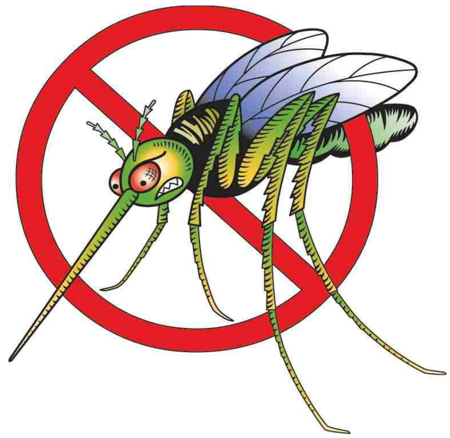
TRANSPARENCY AND ACCOUNTABILITY NETWORK



THE IMMC CONSORTIUM

INTEGRATED MOSQUITO AND MALARIA CONTROL

A comprehensive integrated mosquito and malaria control program to reduce the incidence of malaria, and other insect spread diseases.

EXECUTIVE SUMMARY
LIBERIA PROGRAM

July 2006

DRAFT – FOR DISCUSSION ONLY

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INTEGRATED MOSQUITO AND MALARIA CONTROL CONTEXT

THIS DOCUMENT IS PART OF A SERIES THAT INCLUDES THE FOLLOWING:

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EXECUTIVE SUMMARY – LIBERIA
EXECUTIVE SUMMARY – REGIONAL

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B ... BP for IMMC – THE MALARIA CRISIS
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INTEGRATED MOSQUITO AND MALARIA CONTROL
INTRODUCTION AND OVERVIEW

An estimated 500 million cases of acute malaria occur worldwide each year, predominantly in Sub-Saharan Africa where there are about 450 million cases annually. There more than 1 million deaths a year, primarily among infants and young children. Every 3 minutes a child dies of malaria, or about 3,000 children a day. Malaria is not only a killer of children, but is a debilitating disease for adults.

The malaria situation in Liberia is as bad as anywhere in the world. The climate is particularly suited to mosquitoes, and the proximity of the main urban populations to primary breeding places makes Liberia, and especially Monrovia, a perfect locus for endemic malaria. The situation has not been helped by many years of civil war and a deteriorating economy and infrastructure. Rebuilding Liberia is a huge challenge, and having a healthy population will help.

An integrated mosquito and malaria control (IMMC) approach includes both: (1) a framework of management information that will help make malaria interventions more effective, and (2) operational capacity that can be easily mobilized to implement cost effective mosquito and malaria control (IMMC) interventions.

In addition to management information, an integrated approach incorporates (1) community awareness, education and training; (2) neighborhood cleanup to reduce mosquito breeding places; (3) interior residual spraying (IRS); (4) ultra low volume (ULV) adulticide spraying to kill flying mosquitoes; (5) larviciding to kill larvae and stop mosquito recruitment into the population; (6) personal use of insecticide treated bednets (ITN); and, (7) malaria treatment will be the least cost and most successful in reducing the prevalence of malaria.

The IMMC Consortium is made up of: (1) Tr-Ac-Net Inc. (The Transparency and Accountability Network) with a focus on management information; (2) West Coast Aerial Applicators (WCAA) specializing in aerial operations and pest control, (3) ADAPCO, pesticide experts and consultants, (4) Acroloxus, experts in wetlands management; (5) Africa Fighting Malaria, experts in mosquito and malaria control; and, (6) an IMMC team of expenenced entomologists. Together, the IMMC Consortium has expertise in operational matters, in management information and scientific analysis, which are all required together for success in mosquito and malaria control.

The economic benefits of an IMMC program are significant. An adult getting malaria can expect to lose between 10 and 30 days of work ... maybe a lot more in a years time ... a substantial loss of economic output that, in a population of 3 million people, can be valued at somewhere between US$30 million and $100 million a year. This is substantially more than the costs that are estimated at around $10 million in year one and two, and $5 million a year subsequently.

It is difficult to predict results with complete reliability because the underlying biology is complex. The goal is a reduced malaria prevalence of 50% after one year and down by 80% after two years. A sustained program will aim to reduce malaria prevalence and local transmission to negligible levels.

The following are estimated costs for an IMMC program for Liberia assuming use of DDT. These numbers are:

Operating Costs for Five Years In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5 Year Total
TOTAL PROJECT COST	**10,000**	**7,500**	**7,500**	**7,500**	**7,500**	**40,000**

In addition there is a be launched there needs to a commitment for the mobilization costs. The following are the estimated costs for mobilization:

Year 1 Capital Costs (including working capital) In thousand dollars ($ 000)	
International (mainly ICT)	300
Aircraft, vehicles and other equipment	2,000
Buildings, vehicles in Liberia	1,500
Working captial	700
Contingency	500
TOTAL (Year 1)	**$4,000**

CAVEAT

The numbers set out above are preliminary. The detailed calculations and projections are being revised and the summary tables will be updated as soon as the projection information is available.

THE SITUATION IN LIBERIA
SUITED TO THE LOCAL CONDITIONS

About Liberia

Liberia has a population of 3.0 million (a 2006 estimate from the CIA World Book of country information). The Republic of Liberia is located on the west coast of Africa and has an area of 43,000 square miles. It is bounded on the north by Sierra Leone and Guinea, on the east by the Ivory Coast, and on the south and west by the Atlantic Ocean. Liberia is the oldest republic on the African continent. Approximately 40% of the population resides in urban areas, with over one half of these living in or around the capital city of Monrovia.

The coast of Liberia is approximately 370 miles long and extends inland about fifty miles. This coastal strip is virtually the only developed region. The climate is typically equatorial, with an annual mean temperature of 82 degrees Fahrenheit, accompanied by an annual rainfall of about two hundred inches along the coastal strip and seventy inches in the interior. The rainy season occurs between April and October with drier periods from November through March.

The country experienced economic growth in the 1960s and the 1970s. However, the combination of political uncertainty after the 1980 coup, a worldwide decline in the commodities exported by Liberia, and the withdrawal of financial support by the World Bank, IMF and United States resulted in very difficult economic conditions. The country is rich in natural resources, especially iron ore, gold, and diamonds. It is also rich in timber, and has been a major producer of rubber. But this natural resource wealth has been squandered in a long lasting civil war. Over 70% of the population in the production of food crops like rice and cash crops like cocoa and coffee. The largest single employer is the government. The jobs crisis has been aggravated by the demobilization after the civil war.

Information about Liberia can be found in the CIA World FactBook at the following URL:

https://www.cia.gov/cia/publications/factbook/print/li.html

Malaria in Liberia

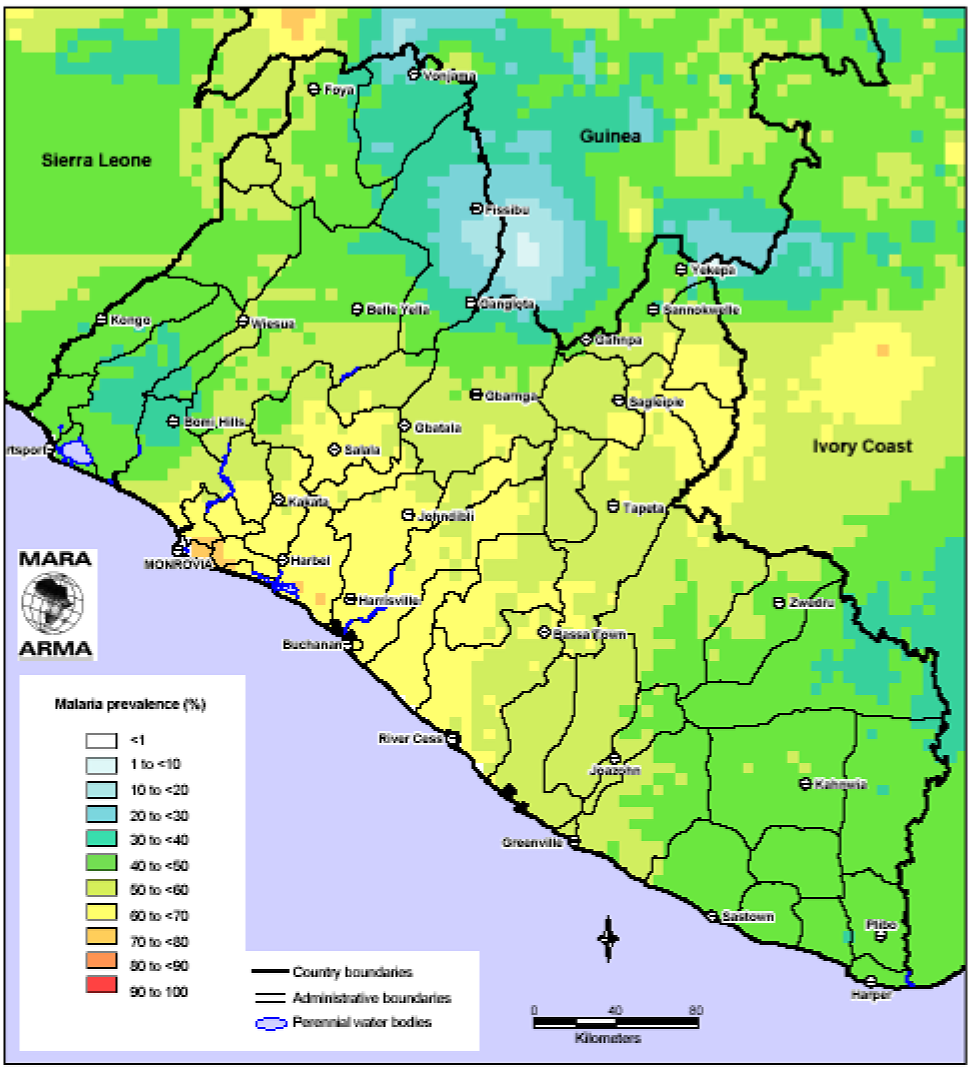
Liberia, is one of the countries that, according to WHO, has as much malaria as any place in the world (See Business Plan – Appendix). The conditions are perfect for a virulent mosquito population, there is a high prevalence of malaria in the human population. The following map shows the distribution of malaria in Liberia according to information in the MARA-ARMA database. The data are from the 1980s and 1990s.

Malaria is endemic to Liberia, including the greater Monrovia district. The condition is said to be autochthonous because indigenous malaria acquired by mosquito transmission is a regular occurrence. In Monrovia, the incidence of malaria is of epidemic proportions. Some in the medical community believe malaria infects 100% of the adult population. The risk of exposure is inescapable. Between 90% and 100% of the population is exposed on a continuous basis.

The rate of infection in Monrovia may be even higher than for Liberia as a whole, with hospitals and clinics reporting that more than 50% of the patients are infected by malaria. Monrovia has a very high incidence of malaria because conditions are very favorable for mosquitoes to breed, there is a very high prevalence of malaria in the human population, and no efforts were under-taken to control the situation for over 20 years, because of a public finance crisis and civil war.

According to MARA information, (see map below) almost the whole country has a prevalence exceeding 40%, and perhaps as much as 80% of the population live in areas with prevalence exceeding 60% and perhaps as much as 50% of the population are in urban areas with a prevalence exceeding 70%. The conventional wisdom that malaria does not thrive in areas near salt water does not apply in the case of Liberia. There has been virtually no anti-malaria intervention in several decades and the prevalence of malaria has gone unchecked.

Liberia: Malaria Prevalence Model

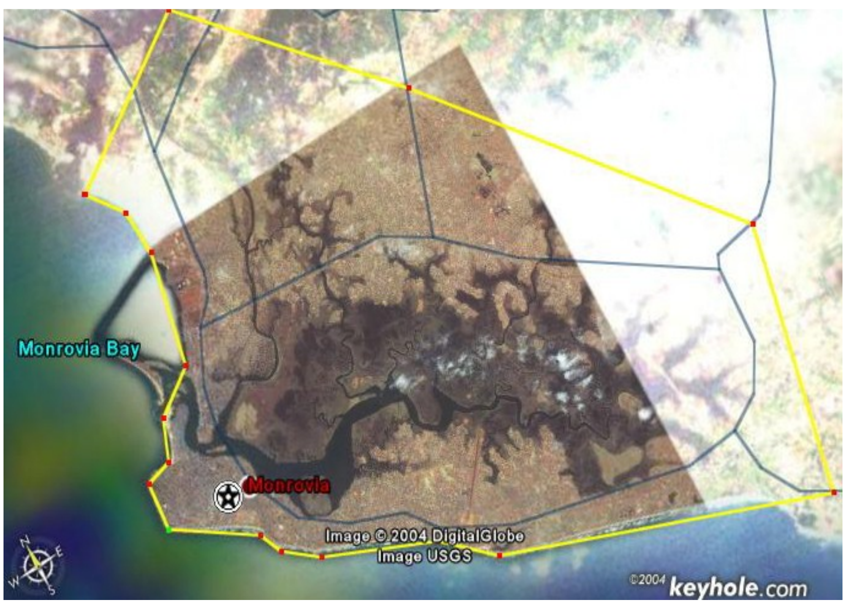


A nationwide children's health survey, conducted between February and July of 1986, found that one of every two children had had fever during the four week period prior to the survey. In 67% of the cases, the child was between twelve and seventeen months old. A 1988-89 report showed that the greatest number of pediatric hospitalization cases were for malaria. In 1984 it was reported that 144 out of 1,000 infants would die before their first birthday and that 220 would die before reaching age five. That is, more than one in every five newborn children is dying before reaching age five.

There are two peak seasons for the transmission of malaria in Liberia, including Monrovia. One is July through August and the other October through November. Each of the major urban areas in the country will be included in the program as a matter of public health policy. Small communities can be included also where there is a need and the community considers IMMC interventions should be a community priority.

Monrovia

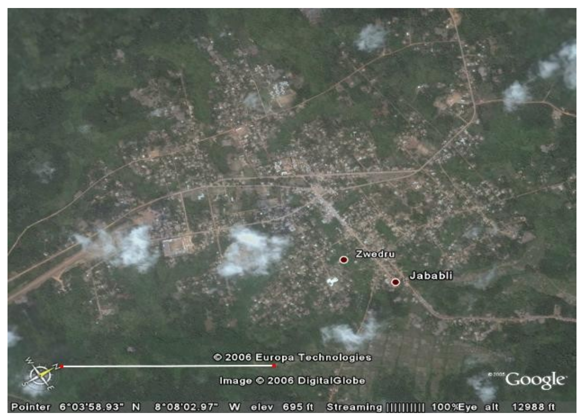
Monrovia is the capital city and the largest urban area in Liberia. The population of the city was around 500,000 prior to the civil war, and since the war insecurity and influx of displaced persons has probably expanded it to more than 1 million. Monrovia covers an area of around 50,000 acres. It is unusual because of some 15,000 acres of marshland, a perfect breeding ground for mosquitoes, located in the center or the built up area. On the map below, the area within the yellow lines is about 50,000 acres. The dark brown represents the marshy area of about 15,000 acres.



Spatial information has an important role in planning efficient IMMC interventions, and it is fortunate that Liberia has good spatial information from satellite images. It is planned to make maximum use of spatial information to optimize results at minimum cost.

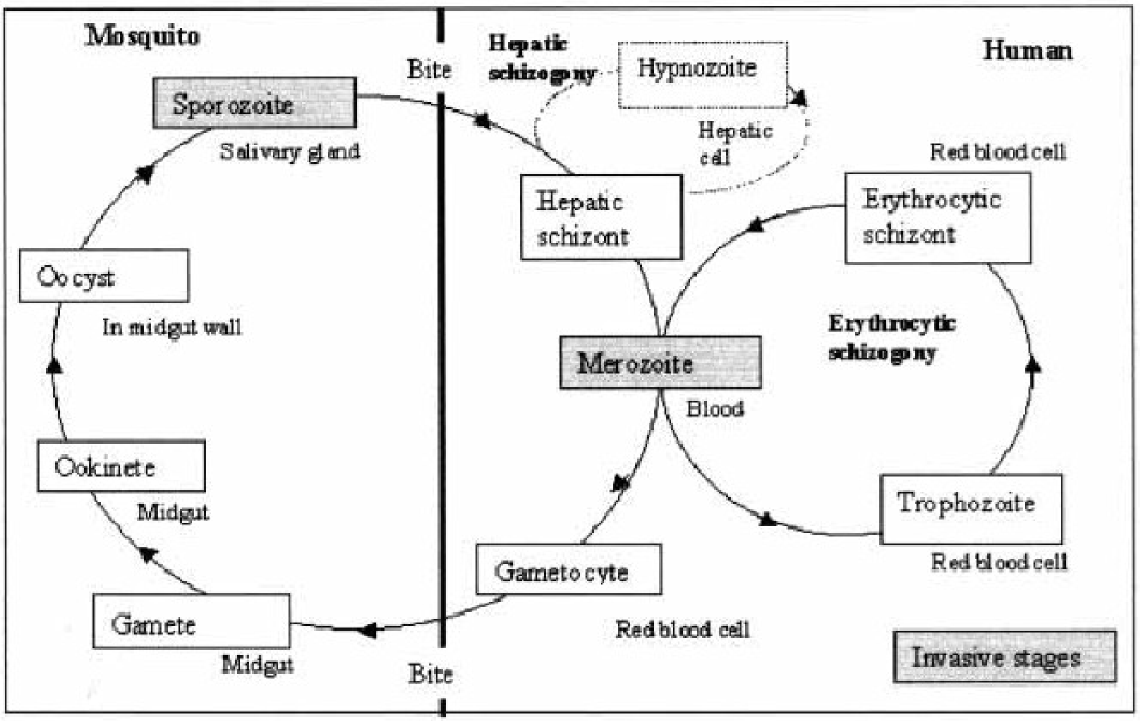
The picture (below left) is of the Bushrop Island neighborhood of Monrovia. It is crowded and many houses do not have easy road access. The picture (below right) of the Sinkor neighborhood shows a different set of physical conditions, and different issues for effective ground operations. Note in both cases how few of the buildings are road accessible and within range of effective mechanized ground fogging. Again, this area is suited to ULV aerial spraying.

There is satellite imagery available for most urban areas, and a lot is available at high resolution that can be used for spatial management. There are 10 or more other urban areas in Liberia including: Robertsport, Harbel, Buchanan, Greenville and Harper all along the coast and Voinjama, Foya, Gbarnga, Yakepa and Zwedru all inland. The image (below left) is for the Buchanan area and the image (below right) is for Zwedru.



THE DYNAMICS OF THE DISEASE
MOSQUITOES, MALARIA AND IMMC INTERVENTIONS

The problem of malaria is a function of the mosquito, the malaria parasite and human physiology. The biting of a mosquito joins the three elements together.



From:

The malaria parasite

When a mosquito bites an infected person, it ingests microscopic malaria parasites *(Plasmodium vivax)* found in the person's blood. The malaria parasite must grow in the mosquito for a week or more before infection can be passed to another person. If, after a week, the mosquito then bites another person, the parasites go from the mosquito's mouth into the person's blood. The parasites then travel to the person's liver, enter the liver's cells, grow and multiply. During this time when the parasites are in the liver, the person has not yet felt sick. The parasites leave the liver and enter red blood cells; this may take as little as eight days or as many as several months. Once inside the red blood cells, the parasites grow and multiply. The red blood cells burst, freeing the parasites to attack other red blood cells. Toxins from the parasite are also released into the blood, making the person feel sick. If a mosquito bites this person while the parasites are in his or her blood, it will ingest the tiny parasites. After a week or more, the mosquito can infect another person.

The mosquito life cycle

The female *Anopheles* mosquito carries and transmits the malarial parasite during blood feeding at the adult sexual stages. The mosquito is an uninterrupted individual feeder and is predominantly a night biting insect. The *Anopheles* mosquito lays eggs that hatch in shallow, warm, slow moving or relatively still water. Any site that holds rain water or permanent standing water for one week or more is ideally suited for breeding. The gestation period is approximately twenty to twenty-one days. In dry conditions, eggs may last up to five years, waiting for water to trigger the larval and pupal stages. One report noted that, in an area the size of a football field, over one million eggs can be found. The number of mosquitoes in relation to the number of human targets is overwhelming. Mosquito broods may peak during any season and the vector's ability to strike is continuous, chronic, and acute.

To add to the challenge, malaria can be imported into the control area. An adult mosquito riding on slight breezes can travel up to fifty miles from its point of origin. People carrying malaria can migrate into the area, bringing with them new parasites to add to the vector's source of infected hosts. The combination of many factors makes the malaria situation an epidemic by any standard, and the situation will be resolved only by all-out intervention.

Impact on human beings

Malaria can easily kill children who have not yet developed any sort of immunity against the malaria parasite. Also pregnant women with low levels of immunity have a higher incidence of contracting the disease, and many die. Placental parasitemia causes not only lower birth weights, but entire lives of increased susceptibility to illness. Exposure to malaria during childhood seems to provide some immunity to the disease in adults. Some scientists express concern that successful programs to control malaria during childhood will reduce adult resistance to the disease with seriously adverse consequences unless there are perpetual control programs for mosquitoes and malaria.

Control of mosquitoes and malaria

Without mosquito bites, malaria does not get transmitted. Without malaria in the human host, a mosquito does not pick up malaria, and if the mosquito does not have malaria, then a mosquito bite does not transmit malaria. The control of mosquitoes and malaria is therefore best done in coordination. A simulation model suggests that an integrated comprehensive coordinated mosquito and malaria control program can be substantially more efficient and cost effective than any single intervention on its own.

The IMMC Consortium is organizing to get results. The first step is to have access to world class expertise that can focus totally on helping to get the best possible results. Several organizations are making available their skills and experience so that the IMMC Consortium can deliver on its aims.

An IMMC program is going to be successful when data, decisions and IMMC activities are coordinated in the most efficient manner. A simulation and planning model has demonstrated that the various possible IMMC interventions require significantly different scale and organizational structure to optimize costs and deliver best results. The simulation, as well as expertise, also shows that timing is critical to optimizing results and getting the most value from money spent.

The IMMC Consortium has two primary areas of focus: (1) a management information dimension; and (2) support for practical IMMC interventions.

THE IMMC CONSORTIUM
MANAGEMENT INFORMATION

The management information dimension is needed to measure progress and plan IMMC interventions. It integrates the scientific and operational data with costs and results information to form an integrated whole. Some characteristics of good management information include (1) timeliness; (2) clarity; (3) consistency; (4) relevance; and, (5) materiality. If results improve and seem to be the best possible, then, arguably the management information is serving its purpose.

The starting point for the IMMC Consortium work has been to collect and organize existing data so that it is easier to understand and to have a baseline and starting point. There are several sets of data that are needed: (1) entomological data concerning the mosquito population and its breeding locations; (2) geographical or spatial information about the community ... population, buildings, water, etc; (3) medical information about malaria in the community and how cases are being treated (if at all); (4) the actual IMMC interventions that have taken place and where; and, (5) updates of all the information so that results can be compared to activities.

Collecting new data

There is a need for a lot more information about Liberia and the mosquito and malaria situation. The IMMC Consortium will seek to make best use of the data rather than setting up to replicate existing work. The information that is critical to measuring IMMC performance is founded on data that are collected “on the ground”. Timely information about the mosquito population and the environment are needed. The success of IMMC is determined in large part by the entomological data that is collected and the analysis of this data to design effective interventions. This is where the data originate ... in the field:

The value of the data is maximised by using it in ways that help planning for the best possible IMMC interventions, and using the data to understand what is working and what is not. The data has a lot of value if it can be used in a timely manner, and in a mosquito / malaria system that changes significantly from day to day, daily data can be very valuable.

Powerful management information is obtained when the data collected from the field is matched to the cost and timing of IMMC interventions. At one level this is very basic accounting, but it is also the raw input for the IMMC simulation models that make optimization possible.. Note that the cost data from accounts must not under any excuse be delayed, and if necessary cost accounts can be run independent of the financial accounts to get timely information.

Spatial information.

Modern information tools can be used, especially modern GPS for spatial information and development of simple useful geographic information. It is very clear that major improvement in performance can be achieved by getting IMMC focus on situations where mosquitoes and malaria are the worst, and the need for intervention greatest. Research work has been done for more than 20 years on various aspects of remote sensing and the development of sophisticated geographic information systems (GIS). Some of this work might be very valuable in a practical implementation if it can be used to help focus interventions on very specific areas of need.

Basic cost information, results and value adding

The IMMC management information system is built on concepts that have a proven track record for totally reliable accounting systems. There are daily transactions that show either status or activity, and an analysis system that links the two and produces timely analysis reports. The analysis reports can be used locally for practical decision needed for local purposes, or can be summarized for broad overview analysis or for comparative purposes.

The single metric that needs the most focus is the relationship between cost and the results achieved ... with result being, more than anything else the reduction in the prevalence of malaria in the area population.

Getting cost information, and knowing what the money is being used for is very basic cost accounting, but it is vital, and must be done in a rigorous manner following sound accounting principles and done in a timely manner. The decision makers should know all the time how much each of the IMMC interventions are costing and what results are being achieved, both in terms of the mosquito population, the larva population and malaria prevalence in the human population.

A number of cost analysis techniques should be used including the standard costing technique that measures the actual costs incurred and compares these costs with the costs that are expected from the interventions implemented and the time and scale of the interventions. The same technique can be applied to results being achieved.

Another technique for analysis that will be used is to compare results being achieved and their costs with the cost and results of a simulation model that is being used by decision makers. The aim of this simulation model is to help make good timely decisions about intervention actiivity so that optimized results can be achieved.

Using an easily accessible relational database

In order to make access to information as easy as possible, a relational database is being established that will be web accessible for all IMMC analysts. The goal of the database is to make it possible to track performance both as a time series and across different locations, and using different sets of interventions.

The same data are needed for detailed analysis at the community level and to assess performance on a global basis and to provide cross country and time series information. However, the data needs to be accessed in different ways so that specific activity optimization can be done at the community level, and at the macro level there can be decision support for the mix of interventions that is optimum and how resources should best be analyzed.

Simulation models

Sumulation or planning models are being developed so that critical variables that affect the dynamic of the mosquito and malaria can be studied with easy to understand "what if?" simulations. The model attempts to relate cost with result, on top of calculations that reflect the underlying science. The model includes costs, scale of interventions and results and helps decision making about what might work, how much it is likely to cost and what results should be expected. The model is in an early version, and has not yet been tested against a lot of field information, but initial indications are that a combination of interventions is very much more cost effective than any single intervention carried out on its own.

Training, oversight and organization for information management

The best information is always information that is USED. A lot of detailed operating information will be collected because it is needed to make decisions. It is needed on a timely basis, and it needs to be right so that good decisions can be made. Local people need to be engaged to collect information, and local organizations should have oversight responsibility for the quality of the data, and accordingly, also some considerable responsibility for the success of the program.

Local telecenters can also be involved in the data collection process and the communication of these data into the database and management information system.

Data from different locations can be compared and lessons drawn from the relationships between costs and results.

The "business" relationship between all the various organizations that need to be engaged will evolve. The underlying principle is that local people should be involved to the largest extent possible, and remunerated on a basis that is reasonable and related to their capabilities and the value of work.

IMMC INTERVENTIONS
OPERATIONAL SUPPORT

The practical IMMC interventions include: (1) community awareness, education and training; (2) neighborhood cleanup to reduce mosquito breeding places; (3) interior residual spraying (IRS); (4) ultra low volume (ULV) external adulticide spraying to kill flying mosquitoes; (5) mosquito larva control to kill larvae and stop mosquito recruitment into the population; (6) personal use of insecticide treated bednets (ITN); and, (7) malaria treatment.

Community awareness, education and training.

The community is where success is best measured, and it is community people that will benefit the most from success. Everyone from an early age needs to be made aware of malaria, and how it can be controlled. A lot of what is needed to have success depends on the community. There are many ways that local organizations, schools, churches, health centers, etc can be engaged in the IMMC program.

The community is the key to success because people live in communities, and progress can be best measured at the community level. However, the challenge of involving the community should not be underestimated. People have a lot to do just to survive, and while malaria may be critical health issue, it may not be recognised as a health issue that is in any way in the local community's control.

Neighborhood clean up

Community level efforts to reduce mosquito breeding places is valuable. These can be organized through schools, churches, women's groups either as independent efforts or as part of a comprehensive set of activities. Reducing mosquito breeding places is a simple way to start getting control of the mosquito population. If the community is organized to help with clean up, and to remove places where mosquitoes can breed, they also learn about other aspects of the malaria problem.

The involvement of local people in clean-up can be on any basis that suits the local situation. It can be a government sponsored program with remuneration, or a “Food for Work” program with resources from the World Food Program (WFP), a program funded by Faith Based Organizations or a totally volunteer program. The key is involvement that helps people help themselves and understand the way in which the whole program is aiming to help the community.

Interior residual spraying (IRS)

The use of interior residual spraying (IRS) has been successful in many different settings, from South America to South Asia, in the Mediterranean region and in South Africa. IRS requires workers to enter houses and do the spraying according to a protocol that is safe for residents and the spray teams.

IRS works through three mechanisms: (1) there is a repellent action that keeps mosquitoes out of the house; (2) there is an irritant action that makes a mosquito leave a house quickly after entering; and, (3) a toxic action that kills the mosquito if it chooses to rest in the house. Broadly speaking, the size of the mosquito population is not affected by an IRS intervention, but behavior is modified so that there is less human blood meal taking by the mosquitoes. In an area where there is a substantial IRS intervention, the mosquito population moves outside, where it can be effectively subject to adulticide control.

IRS is most effective when DDT is used is the pesticide, but DDT use is resisted by some national authorities. Other pesticides can be used but they cost more and are less effective. Nevertheless, according to some peer reviewed reports, IRS is more than 3 times more cost effective that ITN is reducing the number of malaria cases in a community.

IRS requires a well trained team of sprayers in order to get good coverage. The training takes time, and the salary costs are substantial.

Ultra low volume (ULV) adulticide spraying.

Adulticide treatment is commonly used where public health authorities are concerned about the possibility of insect borne disease. In the USA, large areas where sprayed in the aftermath of Hurricane Katrina, and similar interventions have been used after other devastating hurricanes in the USA. Spraying is widely used when West Nile Virus is detected in US communities. Spraying has a role in getting control of mosquito vectors in malaria endemic areas.

The purpose of adulticide spraying is to kill adult mosquitoes. The ULV approach kills mosquitoes mainly when they are flying. The droplets, which are about 50 micron in diameter, attach to the mosquitoes legs. The concentrations of pesticides used are very low, for example: about ¾ oz of Dibrom pesticide is used per acre.

Adulticiding can be done from the air, using vehicle mounted equipment or using hand held equipment. The aircraft used for ULV spraying are very maneuverable, and suited to flying with very precise positioning and they are also equipped with spray equipment that enables them to generate very small spray droplets just microns in size.

Spraying by air is the lowest cost per acre when large areas have to be treated. Spraying by air also makes it possible to have a quick impact over a very large area. The results of the IMMC operation simulation show the importance of timeliness and speed, and argues for rapild aerial treatment as a key component of an integrated coordinated program. Vehicles can also be quite cost effective where there is good road access. Hand adulticiding is very costly for large programs.

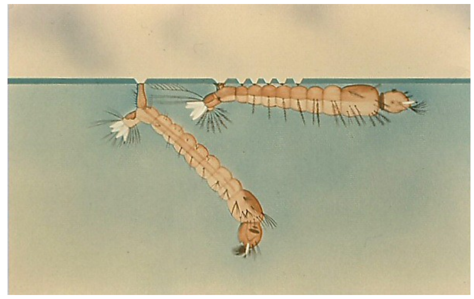
All pesticide use must be done under controlled conditions with strong safety protocols in place. Used in the manner intended, the pesticides and biological agents used are highly toxic to mosquitoes, but safe for humans, animals and the environment. Compared to many of the chemicals used in treatment of malaria and other human diseases, the pesticides have low human toxicity. ULV adulticiding is a safe way of reducing the mosquito population and is used regularly around the world under protocols that ensure safety for people, animals and the environment.

Larviciding and environmental control

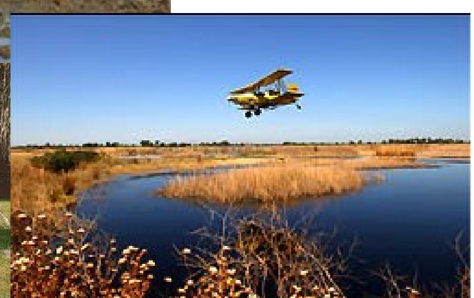
Mosquito population control is best when mosquitoes are never recruited into the flying adult population. Mosquitoes lay eggs in stagnant water, and in a matter of days eggs become larvae, become pupae and then adult flying mosquitoes. The picture below shows what larvae look like, and how they attach themselves to the surface of the water.

There is a high natural mortality in the stages between egg and adult mosquito, and natural mortality can be supplemented by larvicide control measures to stop all the recruitment from the water body. For larviciding to be effective, there needs to be accurate and timely knowledge about the water bodies and the status of the mosquito larvae ... and interventions to control the larvae need to be scientifically suitable and timely. The use of well organized local data collection in combination with modern ICT, and easy access to the required intervention helps to have IMMC success.

The images below show mosquito larvae. The examples hanging vertically are probably Culex larvae. The Anopheles larvae attaches itself horizontally to the surface of the water as shown in the right hand image.



The success of larviciding has been demonstrated over and over again, but it requires a lot of organization. Precise data are needed, timely intervention and well trained staff. Some bodies of water are difficult to access, and larviciding can be done by air. In some places helicopters are used for very precise delivery of treatment.



The environment makes a big difference to the recruitment of mosquitoes into the population. The data seem to suggest that man-made construction has a big role in creating the sort of environment that encourages mosquito breeding. Natural water is often associated with natural vegetation that seems to inhibit mosquito breeding. While the mechanism is not known, the idea that mosquito breeding varies spatially argues for precise information about the spatial entomological situation, and the precise interventions for each place.

Bednets and insecticide treated textiles

Bednets, insecticide treated nets (ITN), are another intervention that should be part of a comprehensive anti-malaria campaign. The model being used for IMMC planning has not been able to demonstrate that bednets on their own are as cost effective as other IMMC interventions, but they do have a favorable impact for the people who choose to use bednets.

The model suggests that bednets in fact have a potential value to help reduce the transmission of malaria from infected humans to others, and could be used to facilitate a form of quarantine for infected patients.

Long lasting insecticide treated bednets have been introduced in Africa since around 2003. These nets retain their effectiveness for about 5 years. The bednet shown below is being used in Uganda.

Data regarding the effectiveness of bednets seems to show that a bednet reduces the risk of malaria infection for the users of the bednets, but has no appreciable impact on the community as a whole that does not have bednets. This is in contrast to IRS, where the community at large seems to benefit from an IRS program, even where less than all the houses are sprayed.

Insecticide treated textiles can be used to manufacture clothes. The technology has been used already for military uniforms for soldiers being deployed in malaria endemic areas. The approach might be used in an IMMC program for uniforms for "Malaria Control Teams" as well as for the various uniformed services of countries in malaria endemic areas.

Malaria treatment

There are many millions of malaria cases in Africa every year. Many Africans get malaria several times a year. Only relatively few of the malaria cases in Africa get any form of professional treatment. Data that only comes from clinics is a subset of data that is not representative of the population as a whole.

With 400 million at risk, it is difficult to comprehend that each case has a human face. This child got to a clinic, but the clinic had no medicine. The child died.

Quinine was found to be a useful treatment for malaria in the 19th century and was used as part of the Panama Canal anti-malaria campaign in the early 1900s. In the post WWII years Chloroquine became the most widespread malaria treatment, both as a prophylactic and for treatment, but many malaria strains have now become resistance to Chloroquine.

Malaria can be treated with drugs. The choice of anti-malarial agent depends on the type of parasite, and the severity and stage of infection. In many parts of the world, *P. falciparum* is resistant to chloroquine, the mainstay of malaria treatment. The following medications are used alone or in combination:

- Chloroquine
- Mefloquine (Lariam)*
- Doxycycline*
- Clindamycin*
- Malarone*
- Quinidine*
- Quinine*
- Combination of pyrimethamine and sulfadoxine (Fansidar)*
- Primaquine (for hepatic phase of *P. vivax* and *P. ovale*)
- Artemisinin*

*Commonly used to treat chloroquine-resistant strains of *P. falciparum*.

The cost of the alternatives to Chloriquine are much more expensive and this makes large scale free treatment a huge burden for the health budget.

Concern over the development of resistance and side effects from anti-malaria treatments are valid, and as long as endemic malaria in the environment prevails, there will have to be ongoing leap-frogging of medical science and resistance development. This of course, argues for an anti-malaria strategy that addresses the environment and the endemic malaria.

A malaria vaccine has not yet been developed. Malaria is not an easy disease to control with a vaccine, but it is scientifically possible. Whether there is an enabling economic environment for vaccine development and deployment is questionable, and needed political support is also problematic. For the purposes of this IMMC program a malaria vaccine is "in the future". However, the understanding of the parasite may help in accelerating treatment so that the environment can be improved by more rapid treatment to minimize parasite prevalence.

IMMC INTERVENTIONS RISKS

The issue of risk is important. Ineffective control of mosquitoes and malaria has created as situation where 3,000 children a day are dying from malaria in Africa. Inaction and ineffective interventions has a huge cost. How much is an African child's life worth? If it is $1,000 then the daily cost is $3 million and the annual cost more than $1 billion, and at a more reasonably $10,000, then the annual cost is more than $10 billion.

The risks of an IMMC program are small compared to the cost of doing nothing. The value of taking a DDT risk for IRS, for example, is small even compared to the trade sanctions that could perhaps be imposed by uninformed environmental activists in Europe.

ORGANIZATION AND MANAGEMENT
KEY STAFF AND ADVISERS

Experienced team

An experienced team of experts and advisers has been identified to manage the operations. This team includes personnel and consultants with management experience in medical entomology, medical science, aerial ULV spray operations, pesticide application management, and accounting, financial control and data processing. The core team includes:

> **Delvin Walker**
> To be general manager, Delvin Walker is a medical entomologist and former consultant, a former professor at Cuttington University in Liberia.
>
> **Bill Nesler,**
> To be manager of operations, Bill Nesler is President of West Coast Aerial Applicators Inc., a veteran pilot and aerial operations manager with experience in US pest control and contract flight operations in Africa.
>
> **Peter Burgess**
> To be CFO, Peter Burgess is CEO of Tr-Ac-Net Inc. and former CFO of Continental Seafoods Inc. a US based international fishing company and management consultant to the UN, World Bank and private organizations
>
> **Bob Novak**
> A medical entomologist, professor at University of Illinois, Champlain and consultant to international programs.
>
> **Jeffrey Widmann**
> VP of West Coast Aerial Applicators and an experienced pilot and trainer.

Advisory Group

The IMMC group has an advisory group that includes a number of people who are very experienced in various elements of modern mosquito and malaria control including:

> **WE NEED TO GET PERMISSION TO INCLUDE SOME OF OUR FRIENDS AND COLLEAGUES IN THIS SECTION**

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FINANCIAL COST PROJECTIONS
FINANCING PLAN

Financial projections

The projections of costs are derived from a set of financial planning spreadsheets that include: (1) an IMMC simulation model; (2) a financial cost projection for Liberia; and (3) a standard cost projection based on unit costs and the scale of projected interventions. The tables below are summarized from these detailed financial and operational projections. THE NUMBERS ARE VERY PRELIMINARY AND ARE BEING REFINED TO REFLECT ADDITIONAL INFORMATION AS IT BECOMES AVAILABLE.

Operating Costs for Five Years* - Summary In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5Yr total
IMMC management	**1,500**	**1,500**	**1,500**	**1,500**	**1,500**	**7,500**
IMMC data and information	**500**	**500**	**500**	**500**	**500**	**2,500**
IMMC physical interventions	**7,000**	**5,500**	**5,500**	**5,500**	**5,500**	**29,000**
Contingency	1,000					1,000
TOTAL PROJECT COST	**10,000**	**7,500**	**7,500**	**7,500**	**7,500**	**40,000**
Increment if not DDT for IRS	2,000	2,000	2,000	2,000	2,000	10,000
TOTAL PROJECT COST	**12,000**	**9,500**	**9,500**	**9,500**	**9,500**	**50,000**

Preliminary – under review

The following table is an estimate (preliminary) of investment required for for equipment, durable assets and working capital. The capital rquirements are small relative to the cost of the supplies needed for the program, mainly pesticides, larvicides and bednets:

Investment Costs for Five Years* In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5Yr total
International (mainly ICT)	100	50	50	50	50	300
Regional (mainly aircraft)	2,000					2,000
Country (Liberia) Vehicles and equipment	300	150	150	150	150	900
Building improvements	400	50	50	50	50	600
Working capital	700					700
Contingency	500					500
PROJECT INVESTMENT	**4,000**	**250**	**250**	**250**	**250**	**5,000**

- Preliminary – under review

The following table shows the program operating costs estimates in more detail for a five year period. The table will be revised as soon as more accurate information becomes available:

Operating Costs for Five Years* In thousand dollars ($ 000)						
	Year 1	Year 2	Year 3	Year 4	Year 5	5Yr total
Organization – mobilization	300	100	100	100	100	700
Public relations - awareness	400	400	400	400	400	2,000
Training	500	500	500	500	500	2,500
Management and admin.	300	500	500	500	500	2,300
IMMC management	**1,500**	**1,500**	**1,500**	**1,500**	**1,500**	**7,500**
Data collection	300	300	300	300	300	1,500
Data analysis	100	100	100	100	100	500
Data system	100	100	100	100	100	500
IMMC data and information	**500**	**500**	**500**	**500**	**500**	**2,500**
Environmental Clean Up	300	200	200	200	200	1,000
IRS using DDT	1,000	1,000	1,000	1,000	1,000	5,000
Aerial adulticiding	2,000	1,000	1,000	1,000	1,000	5,000
Ground adulticiding	600	300	300	300	300	1,500
Larviciding (air)	1,000	500	500	500	500	2,500
Larviciding (ground)	500	500	500	500	500	2,500
Medical treatment (staff)	500	500	500	500	500	2,500
Medical treatment (drugs)	500	500	500	500	500	2,500
Bednets (distribution)	200	500	500	500	500	2,500
Bednets (product)	200	500	500	500	500	2,500
IMMC physical interventions	**7,000**	**5,500**	**5,500**	**5,500**	**5,500**	**29,000**
Contingency	1,000					1,000
TOTAL PROJECT COST	**10,000**	**7,500**	**7,500**	**7,500**	**7,500**	**40,000**
Increment if not DDT for IRS	2,000	2,000	2,000	2,000	2,000	10,000
TOTAL PROJECT COST	**12,000**	**10,000**	**10,000**	**10,000**	**10,000**	**50,000**

* Preliminary – under review

At $40 million over 5 years, with 2 million people benefitting, the 5 year per capita cost is $20 or an annual per capita cost of $4.

The IMMC simulation model suggests that the costs can be significantly lower than this, but there are little data that shows conclusively that results can be achieved at lower cost. This program will be cost reduced when facts are available to improve decision making about the effectiveness of alternative combinations of interventions.

APPENDIX 1

MANAGEMENT AND STAFF BIOGRAPHIES

Biographies of Some Key Staff

The following are some of the people who are committed to the success of this initiative and will form the core of the management team – in alphabetical order.

Delvin Walker
General Manager
Delvin Walker will be the overall manager of the project. He was chief of the science department at Cuttington College in Liberia prior to the outbreak of the civil war. He has extensive experience in program management and is a trained entomologist. He has worked with international relief and development assistance organizations in countries around Africa for many years. He received a master's degree from California Polytechnic and has other academic training from other universities.

Robert J. Novak
Medical Entomologist
Robert Novak will ensure that the Program follows rigorous scientific discipline and help to optimize the activities of the Program to ensure effective operation and good results. He is a professional scientist affiliated with the University of Illinois at Urbana-Champaign with vast experience with vector control both in the United States and in Africa. He earned a Masters degree at the University of Utah and PhD at University of Illinois.

William Nesler
Operations Manager and Senior Pilot
Bill Nesler is commercial aircraft pilot with over 20,000 hours of flying time, of which 15,000 hours have been in agricultural pest control operations. He has been chief pilot in charge of 8 airplanes, 9 pilots, 3 mechanics and numerous ground crews. He has been licensed and has worked in most of the agricultural states in the USA and has lived and worked in Liberia for almost 20 years. He has experience working with Liberians and an understanding and appreciation of the local traditions and customs. While living in Liberia, Mr. Nesler and his family suffered from severe attacks of malaria, giving him a personal understanding of the problem. Mr. Nesler will serve as the Program's operations manager.

Peter Burgess
Controller and Management Information Services
Peter Burgess is an expert in financial control and management with experience with international companies and the global relief and development sector. He is the founder and CEO of Tr-Ac-Net Inc, the Transparency and Accountability Network. He has been a pioneer in using available data to improve management informations and decision making. During his corporate career, he was CFO of Continental Seafoods, Inc, a US company that operated a successful fisheries joint venture in Liberia and around the world during the 1970s. He earned a double major in engineering and economics at Cambridge University and trained as a chartered accountant with Coopers and Lybrand in London.

Jeffrey Widmann
Training Manager and Senior Pilot
Jeffrey Widmann is an experienced aerial applicator and an active and highly regarded flight instructor, with over thirty years experience, he has provided students with the specific training necessary to operate the Grumman Agcat safely. He is a retired U.S. military officer with experience in international flight operations and training and is a Federal Aviation Administration certified aircraft mechanic. Mr. Widmann will assume the position of training manager and chief pilot to train selected Liberian pilots in the field of aerial application of pesticides. Mr. Widmann has lived and worked in Monrovia and is familiar with the customs and culture of the Liberian people. He has flown commercial flight operations in Liberia and has held a Liberian commercial pilot certification and work permits.

ORGANIZATIONAL STRUCTURE