged in the proposed stepped-wedge design, we would have time for this approach.

Regarding the story-line for a theatrical production, there are several possibilities:

1) The story of two mosquitoes, a sophisticated Anopheles and an unsophisticated Culex. The former plans very carefully: she is sure to hide until the people are asleep, and then attacks. There could be a scene where the Anopheles is being instructed by a pig about techniques for tricking human beings. Anopheles dutifully takes notes. The Culex does not plan well, and attacks when people are awake. Anopheles ends up getting more people infected, and is extremely boastful about this. Then one day the family gets bed nets. Anopheles at first is scared off, but later finds a hole to go through and thinks she has triumphed again. Later, however, she rests on the net after feeding and the dies.

2) The story of two families. In the first family, everybody uses nets, even the husband. In the second family, the husband does not use nets because they are too hot, and because "adult men never get bad fevers, only women and children". "I have been bitten by mosquitoes for years, but I have never suffered fever". An Anopheles comes by one day and bites the father, which does not bother him at all. "Only weak people are bothered by mosquito bites". Eight days later, the man's child gets up during the middle of the night because the child thinks he/she has heard some pigs attacking the rice. At that moment the same Anopheles attacks the child, giving it a bad fever. The wife castigates the husband: "if only you would use a net all year round like we do, then maybe our children would get sick less often".

After the play, there would be a demonstration of how to set up and use a net properly, and some information on how to make your net last as long as possible.

VIDEOS

Videos could be made in several ways. One way, suggested by Japhet Minjas, would be to buy a small video camera and make a video about the use of bed nets for each village in which the actors would be the members of that village. Another way would be to make a professional video about the use of bed nets, which apparently has been done by UNICEF in Pawaga District, Iringa.

The videos could then be shown to students in schools, women's groups, meetings in different parts of each village etc. Three factors should be considered before a decision is made to pruchase video equipment:

1) A big limitation would be the unavailability of electricity in many of the villages.
2) The use of such expensive equipment may make people wonder why we want them to pay for nets, if we have enough money to buy video equipment.
3) Transport of the video equipment may be difficult. A Suzuki normally holds up to five people. A Suzuki with video equipment in it would hold two to three people. In addition, travelling on bumpy roads may damage the video equipment in the long run.

POSTERS

Posters could be placed in places where people gather such as CCM offices, markets and clinics. Posters would promote the use of bednets, perhaps by showing a sick person who does not use a net, and a healthy one who does. Posters would have significant limitations. The villages are very spread out, so many people would never pass by the locations where the posters are displayed.

IMPLEMENTATION PHASE

The main communication objective of the implementation phase would be to promote proper and sustained usage of impregnated bed nets. Additional objectives would be to warn people to keep nets away from fire, to use nets all year even when there are few mosquitoes, to not wash nets before it is time for reimpregnation and to reimpregate nets every six months (including how and where). The following communication channels might be used:

PAMPHLETS

Instructional pamphlets could be included with the nets when they are distributed with pictures showing how to set them up, what not to do (use fire around net, abandon net during the hot season), as well as information reviewing the dangers of malaria and the dangers of nets.

CALENDARS

An important problem which may emerge is that, although people will all use nets initially, later a pattern will probably emerge in which people use nets when the mosquito populations are very high, but not at other times. This pattern of irregular use would probably have little impact on malaria transmission since Anopheles gambiae s.s. is such an efficient vector.

One way to encourage sustained use during the implementation hase would be to distribute a malaria calendar. One column would have the months of the year, using local terminology. For example, the months are commonly referred to their position in the calendar e.g. month 1, 2, 3 instead of their name e.g. January, February, March. The second column would have picture of the usual weather, e.g. the hot sun, rain clouds etc. The third column would either depict a few mosquitoes or many mosquitoes. The fourth column would indicate either much malaria or less malaria. The aim of the calendar would be to stress that malaria is always present, as are malaria mosquitoes.

Bed Net Calendar 1993				
Month	Weather	Mosquito	Fever	
1				Picture of a bed net Captions "use your bed net all year"
2				
3				
4				
5				
6				
7				Picture of a mosquito Caption: "I don't take any time off"
8				
9				
10				
11				
12				

III. Work Plan for Social Science Team July to November 1991

Work should continue on explorations of illness definitions and other areas as described in the SS/HC job description. When Clive Shiff is present, a "tour" of a few ubalozis with Shiff, Minjas and the social science team should be made to start the decision making process about the type of netting to be ordered (cotton, nylon, polyethylene), the size of nets to be used and the type of insecticide (permethrin, lambdacyhalothrin etc). The ubalozis visited could be location where the team is well known, especially sites where they have slept overnight. The result of this process should be the definition of what additional information is needed from the social scientists regarding sleeping conditions so that nets and insecticide can be ordered.

A trip to Muheza with Shiff, Minjas and others would be useful as staff needs and operational difficulties could then be predicted.

The most important health communication activitiy will be dialogue with different groups in each village about the prevalence survey results and its meaning. In additional, the team will work closely with Lubega and Hamisi in setting up the malaria surveillance system, including participating in dialogu with the communities involved and advise on the wording used in forms, given local illness definitions. Finally, the visits of John Beier, Paula Tavrow and Clive Shiff should be used as opportunities for learning.

	RESEARCH TOPICS	COMMUNICATIONS	LEARNING
JULY	Illnesses Seasonal variations Pregnancy	Prevalence survey feedback Explanation of surveillance system	ANTHROPAC Entomology
AUGUST	Illnesses Biting insects Bed nets Pregnancy	Prevalence survey feedback Explanation of surveillance system	Economics
SEPTEMBER	Biting insects Bed nets Pregnancy Health services	Explanation of surveillance system Importance of malaria	To be planned
OCTOBER	Bed nets Food and nutrition Health services	Importance of malaria	To be planned
NOVEMBER	Social science and economic impact survey	Importance of malaria Begin to plan mobilization in Mlingotini, Kondo and Pande	

ANNEX 7B: RESULTS OF MULTIDIMENSIONAL SCALING WITH 27 ILLNESS TERMS, BAGAMOYO DISTRICT

Peter Winch, July 17, 1991

I have taken the pile sort data based on 41 illnesses and removed the 14 illnesses which tended to be placed in piles of one or two only. I did this because the ANTHROPAC programme was not able to place them on a "map", because there was too little information on how they were related to other illnesses.

The 27 illness terms are:

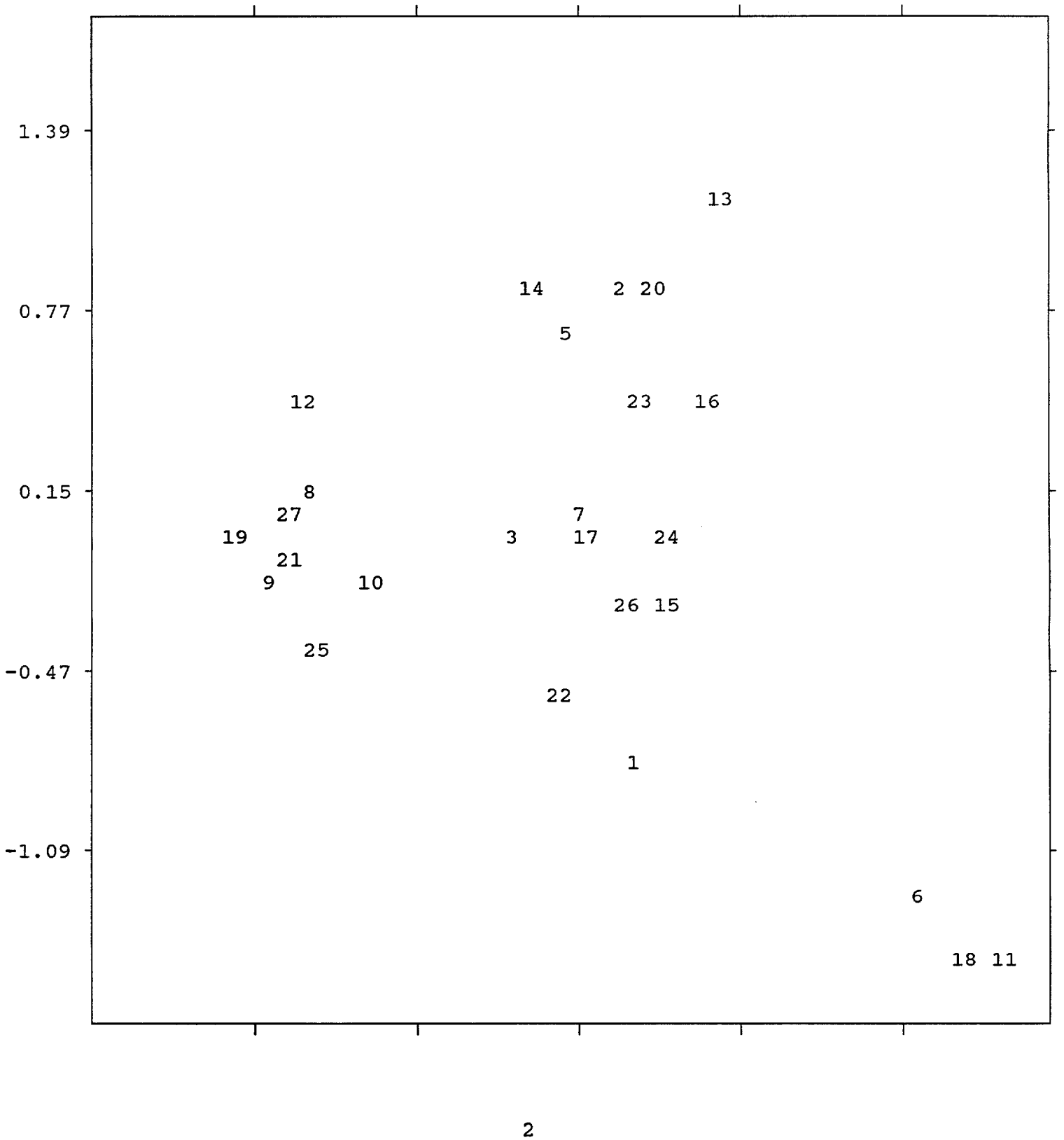
1 homa zisizo za kawaida
2 ugonjwa wa kitoto
3 malaria iliyopanda kichwani
4 homa za vipindi
5 pepo punda
6 mshipa wa kuvimba
7 malaria
8 kumbazi
9 kinyamkera
10 mawewe
11 ngiri
12 kiarusi
13 mkulumkulu
14 utapia mlo
15 homa
16 vichango
17 homa za malaria
18 busha
19 zimbu moto
20 degedege
21 magonjwa ya shetani
22 homa za matatizo
23 kifafa
24 homa za kuchemka
25 magonjwa ya kulogwa
26 homa za kawaida
27 homa zisizokubali tiba ya hospitali

The map of 27 illnesses that resulted from this procedure shows four main groups (see next page):

1) The ngiri group (6, 11, 18)
2) The homa group (1, 3, 7, 15, 17, 22, 24, 26)
3) The shetani/ulogi group (8, 9, 10, 12, 19, 21, 25, 27)
4) The children's illnesses group (2, 5, 13, 14, 16, 20, 23)

The horizontal axis may refer to degree of personalistic etiology: left is more personalistic, right is more physical. The vertical axis may refer to the age group affected: up is illnesses which affect children more, down is illnesses which affect adults more.

Results of non-metric multi-dimensional scaling with ANTHROPAC 3.0:



I think that there are a number of questions that remain to be answered, in particular regarding the illnesses in groups 2, 3 and 4.

The homa group

I think the problem we may be having with this group is that we are confusing terms that are used to indicate the degree of temperature elevation with terms that are used to indicative different types of febrile illnesses. I will illustrate this problem with a chart on how to classify project vehicles, using the type and the colour:

	White	Blue
Suzuki	✓ ✓	✓
Toyota	✓	

If, however, we were unsure of what the terms Suzuki, Toyota, White and Blue meant, we might make the chart like this:

	Toyota	Blue
Suzuki	?	✓
White	✓	?

I feel that we may be committing the type of error shown in the second chart, because we are unsure whether some terms such as homa za kawaida and homa za kuchemka refer to degrees of temperature elevation or to distinct types of febrile illnesses. I hypothesize that homa za kawaida is not a type of febrile illness, but possibly a term to indicate the degree of temperature elevation, and that we could make a chart like this:

Degree of temperature elevation ▸▸ / Type of illness ▾	Homa or "Homa tu" LOW	Homa za kawaida MODERATE	Homa zisizo za kawaida HIGH	Homa za kuchemka VERY HIGH
H. za matatizo			✓	
H. za vipindi	✓	✓		
H. ya malaria		✓	✓	✓
H. za vidonda	✓	✓		
H. zisizokubali tiba za hospi-tali, magonjwa ya shetani			✓	✓

One way to sort out this problem would be to do several more sets of pile sorts with the shortened list of 27 illnesses. In addition to sorting illnesses, there would be an emphasis on finding out the meanings of the different illness terms. For example, if homa ya malaria and homa ya kawaida are placed together in the same pile, we need to find out why exactly. If someone says "homa za malaria ni sawa na homa za kawaida", we need to find out whether this means

a) both terms are synonyms for the same febrile illness;
b) they are two illnesses with the same symptoms and treatment, but have different causes;
c) whenever homa ya malaria occurs, the degree of temperature elevation produced is not high, but "kawaida".

We also need to ask very specific questions about the differences between pairs of terms, for example:

a) What is the difference between homa za kawaida and homa zisizo za kawaida? Is it the degree of temperature elevation produced? Is it the cause (abnormal causes like shetani versus normal causes like hard work)? Is it the frequency of occurrence (common for "kawaida" versus rare for "zisizo za kawaida")?

Similarly:

b) Homa zisizo za kawaida versus homa za matatizo.
c) Homa zisizo za kawaida versus homa za kuchemka.
d) Homa za kawaida versus homa za malaria.
e) Homa za vipindi versus homa za malaria. etc.

To answer the above questions we will need to speak with the very best informants, as the questions are confusing. This information will be useful for health communication about the many forms malaria can take. If homa za kawaida, homa zisizo za kawaida and homa za kuchemka do all refer primarily to degree of temperature elevation, then we could say that malaria can produce all these types of fever.

The shetani/ulogi group

The questions to be answered here are

a) whether shetani or ulogi produce specific illnesses, or can produce any illness. For example, if you are bewitched (ukilogwa), can this process result in you getting illnesses such as malaria, kichocho, kifafa etc etc or does ulogi only result in one or two specific types of illnesses such as mawewe; and
b) how is the diagnosis of one of the magonjwa ya shetani or kulogwa made? Do people know what the illness is before going to the fundi, and if so, how do they make the diagnosis, OR is the fundi responsible for all the diagnosis. What symptoms lead a person to go to the hospital?

The children's illnesses group

We need more information (symptoms, treatments, causes etc.) on degedege, mkulumkulu/ mkulu atambula and vichango, as well as other illnesses mentioned in interview K040791A.YOM such as longo, bunduga/surua, bandama/wengu and nzasa. We might want to do a new pile sort, just with these illnesses. The concept of longo may be important for communication about anaemia and malaria.

95

Seasonality

To continue the investigation of seasonality, I suggest the following:

a) Make a list of all the seasons:
kiangazi cha kulimia
masika
kipupwe/mlao
kiangazi cha wakati wa matunda
vuli

b) Make paired comparison questionnaires

c) Do comparisons on
- amount of mosquitoes
- amount of homa in general
- amount of malaria

You can do multiple comparisons on the same form as long as you keep the results separate.

Start with eight informants. If they all agree, there will be no need to do more. If they do not all agree, check to see if the differences are related to geography: coast versus inland, and collect more data. These do not need to be full two hour interviews - you can do the comparisons only in about fifteen minutes.

ANNEX 8: SUMMARY OF MALARIA PREVALENCE SURVEY FEEDBACK MEETINGS

Introduction:

The Malariometrics group of the BBNP did a malaria prevalence survey in the 13 villages in the project area, using the children in Standard I and II (the first two years of school) aged between 7 and 15 years of age. Blood slides were taken at the 11 primary schools found in this area. The findings are summarized in Annex 4. The survey took place during late May and early June 1991 just before the first term break.

A prior written or oral notice was given to the headteacher and or to the village leaders, stating the day, date and time this examination was to take place at any primary school. There were some difficulties in communication that resulted from this strategy. At some schools arrangements were not done as scheduled resulting in the postponement of the exercise. This was an outcome of:

a. Poor information the teachers had about the project to the extent that they failed to communicate at length with the parents and other villagers, either through their children or through a written message stating the purpose of this examination. This problem resulted in pupils running away from the school or not attending at all on the day set for taking the blood slides. The experiences in Pande and Yombo primary schools made this clear.

b. In most cases no written message was left with the headteacher or the village leaders. This limited the rate of information flow among the teachers and village leaders as well as to the parents. In two schools named in (a) above the absence of the headteacher (to whom the procedrue had been explained) meant that the examination could not take place.

c. The term "kupima damu" (measure blood) had the connotation of "kugema damu" (blood sucking) and lead to great fear among some pupils as to the true nature of the tests to be performed. A preferabel term is "kupima ugonjwa wa malaria" (measure malaria). The misinterpretations lead some of the parents to instruct their children to run away from such a group of people. Some factors that increased the chances of misinterpretation were:

* Some parents and the villagers did not receive first-hand explanations about the project and its operations. Many of the second-hand explanations they received contained numerous exaggerations. It had been anticipated that the village leaders would have taken trouble to explain what they had heard at the meetings. This though had been proved untrue. In the future there will be project meetings with all concerned parties directly.

* Most of the villagers have never seen a blood slide being taken. This is due to the fact that laboratory examinations are rarely (if any) done at the health centers found in this area. This problem was mentioned at every of the 13 group discussions conducted in these villages. Lack of essential drugs is also common, so people may only rarely, if at all, go to the clinic.

Timetable:

For the above reasons, meetings were arranged in every village in order to provide detailed feedback on the results of the malaria prevalence survey and to address any other concerns villagers might have. The schedule of the meetings was:

Date	Time	Meeting Place	atten-dants (pare-nts)	Spokes-man	Secretary
16.7.91	10.a.m	Pande P/School	30	Makemba	Mrs. Lilah
18.7.91	9 a.m.	Mlingotini P/Sch.	33	"	"
25.7.91	10 a.m	Kerege P/Sch.	15	"	" *
25.7.91	2 p.m.	Mapinga "	36	"	"
01.8.91	2 p.m.	Zinga "	35	Kamazima	"
06.8.91	9 a.m	Mtambani "	64	"	Makemba
06.8.91	2 p.m.	Kerege "	19	"	" *
08.8.91	10 a.m.	Yombo "	91	"	"
08.8.91	2 p.m.	Kongo "	41	Makemba	Kamazima
16.8.91	9 a.m.	Kiromo "	36	Kamazima	Mrs. Lilah
20.8.91	10 a.m.	Buma "	53	"	"
20.8.91	2 p.m.	Mataya "	49	"	"
21.8.91	10 p.m	Miembe Saba	51	"	Makemba

*The meetings were arranged at this school due to the poor attendance during the first meeting (25.07.1991)

Meeting Format:

* The meetings were opened by either the Headteacher, the Village Secretary or the Village Chairman (3 - 8 min)

* The BBNP spokesperson:

(i) Introduced the team (3-5 min.)
(ii) Gave background on the project and its objectives (20-30 min) and fielded questions.
(iii) Presented the prevalence survey results and their implications (10-15 min) and fielded questions.
(iv) Explained the treatment that was to be given to pupils found to have malaria parasites (20-30 min)
(v) Spoke of future plans of the BBNP and thanked the community for their cooperation (10-15 min)

* The meetings ended with concluding remarks from the Headteacher, the Village Secretary, Village Chairman or any respected parent appointed. (5 - 10 min)

* On the average the meetings lasted for one and half to two hours. The longest meetings were those at Kiromo, Buma, Mataya and Miembe Saba Schools. They took 3 hours.

Questions asked:

The following questions were asked almost at every feedback meeting:

* Will the nets be sold or given free of charge?
* When and how will the nets be distributed. Will the poor get them?
* Preliminary base line data collected so far show that malaria is a problem. Why a complete year's work before intervention?
* What plans are made to treat other children and adults in these villages?
* Any protective measure (against mosquitoes) which can be given before nets are made available

* What is done with the mosquitoes caught from our houses?
* Do all mosquitoes seen around transmit malaria?
* How does this project differ from that conducted in Dar es Salaam and Tanga regions?
* The side effects of the insecticide to be used.
* The availability of the insecticide for re-impregnation of nets after six months of use.
* Which types/groups of mosquitoes have so far been collected in our are/village
* What causes pruritus?
* Will it be possible to impregnate the nets which are currently in use? (Some people in Kiromo asked if they could impregnate their traditional/ local nets i.e. "mtuti" and "viroba")
* Mosquitoes bite at night mainly from late in the evening to early hours i.e. few hours before sun rise. Will there be a rate of going to be at pre-determined times?
* Is degedege associated with malaria?
* What causes "matende" and "busha"

These questions were collectively answered by the BBNP team . Experience from some villagers helped to clarify some issues.

Observations:

From these meetings the following has been observed and concluded:

(i) The project is not yet clearly understood at the grassroots level. This was clear from the way the team was addressed to e.g. "watu wa mbu","wataalam toka Muhimbili", "Mabwana Afya", "wageni", etc. In addition, there was the suspicion in the minds of a few individuals that we are a team of blood suckers "mumiani" or "chinjachinja".

It is planned to hold more meetings with the villagers. The meetings will take place at different levels e.g. at the "Balozi" level, family and the individuals. People who can be identified who intentionally distort the information about our project should be visited on a friendly basis and their concerns addressed one-on-one.

(ii) Those who have heard about the project from us, are greatly interested with and promise to cooperate with the team. It was not uncommon to hear one of the parents or the "Mwenyekiti" saying/requesting that their village should be given "upendeleo maalum" priority that it is the first to receive the nets.

(iii) Villagers are highly/eagerly waiting for the nets. What should be considered now is how to make them use the nets as required. That is throughout the year and not only when there are many mosquitoes. They should not be kept waiting for so long.

(iv) Some of the team members need to be made the banks of the information about the project. If this happens it will enable any of the staff to explain and answer any arising questions about the project more confidently. The common language will be used.

(v) Some parents have been identified as good informants. The Yombo, Buma and Matimbwa Village Chairmen were of great help. They explained every point to the parents and they made sure that at least everyone had got the message clearly. The Mataya P/School Headteacher was also very effective.

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The effect of insecticide-treated bed nets on mortality of Gambian children

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Insecticide treatment of bed nets ("mosquito nets") may be a cheap and acceptable method of reducing the morbidity and mortality caused by malaria. In a rural area of The Gambia, bed nets in villages participating in a primary health-care (PHC) scheme were treated with permethrin at the beginning of the malaria transmission season. Additionally, children aged 6 months to 5 years were randomised to receive weekly either chemoprophylaxis with maloprim or a placebo throughout the malaria transmission season. We measured mortality in children in PHC villages before and after the interventions described, and compared this with mortality in villages where no interventions occurred (non-PHC villages).

About 92% of children in PHC villages slept under insecticide-treated bed nets. In the year before intervention, mortality in children aged 1–4 years was lower in non-PHC villages. After intervention, the overall mortality and mortality attributable to malaria of children aged 1–4 in the intervention villages was 37% and 30%, respectively, of that in the non-PHC villages. Among children who slept under treated nets, we found no evidence of an additional benefit of chemoprophylaxis in preventing deaths. Insecticide-treated bed nets are simple to introduce and can reduce mortality from malaria.

Lancet 1991; 337: 1499–502.

Introduction

In rural areas of The Gambia, as in other parts of tropical Africa, malaria remains one of the most important causes of death in children under the age of 5 years.[1] Until a cheap, safe, and effective vaccine becomes available, malaria control in such communities will rely primarily on antimalarial drugs for treatment and prevention, and on the reduction of man-vector contact.

Insecticide-treated bed nets ("mosquito nets") may be a relatively cheap and acceptable method of reducing man-vector contact.[2,3] However, the efficacy of insecticide-treated materials as a form of malaria control is controversial. Results of some previous studies are difficult to interpret and are complicated by variations in the epidemiology of malaria in the different areas where trials have been done. Moreover, comparison between the few studies that have attempted to evaluate the effect on morbidity of insecticide-treated material has been made difficult by the use of different clinical and parasitological measurements.[4] No studies have shown an effect of insecticide-impregnated bed nets on mortality.

Studies in the Farafenni area of The Gambia showed that morbidity from malaria was reduced by targeted chemoprophylaxis with maloprim (pyrimethamine and dapsone) and the use of permethrin-impregnated bed nets, and that each of these malaria-control strategies can be used in a village-based primary health-care (PHC) scheme.[5,6] Therefore, we have done a field study to determine whether insecticide treatment of bed nets could be implemented on a large scale as a malaria-control strategy, and we report the impact of this intervention on mortality in young children. In addition, we report the effect on mortality of targeted chemoprophylaxis in children already protected by insecticide-impregnated bed nets.

Subjects and methods

Study area and study population

The trial was done in 73 villages on the south bank of the river Gambia, east of the town of Soma and about 200 km from the Atlantic coast. The area is one of flat Sudan savanna, with mangrove swamps bordering the river which is still partly saline at this point. The climate is characteristic of the sub-Sahel, with a long dry season

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90

and a shorter rainy season from June to October. Rainfall was 1051 mm in 1988 and 887 mm in 1989.

The area is one of holoendemic, seasonal malaria.[1] Large numbers of *Anopheles gambiae* mosquitoes are present from July until December when most deaths and the most severe disease occurs. *A gambiae* bites predominantly at night so that bed nets might be expected to provide some protection against malaria.

In 1983, the Gambian government initiated a national PHC programme, and villages with a population of 400 or more were invited to join the scheme. Each village selected a village health worker (VHW) and a traditional-birth attendant (TBA) who both received 6 weeks training. VHWs can purchase a simple list of drugs, including chloroquine, from a government store, and these drugs are then sold to patients at a small profit. Villages that join the programme are commonly known as PHC villages, while villages too small to join are known as non-PHC villages. The study area contains 17 PHC villages and 56 non-PHC villages, with a population of 21 157 individuals. The two main ethnic groups are Mandinkas and Fulas.

Mortality surveillance

The study population participated in a census at the beginning of the study, and this has been updated by yearly re-enumerations. Demographic surveillance was started on July 1, 1988, and has been sustained ever since. Deaths in study villages are recorded by village reporters and this information is collected weekly by Medical Research Council field assistants. The parents or guardians of all dead children are visited by a senior field assistant who seeks their help in completing a questionnaire on the child's death.[7,8] Questionnaires are analysed independently by three doctors; a probable cause of death is accepted if this is agreed on by at least two doctors.

In early 1990, a retrospective survey was done of all women of reproductive age in the study area to ascertain past levels and trends in childhood mortality. Women were asked about their child-bearing history, including the dates of birth of all their children and the date of death of a child when applicable. From these data, life table measures of past mortality were obtained.

Intervention with impregnated bed nets and chemoprophylaxis

In July, 1989, bed nets were impregnated with insecticide in the 17 PHC villages. Dipping was organised by the VHW in each village assisted by the TBA and the head of the women's group. These individuals were supervised by a community health nurse under the overall direction of a malaria control officer seconded from the Gambian Medical and Health Department.

Most nets were washed on the day before treatment. The TBA and the head of the women's group arranged for the village women to collect their nets for dipping and to fetch water from a local well. The target dose of permethrin on netting was 500 mg/m^2. The 40 ml of permethrin (25% EC; ICI Public Health) needed to treat each net was measured in an empty evaporated milk tin, calibrated previously for the purpose, and then poured into a large plastic bowl. 1 l of water was added with a plastic drinking mug. All items used in the dipping procedure were purchased locally. Women dipped their own nets, excess fluid was wrung out, and the nets dried indoors on top of a bare mattress. After dipping, women washed their hands with soap and water provided by the VHW. The head of the women's group checked that all nets had been treated and marked them with an indelible pen. A record was made of the number of marked nets in each village.

After treatment of the bed nets, all children in the PHC villages over the age of 6 months on July 1, 1989, and who would not reach 6 years old by December 31, 1989, were randomised to receive weekly chemoprophylaxis or placebo. One tablet of quarter-strength maloprim (25 mg dapsone and 3·13 mg pyrimethamine; Wellcome) or one tablet of a placebo was given per week to each child by the VHW at the village health post. Both types of tablets were the same size and had a similar taste, but differed in their colour. Accurate records of compliance were kept in colour-coded ledgers.[9] The accuracy of these records was checked by the assay for dapsone of randomly collected urine samples.[10] Urine samples were also tested for chloroquine.[11]

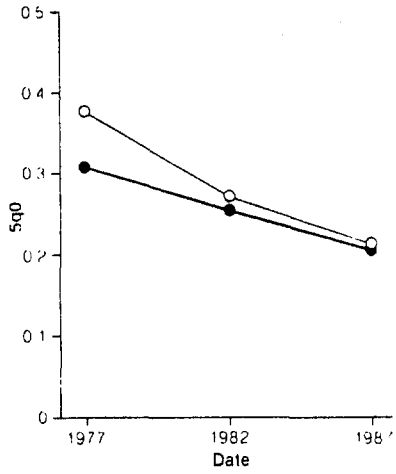

Fig 1—Mortality in children under 5 years old in pre-intervention years in PHC and non-PHC villages.

Mortality measured retrospectively with life tables constructed from birth histories. 5q0 is an estimate of the proportion of children born alive who will die before reaching their fifth birthday. ○ = PHC villages. ● = non-PHC villages.

Chemoprophylaxis was given for 20 weeks (July–November) covering the main malaria transmission season. Thus, in the post-intervention year three groups of children were available for study: those sleeping under insecticide-treated bed nets and receiving weekly malaria chemoprophylaxis with maloprim, those sleeping under insecticide-treated bed nets and receiving weekly placebo, and those living in non-PHC villages where there were no interventions.

Results

Bed-net usage and compliance with chemopropnylaxis

In the 17 PHC study villages there were 6093 bed nets. About 96% of the children in PHC villages regularly slept under a net, as did 77% of children in non-PHC villages. 5380 (88·3%) bed nets were dipped in insecticide in the PHC villages and 92% of children in these villages slept regularly under a treated bed net during the post-intervention year.

The median compliance with drug administration was the same among children who took maloprim as among those who took placebo (95%). 768 of 952 (81%) children receiving maloprim took more than 90% of their tablets, as did 743 of 946 (79%) in the placebo group.

Urine samples were obtained from 496 randomly selected children during a survey at the peak of the malaria transmission season. Dapsone was detected in the urine of 153 of 171 (89·5%) children who should have been receiving maloprim. Chloroquine was detected in 54 of 156 (34·6%) samples from children resident in non-PHC villages and in 84 of 340 (24·7%) samples from children resident in PHC villages ($\chi^2 = 5·2$, df = 1, p = 0·02). In PHC villages chloroquine was found less frequently in the urine of children receiving maloprim than in the urine of those receiving placebo (33 of 171 [19·3%] *vs* 51 of 169 [30·2%]; $\chi^2 = 5·4$, df = 1, p = 0·02).

Mortality in intervention and control villages

Because intervention (PHC) and control (non-PHC) villages differ in size and in the ethnic groups of their

TABLE I—MORTALITY RATES FOR INFANTS (DEATHS/1000 LIVE BIRTHS) AND CHILDREN AGED 1–4 (DEATHS/1000 PER YEAR) FOR 1 YEAR BEFORE AND AFTER INTERVENTION

Age (yr)	PHC villages	Non-PHC villages	Rate ratio PHC/non-PHC (95% CI)	p*
Pre-intervention				
<1	115·5 (65/563)†	127·1 (46/362)†	0·91 (0·64–1·29)	NS
1–4	47·6 (81/1700)‡	31·5 (37/1176)‡	1·51 (1·03–2·22)	0·03
5q0§	267·5	224·6	..	..
Post-intervention				
<1	73·5 (41/558)†	105·1 (37/352)†	0·7 (0·46–1·07)	NS
1–4	9·0 (16/1787)‡	24·2 (30/1240)‡	0·37 (0·2–0·68)	0·001
5q0§	104·4	186·7	..	..

*χ^2 test. NS = not significant †Deaths/live births. ‡deaths/approximate mid-year population §Of 1000 live births, this is an estimate of the number that do not live until 5 years old.

residents, it was important to determine whether mortality rates differed between them before intervention started. Past levels of mortality in children under 5 years old in the two sets of villages are shown in fig 1. Mortality rates over the past 15 years have followed a convergent and then a closely parallel course, with rates tending to be higher in PHC than in non-PHC villages.

We determined mortality rates in children under 5 years old during the year before intervention using a prospective surveillance system (table I). The child-mortality rate (mortality in children aged 1–4 years) was significantly higher in the PHC than in non-PHC villages, but infant-mortality rates were similar in the two sets of villages. However, in the year following intervention, the child-mortality rate in PHC villages was 37% of that in the non-PHC villages (95% CI = 20–68%).

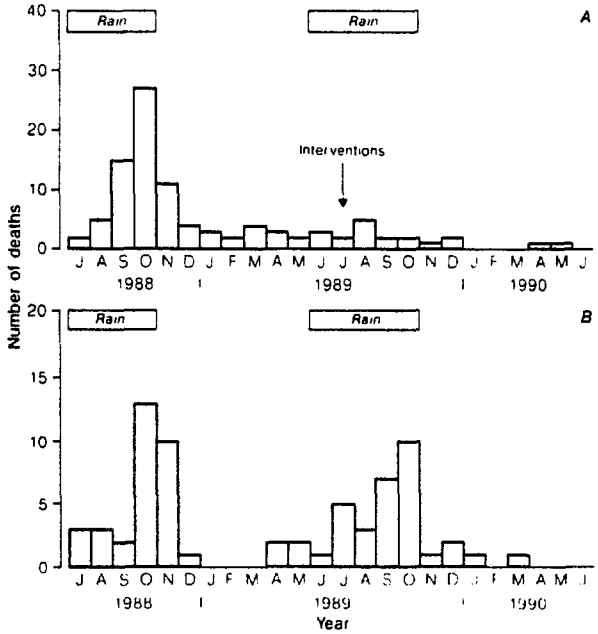

Fig 2—Deaths in children aged 1–4 years in pre and post intervention years in PHC and non-PHC villages.

(A) PHC villages, (B) non-PHC villages. Over 90% of children in PHC villages slept under insecticide-treated bed nets in the post-intervention year and about one half received additional chemoprophylaxis.

TABLE II—MORTALITY RATES ATTRIBUTABLE TO MALARIA FOR INFANTS (DEATHS/1000 LIVE BIRTHS) AND CHILDREN AGED 1–4 YEARS (DEATHS/1000 PER YEAR) FOR 1 YEAR BEFORE AND AFTER INTERVENTION

Age (yr)	PHC villages	Non-PHC villages	Rate ratio PHC/non-PHC (95% CI)	p
Pre-intervention				
<1	19·5 (11/563)†	2·8 (1/362)†	7·07 (0·92–54·55)	0·03*
1–4	20·6 (35/1700)‡	11·1 (13/1176)‡	1·86 (0·99–3·5)	0·05§
Post-intervention				
<1	3·6 (2/558)†	2·8 (1/352)†	1·26 (0·11–13·86)	NS*
1–4	3·4 (6/1787)‡	11·3 (14/1240)‡	0·3 (0·11–0·77)	0·01§

NS = not significant *Fisher's exact test. †death/live births. ‡deaths/approximate mid-year population. §χ^2 test

The seasonal distribution of childhood deaths in the two sets of villages is shown in fig 2. During the pre-intervention year, 96 of 118 (81%) deaths in children aged 1–4 years occurred between July and December, when most malaria transmission takes place. The seasonal peak in child mortality during the rainy season almost disappeared in PHC villages in the post-intervention year. Analysis of death rates by season showed that infant and child mortality rates were both significantly lower in PHC villages than in non-PHC villages during the wet season of the post intervention year ($\chi^2 = 4·1$, df = 1, $p < 0·05$ and $\chi^2 = 11·6$, df = 1, $p < 0·001$, respectively).

Mortality rates attributable to malaria are shown in table II. During the pre-intervention year, infant and child malaria mortality rates were higher in PHC villages than in non-PHC villages. However, the child malaria mortality rate in PHC villages was 30% (95% CI = 11–77%) of that in non-PHC villages during the post-intervention year. No significant effect was seen in infants.

The effects of chemoprophylaxis on mortality

In villages where insecticide-treated nets were in use, there were 10 deaths in the group receiving maloprim (mortality rate = 10·5/1000) and 9 deaths in the placebo group (mortality rate = 9·51/1000) ($\chi^2 = 0·05$, df = 1, $p = 0·83$; relative risk = 0·91, 95% CI = 0·37–2·22). 6 deaths in the placebo group were attributed to malaria as were 2 in the maloprim group ($p = 0·18$, Fisher's exact test).

Discussion

Our finding of a pronounced reduction in mortality in children under 5 years old following the introduction of insecticide-treated bed nets and chemoprophylaxis, supports the view that treated bed nets are an effective malaria-control measure in The Gambia.[12] Malaria-specific and overall protective efficacies of 70% and 63%, respectively, were found in children aged 1–4 years. It is probable that impregnated bed nets prevented most malaria-associated deaths because chemoprophylaxis, shown previously to have a beneficial effect on childhood mortality in rural areas of The Gambia,[6] gave no additional protection. The pronounced effect of insecticide-treated bed nets on mortality means that the power of the study to detect an additional effect of chemoprophylaxis is low. However, chemoprophylaxis plus treated bed nets significantly reduced morbidity from malaria compared with treated bed nets alone (data not shown).

Impregnated bed nets and chemoprophylaxis were introduced into villages which had been part of a primary health-care programme for some years, and therefore had the local structure for implementing and sustaining a simple malaria-control programme. Because climatic and other factors can cause malaria transmission and its associated morbidity and mortality to vary considerably from year to year, we felt that villages where there was no intervention (non-PHC villages) should be monitored at the same time as PHC villages. However, PHC and non-PHC villages differ in size and in other characteristics that might have confounded interpretation of results. Thus, it is possible that changes in the post-intervention year in PHC villages (in addition to the introduction of impregnated bed nets and maloprim) that did not occur in non-PHC villages might have affected mortality. However, the only new health interventions in PHC villages during the study period were the impregnation of bed nets and the distribution of chemoprophylaxis. No new insecticides were introduced for agricultural or other purposes, and there were no obvious behaviourial or socioeconomic changes in the PHC villages. Thus, it is difficult to conceive of any other change that could have selectively affected the incidence of malaria, and caused an immediate and sharp reduction in mortality during the malaria transmission season in PHC villages but not in their neighbours. We are thus confident that the reduction in mortality in PHC villages was due to the interventions we describe and not to some other factor.

In the present study, the overall reduction in mortality was greater than that which would have been expected from the prevention of deaths directly attributable to malaria. There are a number of possible explanations for this finding. Firstly, our verbal questionnaire of the parents of dead children may underestimate the true malaria death rate. Secondly, in The Gambia, as in Guyana,[13] malaria may be an important indirect cause of death. Thirdly, it could be argued that the fall in mortality in PHC villages was due to concomitant improvements in health care, such as an increased use of chloroquine. This is unlikely since urine tests showed the chloroquine consumption was higher in non-PHC than in PHC villages. Finally, it is possible that insecticide-impregnated bed nets provided protection against other insect-borne infections. However, apart from malaria, lethal insect-borne diseases are rare in The Gambia: sleeping sickness has disappeared from the human population and kala azar is extremely uncommon, arbovirus infections occur but, except during epidemics, are rarely fatal. A reduction in flies and hence in enteric infections is possible but seems unlikely to be important. Thus, the most probable explanation for our findings is that the importance of malaria as a direct and indirect cause of death in Gambian children, and perhaps in children in other parts of West Africa, has been underestimated.

The introduction of insecticide treatment of bed nets, through the PHC scheme, to communities that already use bed nets was well accepted, easily implemented, and had a major impact on mortality. There is a growing tendency to overload VHWs with an increasing number of tasks, but we do not believe that the impregnation of bed nets diverted VHWs from other activities. Implementation took less than 1 week, and was often completed within 2 days. Insecticide-treated bed nets remained effective throughout the malaria transmission season, and impregnation thus constitutes a once-a-year activity for this area with seasonal malaria.

Caution should be exercised before extrapolating our findings to other areas. The importance of malaria as a cause of death, the nature and habits of the dominant malaria vector, and the acceptance of bed nets are all factors which vary from area to area and which may affect the efficacy of this intervention. Nevertheless, in the face of increasing drug resistance, insecticide-treated bed nets are the only recent innovation in malaria control that has been shown to reduce morbidity and mortality, and they can be introduced through a simple primary health-care programme.

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From The Lancet

Votes and vocation

It is now generally admitted that in a free country, under a representative government, medical men should not disfranchise themselves. At the elections they have rights to exercise, and a duty to perform. Their education, rank, and intimate practical acquaintance with the condition and wants of all classes of society, render it highly important that they should not only give their votes, but bring their influence to bear on the choice of legislators. The effects of this influence will not be the less certain if it be employed temperately and rationally; if they never forget the sacred character which they sustain as the disciples of scientific truth, and the friends of the helpless; if they be never hurried into the excesses of party fanaticism, but keep constantly in view, in their public conduct, the great end of their existence as a profession—the welfare of mankind.

(June 26, 1841)

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Monitoring human-biting mosquitoes (Diptera: Culicidae) in Tanzania with light-traps hung beside mosquito nets

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Abstract

Mosquitoes were caught in bedrooms in Tanzanian villages by human-biting catches and in light-traps set close to occupied untreated bed nets. Catches by each method were carried out on pairs of nights in the same week at different seasons and in different villages. The pairs of adjacent catches by the different methods showed a strong correlation. Analysis of the ratio between the catches by the two methods on pairs of nights in the same week indicated that on average three light-traps caught about the same number of mosquitoes as a team of two human catchers. The ratio did not differ significantly between *Anopheles gambiae* Giles (*sensu lato*), *A. funestus* Giles, and *Culex quinquefasciatus* Say, nor between the villages, or between times when mosquito populations were high or low. The distribution of numbers of ovarian dilatations differed significantly between catches in different villages and seasons but not between pairs of catches by the two methods. Similarly, the parity and sporozoite rates agreed between pairs of light-trap and house-resting catches, but differed markedly between villages and seasons. Thus it is concluded that light-traps used in conjunction with bed nets catch a representative sample of the vectors which would have bitten humans in bedrooms in this area.

Introduction

This paper compares two methods of catching mosquitoes: human-biting catches, and the use of light-traps combined with mosquito nets. The two methods are compared in terms of their suitability for use in the evaluation of a malaria vector control trial.

In attempts to control malaria by attacking the vector, it is important to measure the impact of intervention measures on the mosquitoes as well as on malaria illness. In entomological terms, success can be defined as a reduction in the frequency with which people are bitten by infective mosquitoes – the entomological inoculation rate. Measuring this requires a method of sampling human-biting mosquitoes. The most direct way to do this is with a team of people who wait, often all night, to catch the mosquitoes which come to bite them. As a sampling method, this has several technical disadvantages (see Garrett-Jones, 1970; Garrett-Jones & Shidrawi, 1969; Gillies, 1970; Service, 1976). It can also be tedious, uncomfortable and exhausting for the catchers, as well as expensive, in overtime payments, for research projects. But perhaps the most serious problem arises when the catching team is usually protected from anopheline biting – for instance by sleeping in a town or under a mosquito net – and is then exposed, during a human-biting catch, to a greatly increased risk of malaria infection. This risk may be hard to avoid in areas of drug-resistant malaria.

Yet human-biting catches are still considered indispensable to the evaluation of many vector control operations (Service, 1976). The unique advantage of human-bait catches is that the mosquitoes are caught in precisely the act in which we are interested – the act of biting a person. For this reason, the sample obtained from a human-bait catch can be presumed to be representative of the mosquitoes which are responsible for transmission. That is to say, the catch of each species and age-group can be assumed to vary in proportion to the number biting one person in one night.

Most other sampling methods, in contrast, depend on mosquito habits which are only loosely related to the act of feeding on a human being. For instance, sampling indoor-resting mosquitoes tends to miss the mosquitoes

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that leave the house immediately after feeding, and may include those which enter after feeding outdoors on non-human hosts (Garrett-Jones, 1970). With species that normally both feed and rest indoors, the presence of an irritant insecticide such as DDT may drive the mosquitoes to rest outside, without preventing them from first feeding indoors; indoor-resting catches can then give rise to a false impression of effectiveness.

Light-traps have also been tried, although species are known to differ in their response to light, and the mechanism of attraction is not well understood (Service, 1976). In North America, light-traps are now in widespread and routine use. In most other places, however, their application so far has been limited to evaluation trials (e.g., Zaim *et al.*, 1987). In Sabah, Hii *et al.* (1986) compared the anophelines caught by CDC light-traps indoors and by two human-baits working outdoors up to midnight; overall, each trap caught on average 24–71% as many mosquitoes as the baits, although there was some evidence that the ratio varied seasonally. With some exceptions, the parity rates of females caught by the two methods were similar on each occasion.

In Africa, Odetoyinbo (1969) working in The Gambia made the first comprehensive study of light-traps as a sampling tool for malaria vectors. Since then, light-traps have been tried by several groups of workers in both West and East Africa, with very variable degrees of success (Carnevale & Le Pont, 1973; Chandler *et al.*, 1975; Coz *et al.*, 1971; Garrett-Jones & Magayuka, 1975; Joshi *et al.*, 1975; Service, 1970). A careful evaluation in Kenya, by Highton (1981), showed that light-traps in houses could give reliable and unbiased samples of vector populations.

Garrett-Jones & Magayuka (1975) were apparently the first to show that when a light-trap is used to sample indoor-biting mosquitoes, its efficiency is greatly increased by providing a mosquito net for the sleepers in the room. In Papua New Guinea, Charlwood *et al.* (1986) successfully used an updraught trap to catch malaria vectors between the inner and outer layers of a double mosquito net, and showed that this trap caught on average about 60% as many mosquitoes as a single human bait.

We used a light-trap and net combination similar to that of Garrett-Jones & Magayuka (1975) for entomological monitoring during a village-scale trial of malaria vector control in Northern Tanzania. We chose this technique mainly in order to limit the need for conventional human-biting catches. The light-traps were hung in bedrooms in village houses, and the occupants of these bedrooms were all given untreated mosquito nets. In this paper, we report the results of a parallel series of conventional human-biting catches and light-trap catches, which was carried out in order to assess the value of the technique. We show that the samples obtained by the light-trap/mosquito net combination tended to be proportional in size, and similar in both species-composition and age-distribution, to those from the matched human-biting catches.

Methods

Study area

The five villages of this study are near the town of Muheza in Northern Tanzania. There are two rainy seasons; the intervening dry seasons are usually neither very long nor very dry. Malaria vectors (*Anopheles gambiae* Giles (*sensu lato*) and *A. funestus* Giles) are present in fluctuating densities throughout the year. More than 90% of the *Anopheles gambiae* (*sensu lato*) in the area are *A. gambiae* (*sensu stricto*) (Mnzava & Kilama, 1986; A. Mnzava & I. Amri, pers. comm.).

Light-trap catches

These were carried out as part of the routine monitoring of the mosquito populations in the five villages in the control trial. Three houses were selected in each village. In each house, new untreated bed nets were given to the occupants of one bedroom. Every two weeks, the three houses were visited during the morning. A miniature CDC light-trap with a standard 6V 100mA incandescent bulb was hung in each selected bedroom, about 1.5 metres from the floor and about 50 cm from one of the bed nets. Cotton wool soaked with sugar solution was placed in the trap collection bag, under a small 'shelter' made of a perforated and inverted paper cup, in an attempt to minimize the deaths of trapped mosquitoes through desiccation by the draught of the fan. The rechargeable battery, which powered the trap, was left with one terminal connected. The householder was asked to set the trap going at sunset by connecting the other terminal, and at dawn to tie the neck of the trap bag to prevent the mosquitoes escaping, and then to disconnect the battery. The traps were collected later in the morning, and enquiries made as to whether the trap fan and light had both worked well all night. Catches from traps reported faulty were discounted. This arrangement worked well; both human and mechanical failures were rare. On the two occasions when one of the light-traps failed, the light-trap catches were multiplied by 3/2.

Human-biting catches

These were carried out in an irregular series in the five villages. The venue was usually one of three houses used for light-trapping. As far as possible, the biting catch was carried out on either the night before or the night after a light-trap catch; sometimes two or three nights intervened between the two types of catch. On each occasion, mosquitoes coming to bite indoors between 18.30 h and 06.30 h were caught by people sitting with legs and feet bared to the knee. On three other occasions, only one catcher worked inside (and one outside) the house for the whole night. Presumably, fewer mosquitoes were attracted by the odour of one catcher than would have been by two catchers, and in the absence of more exact measures of the appropriate correction factor, the human bait catches were doubled on these occasions; this was considered preferable to omitting these data altogether.

Processing of samples

At the laboratory, samples were sorted and counted. Surviving females were dissected for sporozoites, and for parity by Detinova's method (Detinova, 1962). Some were age-graded (by T.J.W.) using Polovodova's method (Detinova, 1962) to determine the

Table 1. Comparison of numbers of mosquitoes caught by two human baits inside a house, and three light traps in separate houses in the same village.

Village	Date of Human bait catch	Number of females caught of:					
		Anopheles gambiae s.l.		*Anopheles funestus*		*Culex quinquefasciatus*	
		Human bait	Light traps	Human bait	Light traps	Human bait	Light traps
Mn	27.xi.86	120	49	32	30	2	9
Mn	30.i.87a	216	422	7	6	0	1
Mn	15.x.87	3	1	7	0	0	0
Mn	12.xi.87	5	9	8	10	0	3
Mn	11.xii.87	21	1	11	1	1	0
Mn	22.i.88	50	81	1	3	0	5
Mn	18.ii.88	72	75	0	0	0	0
Mn	11.iii.88b	48	208	0	0	2	0
Mn	16.iv.88	330	321	2	45	28	11
Mn	28.v.88	56	46	2	3	9	15
Mn	28.vi.88	102	70	7	1	13	8
Ml	11.xii.86	16	46	2	0	181	49
Ml	16.vi.87	98	68	2	1	120	84
Ml	20.x.87	6	4	1	1	20	20
Ml	17.xi.87	0	1	2	0	18	21
Ml	14.xii.87	1	2	0	1	28	23
Ml	26.i.88	1	0	0	0	78	43
Ml	23.ii.88	0	6	0	0	18	72
Ml	09.iii.88a	2	3	0	1	7	2
Ml	21.v.88	30	1	1	0	55	60
Ml	04.vi.88	10	9	0	0	32	47
Km	18.xii.88	1	9	1	1	0	0
Um	05.xii.86	47	189	3	38	12	27
Um	20.ii.87	7	7	5	2	6	8
Um	05.vi.87	143	418	0	0	253	151
Um	06.x.87	73	62	6	0	9	19
Mi	21.xi.87	2	0	1	1	1	0
Mi	01.ii.88b	0	2	0	0	0	0
Mi	01.iii.88b	0	1	0	0	0	0
Mi	15.iii.88	1	1	0	0	0	0
Mi	12.iv.88	18	39	0	0	0	0
Mi	07.v.88	2	24	0	0	0	0
Mi	24.vi.88	1	3	0	0	0	2
Mi	19.vii.88	0	1	0	0	0	2

a: number caught by two traps, instead of usual three.
b: number caught by one human bait indoors, instead of usual two.

number of times each female had developed eggs. The light-trap samples were dissected regularly by these techniques, as were samples of indoor-resting females, obtained by conventional spray-catches or hand-catches on the morning before the light-traps were set. Samples from human-bait catches were dissected less regularly.

Results

The light-trap samples were compared with the matched human bait samples, to check whether the relative sampling efficiency of the two techniques differed according to (i) mosquito species, (ii) mosquito population density, and (iii) age or sporozoite infection in the mosquito.

Analysis of the numbers caught

The numbers of each species (*A. gambiae* (*sensu lato*), *A. funestus*, and *Culex quinquefasciatus* Say) caught by each method on each occasion are shown in table 1. The distributions in table 1 show a strong positive skew in both types of catch, so the numbers in each catch (x) were transformed to $y = \log(x + 1)$. The skew is largely due to occasions when no mosquitoes were caught by either method, but these were included in the analysis because such observations are frequently encountered in natural populations. Plotting the two types of catch against each other for each occasion (fig. 1) shows that, when the species are pooled (see below), there is a clear correlation between the two sampling methods ($r = 0.85$, $P < 0.0001$).

One might wish to go further, and predict what the human-biting catch would have been on the night of a given light-trap catch. Altman & Bland (1983) have pointed out that making such predictions from a linear regression may be misleading for the following reasons:

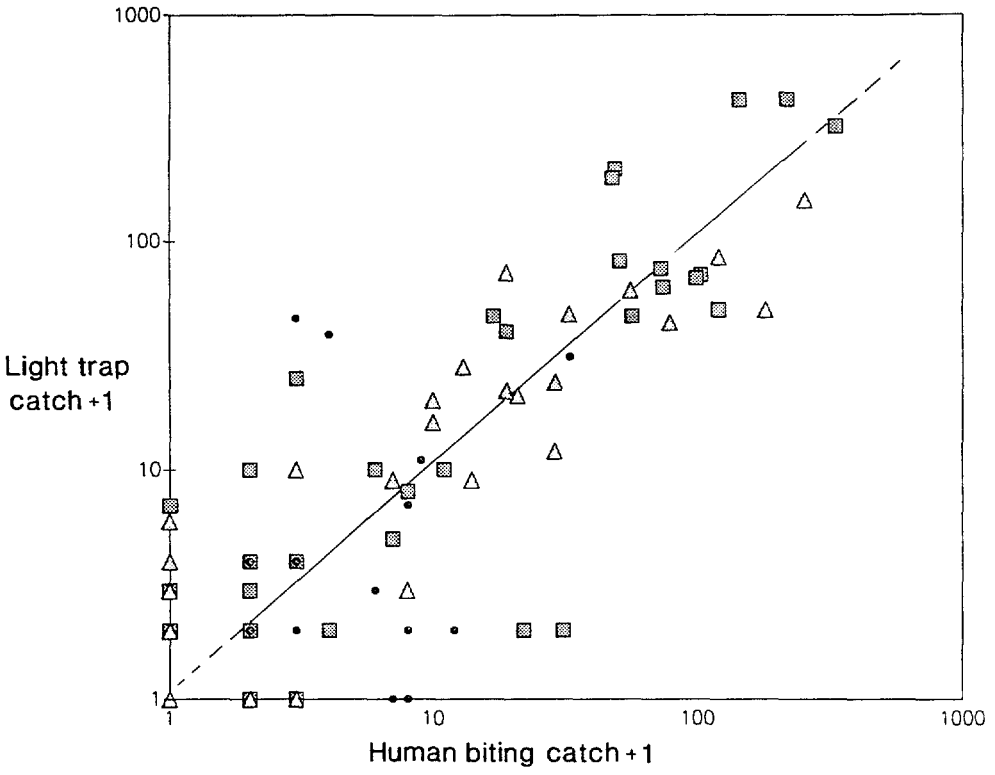

Fig. 1. The numbers of female mosquitoes caught by three light-traps hung near to occupied bed nets, plotted against the numbers caught by two people indoors in matched human biting catches (logarithmic scales). ■ = *Anopheles gambiae s.l.*; • = *A. funestus*; ▲ = *Culex quinquefasciatus*. The line shows the predicted relationship between the two trapping methods, derived from the geometric mean of the ratios, as shown in fig. 2.

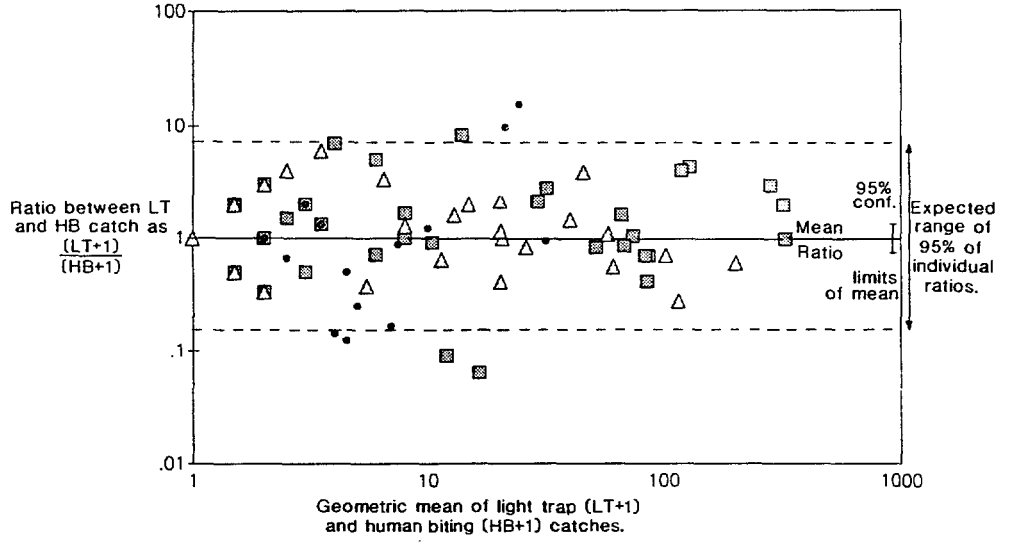

Fig. 2. The same data as in fig. 1, re-plotted as the ratio between the light-trap (LT) and human biting (HB) catches (calculated as (LT + 1)/(HB + 1)), against the geometric mean of the two catches (logarithmic scales). Symbols as in fig. 1. The ratio showed no significant tendency to vary with the geometric mean (r = 0.07). The mean ratio, 1.07, is shown as the solid line. Dotted lines show the range within which 95% of ratios from paired catches are expected to fall.

(i) both variables are subject to sampling error, which is contrary to the assumptions of the regression calculation – calculating a regression line in such a case leads to under-estimation of the slope and over-estimation of the intercept;

(ii) the relationship may be curvilinear (i.e., the light-traps may be relatively more or less efficient at high mosquito densities) and imposition of a linear regression would then be inappropriate and difficult to interpret, because of the logarithmic scales;

(iii) the confidence limits of the regression coefficient would depend on the range of densities for which data are available.

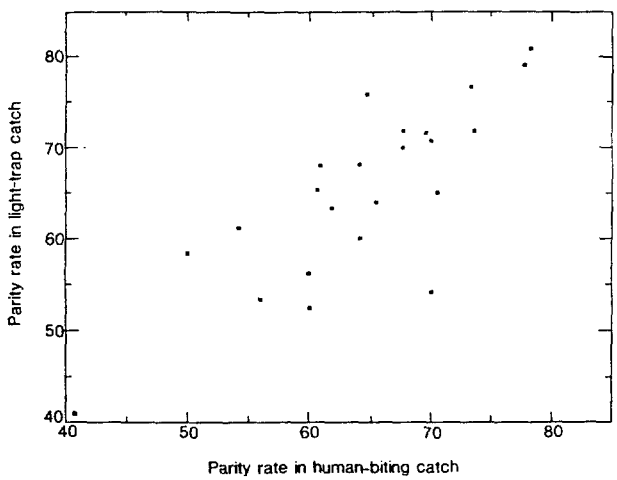

Fig. 3. Parity rates in light-trap samples compared with those in matched samples of indoor-resting females, on the 23 occasions when more than 10 insects were dissected from both sampling methods. In spite of a wide range of parity rates on different occasions, the rates remained similar between the two types of catch.

Instead, the ratios between the two types of catch were used as a measure of their relative sampling efficiency. The ratios were logarithmically transformed (note that $\log[(LTC + 1)/(HBC + 1)] = \log(LTC + 1) - \log(HBC + 1)$), to normalize the distribution.

Analysis of variance was used to test whether the relative sampling efficiency of the two types of catch varied according to species, or to the village where the catches were made. No such biases were found (table 2).

To test whether the relative sampling efficiency depended on mosquito density, the ratios were plotted (on logarithmic scales) against the geometric mean of the two catches. The latter was used as joint estimate of population density (fig. 2; see Altman & Bland (1983)). There was no significant correlation between the ratio and the geometric mean ($r = 0.07$). Fig. 2 also shows that the vertical scatter of the observations (i.e., the variance of the log-ratios) shows little or no relationship to mosquito density.

The mean log ratio was 0.0315 (s.e. 0.0402). Taking the antilog gives the geometric mean ratio, 1.07 (95% confidence interval 0.89 to 1.29), shown as the solid lines in figs 1 and 2. This means that on average, the catch from the three light-traps was 1.07 times that from the two catchers indoors. The two broken lines in fig. 2 represent the 95% range, which is expected to include all but 5% of individual pairs of observations. These show that 95% of light-trap catches (with three traps) are expected to lie between limits about seven-fold greater, or six-fold smaller, than the catch with two human collectors indoors.

Age distribution of A. gambiae *samples*

Only *A. gambiae* (*sensu lato*) females were dissected in sufficient numbers to allow testing for an age-related bias in sampling efficiency. Fig. 3 shows a comparison of the parity rates among samples collected on the same day as each other from light-traps and indoor-resting samples (data are shown for cases where ten or more insects from each type of catch were dissected). The paired parity rates were similar to each other, in spite of wide variation – from 41% to 81% – between occasions. The pairs of parity rates were compared by the Mantel-Haenszel summary test (Kirkwood, 1988), stratifying for sampling occasion. This gave a $\chi^2_{M\text{-}H}$ value of 0.06 (1 d.f; $P > 0.8$), showing that the parity rates in the corresponding samples showed no overall tendency to differ, in spite of the fluctuations between occasions. The overall sporozoite rates of these matched samples were also similar (44/499 = 8.8%, and 50/575 = 8.7%, in the indoor-resting and light-trap catches, respectively), and the Mantel-Haenszel test confirmed that the rates showed no tendency to differ throughout the pairs of samples ($\chi^2_{M\text{-}H} = 0.015$, $P > 0.8$).

Similar tests on the parity and sporozoite rates of *A. funestus* females showed no evidence for an age-related sampling bias for this species, although the numbers dissected were much smaller. *C. quinquefasciatus* females were not dissected.

That not all catching methods yield samples of the same age-structure is shown by comparing the parity rates of matched *A. gambiae* (*sensu lato*) samples (restricted as above to those with $n > 10$) from the light-traps and from outdoor-resting females in pit-traps. In this case the parity rate in the light trap samples was 44.5% ($n = 236$), significantly greater than that in the pit-traps which was 31.0% ($n = 126$: $\chi^2_{M\text{-}H} = 5.62$, $P < 0.02$). This is consistent with previous observations (e.g., Brengues & Coz, 1973; Gillies, 1954a, 1954b) that newly-emerged *A. gambiae* females are more likely than older females to be found resting outdoors.

Since the light-trap samples are intended as a substitute for human-biting catches, the most important comparison of age structure is between these two. There were only four matched pairs (with $n > 10$) of light-trap and human-biting samples dissected for parity. When pooled these had overall parity rates of 55.7% ($n = 201$), and 56.4% ($n = 227$), respectively. Comparing the two sets of proportions showed no significant difference ($\chi^2_{M\text{-}H} = 0.016$, $P > 0.8$).

On three occasions, good numbers (> 20) of insects from both the light-traps and human-biting catches were dissected by Polovodova's technique. The age-distributions (fig. 4) varied greatly between occasions and location, but did not differ significantly between matched pairs.

Taken together, these results imply that the population of *A. gambiae* (*sensu lato*) mosquitoes sampled by

Table 2. Analysis of variance on the log-transformed ratios between the light-trap catches (LT) and the human bait catches (HB) shown in table 1, calculated as $\log[(LT + 1)/(HB + 1)]$.

	d.f	Sum of Squares	Mean Square	F	P
Species	2	0.3695	0.1848	1.12	0.35
Village	4	0.6086	0.1521	0.97	0.38
Residual	95	15.6939	0.1652		
Total	101	16.6720	0.1651		

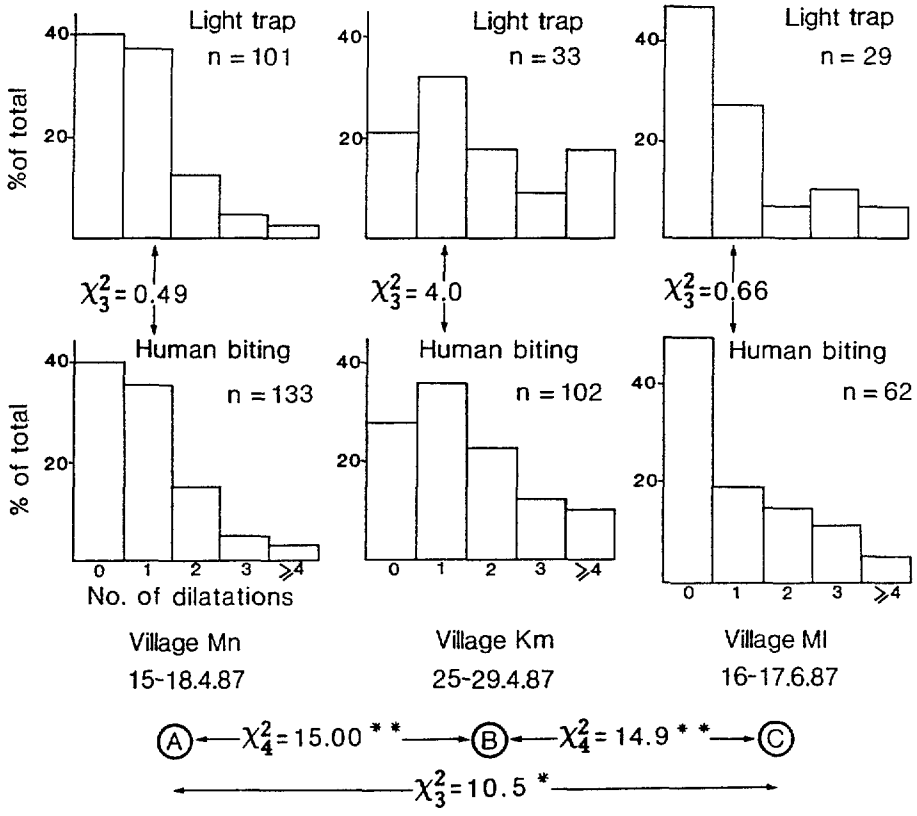

Fig. 4. The age distributions of *A. gambiae s.l.* females from three pairs of matched light-trap and human biting catches which were dissected by Polovodova's technique. The age-structures of the two types of sample were consistently similar, in spite of marked contrasts between occasions.

light-traps used with mosquito nets had the same age-structure and infection rate as that sampled by human-biting or indoor-resting catches. However, with *Culex quinquefasciatus*, a significant difference in the infective rate with *Wuchereria bancrofti* (Nematoda: Filariodea) has been noted between light-trap and resting catches (Maxwell *et al.*, 1990).

Survival of mosquitoes in the trap bag

Despite provision of sugar solution and a 'shelter' in the trap bag, many of the captured mosquitoes died before reaching the laboratory. The percentage surviving was 51% for *A. gambiae* (*sensu lato*), 29% for *A. funestus*, and 71% for *Culex quinquefasciatus*. All the above data on dissection come only from the surviving fraction of the mosquitoes.

Discussion

Both the human-biting catches and the light-trap catches were intended to provide estimates of the density of human-biting mosquitoes in the trial villages. The variability which was observed in the ratio of the numbers caught by each method presumably includes: (i) changes in the true biting density between the night of the trap catch and the night of the corresponding human-biting catch; (ii) sampling error of the light-traps; and (iii) sampling error of the human-biting catch. There is no reason to suppose that the sampling error of the traps was any greater than that of the human-biting catch. Indeed it might be expected that the light-traps would be less subject to at least some of the human sources of error. In practice, it is easy to increase the number of replicate light-traps, whereas the number of regular human-bait catching stations in each village generally has to be limited to one or two. The results with light-traps may therefore be more representative of the biting densities in the village as a whole, and less subject to happenings in a single household, such as the use of domestic insecticides or mosquito coils.

More important than the variability of the ratio between the catches is the observation that it varied independently of changes in mosquito density. The light-traps were not detectably biased (compared to the human-biting catches) in their sampling of the three most common species. At different times and places, a wide range of densities of *A. gambiae* (*sensu lato*) and *C. quinquefasciatus* were encountered, and there is therefore good evidence that the relative sampling efficiency of the two methods was similar for these two species. The evidence is weaker with respect to *A. funestus*, which was never caught in large numbers. The age-structure and sporozoite rates of the *A. gambiae* (*sensu lato*) population

were also subject to wide fluctuation, but there was no evidence for a systematic difference between the two sampling methods.

Several previous tests of light-traps indoors in Africa have revealed differences between the mosquitoes sampled by light-traps and those biting man. In Burkina Faso, Coz *et al.* (1971) tried CDC light-traps in houses and experimental huts, and recorded differing sampling efficiencies of light-traps for *A. gambiae* (*senso lato*), *A. nili* (Theobald), and *A. flavicosta* Edwards, implying a species bias. They also found that the overall sporozoite rates in both *A. gambiae* (*sensu lato*) and *A. funestus* were lower in indoor light-trap catches than in either the 'residual' females caught resting in rooms after the traps had been used, or those caught in outdoor light-traps. In the case of *A. funestus* these differences were statistically significant. Similarly, Carnevale & Le Pont (1973) noted that the parous rates of *A. gambiae* (*sensu lato*) caught by indoor light-traps were significantly lower than in corresponding human-biting catches (47% vs 77%). These observations tend to suggest that the light-traps were biased in favour of younger females. The opposite was implied by some results from the Garki project in Nigeria (Shidrawi, Clarke, & Boulzaguet, 1973, quoted by Zahar, 1985), where there was evidence that the parity rate was sometimes significantly higher in indoor light-traps than in human-biting collections. In addition, the light-traps were found to be so inefficient compared to other methods that their use was abandoned. An age-bias in favour of older females was also seen with *A. nili* by Carnevale (1974), who recorded significantly greater parity rates in light-trap catches than in simultaneous human-biting catches.

In each of these reports, the authors have concluded that light-traps, while useful in some ways, do not catch the same fraction of the mosquito population as that attacking man. In some of these studies, mosquito nets were used in the same room as the light-traps, but the nets presumably did not give effective protection as they were employed specifically in order to collect mosquitoes resting inside the net in the morning. Mostly, however, light-traps have been used without the provision of intact mosquito nets to give effective protection to the people sleeping in the room.

There is little doubt that the addition of intact nets makes a crucial difference. The work of Garrett-Jones & Magayuka (1975), and our own unpublished studies in experimental huts, have shown that the provision of a mosquito net to everyone sleeping in a room has two important effects on the sample of mosquitoes obtained in a light-trap. First, it causes a large increase in the total number of mosquitoes caught – about 9-fold in the study of Garrett-Jones & Magayuka (1975). Second, it leads to a change in the composition of the catch: with no net, a mixture of fed, unfed and gravid mosquitoes are caught; when a net is present, on the other hand, the sample consists almost entirely of unfed females.

One interpretation of this is that, in the absence of a net, only a small proportion of the mosquitoes seeking a meal ever come near enough to the trap to be attracted and caught by it, either before or after feeding. With the bait inside a net, hungry mosquitoes persist in their attempts to find a way in. During this search, the mosquitoes explore all around the net, and in this way a large proportion of them sooner or later come near to the trap and are caught by it. If this interpretation is true, it would explain why combining the light-traps with mosquito nets can give apparently unbiased samples of human biting mosquitoes, while light-traps used without intact mosquito nets yield smaller samples, the composition of which may be different from that of a human-biting catch. (It should be noted that only untreated nets have been used with light-traps; nets treated with insecticide might give very different results.)

One problem which we have not yet been able to overcome is the high mortality of mosquitoes in the trap bags. The dead anophelines can nonetheless be tested for sporozoites by the ELISA method.

An important advantage of the light-trap/mosquito net combination as a sampling method is its convenience. Setting up the traps takes only few minutes, and can be done in the daytime, enabling this task to be combined with others, and keeping demands on personnel and transport to a minimum. In our project in Tanzania, the traps were set when the team visited village schools to collect blood-slides. The traps were recovered the following morning, when the results of the slide-reading were delivered. The occupants of the houses were inconvenienced far less by the traps than by a catching team, and also gained the benefit of the nets, which were left in place permanently.

There have been suggestions that human-biting catches are unethical, and that their use should be abandoned. We do not share this view. There are risks attached to the collection of human-biting mosquitoes, and it is essential to recognise and assess these risks, in order to obtain informed consent, and to provide the collector with appropriate protection (e.g., prophylactic drugs), and treatment if necessary. In spite of the disadvantages of human-biting catches, the technique is likely to remain indispensable for many types of experimental work in the field. For example, it is hard to think of reliable alternatives for the assessment of repellents, or for sampling species which bite either predominantly outdoors, or very early in the night. Even in an entomological monitoring operation such as ours, a limited number of human-biting catches are likely to be necessary, in order to assess whether a substitute sampling method can be relied on to provide an unbiased measure of the density and infection rate of man-biting mosquitoes. This cannot be assumed, and should be re-checked at each new location. Only with such checks can the potential of the light-trap/mosquito net combination be evaluated for more general use.

Acknowledgements

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(Accepted 25 September 1990)

ANNEX 11

September 23, 1991

TO: Dr. Clive Shiff
P.I., Tanzania Bednet Project

FROM: Dr. John C. Beier
Entomological Coordinator, Tanzania Bednet Project

RE: Current direction of the entomological component

We have discussed the entomological component over the last month and have considered the present status of the program, the immediate needs, and our options for the future. This memo summarizes our discussions and proposed changes in the direction of the entomological component.

The major issues include the workplan, personnel, supplies and equipment, and transportation. Modifications in each major area need to be considered within the constraints of the budget, without sacrificing our ability to evaluate properly the large-scale bednet intervention.

A. Workplan

The protocols which were developed with Dr. Minjas, Mr. Majallah, and Mr. Hall during my recent visit included three phases:

1. A preliminary entomological survey in 13 sites.
2. Longitudinal vector surveillance in 13 sites.
3. Operational, discrete studies to examine specific aspects of transmission.

1. Preliminary entomological survey

The preliminary entomological survey is currently being conducted. The study design is simple and will provide important baseline information. Additionally, it is an excellent training mechanism to establish mosquito sampling and laboratory capabilities. This should be completed by the end of October 1991. No changes are necessary.

2. Longitudinal vector surveillance

The longitudinal vector surveillance protocol appears to be beyond our current and expected capabilities. There are concerns that equivalent levels of light trap sampling cannot be conducted in all 13 sites at the same time that detailed biting catches are being conducted in two sites. Major modifications are necessary.

Our intention now is to begin light trap surveillance in all of group II and IV sites. The process of selecting 10 houses per site for light trap sampling should be accomlished within the next 6 weeks (as we wait for traps to arrive in Dar). The fortnightly sampling with light traps should begin in these selected sites. During the first three months, corresponding biting catches (inside houses) will be made to evaluate the light traps. Essentially, we will use the same design as described by Lines et al. 1991; a separate protocol will be developed. This revision in the workplan will allow us to begin the vector surveillance in the most important sites without delay. At the same time, the light trap evaluation will provide the information we need to interpret light trap results and to make decisions on how much we can rely on light traps for malaria

transmission data.

In an effort to make the vector surveillance system more efficient, we will not conduct all-night man-biting catches in the two selected sites every two weeks, as originally planned. Rather, we will conduct biting catches to evaluate the light traps during the first three months of the surveillance program. Then later, we will conduct biting catches, as needed, to study the biting periodicity of vectors in selected sites. Thus, the necessary information on biting periodicity will be collected under a separate protocol.

Vector sampling in the group I and III sites will be done by light traps, once every three weeks, provided that data from the light trap evaluation justify the sole use of light traps for estimating EIR's. The selection of group I and III houses for sampling could be done before December as we wait for the traps to be delivered. However, such efforts should not compromise the efforts in the group II and IV sites.

There are several advantages to these changes. The vector surveillance system can be operated in all 13 sites. This longitudinal data before and during bednet use in all sites will serve as our foundation for evaluating bednet efficacy. The light trap evaluation during the first three months of the surveillance scheme will provide information on the degree to which light trap data correspond with biting catch data. Dropping the fortnightly man-biting catches will permit a more focused approach to the light trap surveillance plan. We are confident that the key information needed from the biting catches can be obtained by designing additional studies that can fit into the work schedule. In this way, we treat each of the entomological components independently, with highest priority given to the light trap surveillance.

There are several other concerns which must be raised at this time:

The revised plan for vector surveillance does not include any sampling by the pyrethrum spray catch method. We decided that quarterly sampling in group I and III sites would not provide useful, interpretable data. Similarly, PSC collections (after the preliminary survey is complete) while we wait for the light trap operations is not justified, except perhaps as a training exercise. However, we do anticipate that PSC collections will be done for some of the later efforts to evaluate specific aspects of transmission, again, under separate protocols.

There is an immediate concern that houses for light trap collections be selected in an unbiased manner. We do not want only those houses that we "think" will yield high densities of mosquitoes (e.g., those next to breeding sites). We need houses that are representative of the diverse ecological habitats within sites, without any preconceived expectations on their "mosquito capacities". Selection of houses should be done initially from the maps with subsequent on-the-ground verification that the houses are suitable for light trap sampling, and of course, that the residents are aware of the nature of the sampling and are receptive.

The revised vector surveillance plan will rely only on sporozoite ELISA tests for determining P. falciparum infection rates. There is no way to combine data from ELISA and dissections. Dissections, will however, be used extensively in protocols to look at specific aspects of transmission. This will streamline mosquito processing for the surveillance component.

3. Operational, discrete studies to investigate specific aspect of malaria transmission and bednet efficacy

None of these studies were detailed in the protocols developed this summer. At this time, the most important objective is to develop the surveillance system. Once this is in place and working, we can plan for the following:

1. Composition of the Anopheles gambiae complex
2. Nocturnal biting periodicity
3. Blood-feeding patterns
4. Vector survival
5. Indoor resting behavior and exophily
6. Insecticide susceptibility testing
7. Effects of bednets on other insects

These are only examples of the necessary, independent studies which will need to be developed. Some of these questions will be approached by sampling over time, before and after bednet implementation. Other questions can be addressed with efficient sampling designs after bednets are implemented.

We should not be overwhelmed by the logistics of any of these necessary studies. The priority and extent of all of these efforts can be determined by our field capabilities when these studies are planned. As we develop the overall entomological component, we must bear in mind that all of these effort are secondary to the vector surveillance operation!

B. Personnel

We recognize that a major shortcoming to the entomological component is the lack of experienced entomologists. Dr. Minjas will play a key role in the supervision and scientific direction of the project. Mr. Majala and Mr. Hall will play key roles in the operations in Bagamoyo, and Dr. Minjas is recruiting one or more junior entomologists to be posted in Bagamoyo. We are also confident that Dr. Minjas will recruit key technical and supervisory personnel in Tanzania.

The key need at this point is to identify an experienced entomologist who can direct operations in Bagamoyo. The person must have experience with entomological field studies and vector-related laboratory techniques, be capable of developing protocols to answer specific questions, be competent to make decisions in the field, have experience with data management, analysis, and publication. According to Prof. Kilama, there are no available Tanzanian entomologists with such skills.

There is no question that the success of the entomological component of the project depends on the identification of a key individual who has the necessary scientific training in vector biology. In this respect, we should not underestimate just how hard it is to train individuals in the field skills of malariology.

C. Supplies and Equipment

The year-two shipment for Tanzania is being planned. The revised entomological plan will require that most of the supplies requested be sent as soon as possible. It is important to re-evaluate the "immediate" requirements to get the vector surveillance system in place, plus anticipated supplies for the rest of year two. We cannot afford not to stock up on supplies which will be used throughout the project.

It will also be necessary to re-evaluate just how much it will cost to mount a reasonable entomological plan. Again, we must give highest priority to the surveillance component. The other studies which need to be developed can only be done if there are sufficient resources.

It is imperative that whatever monetary difficulties are faced in a project of this scope, that the concerns are not a daily burden of those charged with the responsibility of conducting the actual field work. Any workplans that are developed for implementation must have adequate resources.

D. Transportation

We have discussed the need to improve transportation capabilities to meet the demands of the field program.