

INTEGRATED MALARIA MANAGEMENT CONSORTIUM

Working to reduce the incidence of malaria, and other insect spread diseases.

IMMC



An Integrated Malaria Management Strategy for the Eradication of Malaria in Africa

January 2008

*In Cooperation with The Tr-Ac-Net Organization
www.tr-ac-net.org*

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IMMC

Integrated Malaria Management Consortium

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Introduction to Mosquito and Malaria Control

The Goal Is Eradicating Malaria

Eradication of malaria has been done in some parts of the world, but not in Africa where it remains a major health crisis and contributes seriously to poor socio-economic performance. Much of the work done in the past in Africa has been expensive and ineffective. However, there is no reason why an integrated set of interventions for vector control and malaria treatment cannot achieve, not only a substantial reduction in the burden of malaria, but also eradication of the disease. In order to have success, however, there is a need to drive the program with good science and deploy a good management information system with performance metrics so there are timely decisions and selection of best possible interventions.

Integrated Malaria Management (IMM)

Integrated malaria management (IMM) controls both the mosquito and the malaria parasite. The integrated approach reduces the prevalence of the malaria at least cost.

There are three components of IMM:

1. Scientific Data and Management Information;
2. Mosquito and Malaria Control Interventions; and
3. Capacity Building and Training.

Mosquito and Malaria Control Interventions are in the following areas

1. Community;
2. Vector control activities;
3. Medical; and,
4. Personal protection.

Costs and Value

The cost of mosquito and malaria control has been far too much for African health authorities to handle without external assistance. At the same time the socio-economic cost of malaria in Africa has been estimated at between \$10 and \$40 billion a year. A recent WHO estimate was \$18 million. This arises because of the debilitating morbidity associated with malaria attacks and the loss of worktime, as well as death, mainly of young children and pregnant women. The economic loss is aggravated by the loss of tourism and the unwillingness of international companies to commit investment in malaria endemic areas.

During the past few years there has been a rapid increase in the funding for mosquito and malaria and control. The challenge is for these fund to provide the maximum of reduction in the burden of malaria, to do it as fast as possible, to do it at least cost and to have the gains sustainable. It is hoped that integrated mosquito and malaria control will eventually result in eradicating malaria will have generate substantial benefit for the African economy. Area wide eradication or

substantial reduction in malaria will also reduce costs associated with malaria control and medical care.

Integrated malaria management can be as much as five times more cost effective than any single intervention in almost any circumstance. This is achieved by use of management data for decision making that combines key metrics from science, not only medical science, but also entomology, geography, and meteorology as well as basic data from cost accounting.

For a community of one million people and an area of 50,000 acres, the estimated costs to reduce endemic malaria to almost nothing is \$32 million over a five years period. The projected resource allocation for an optimized program would be something like as follows:

\$ million

Cost Estimate: One million population – 50,000 acres						
Item	Yr1	Yr2	Yr3	Yr4	Yr5	Total
Investment	5.0					
Data	0.8	0.8	0.8	0.8	0.8	4.0
Community	0.2	0.2	0.2	0.2	0.2	1.0
Source control	2.0	1.0	0.6	0.4	0.4	4.4
ULV spraying	3.0	2.0	0.5	0.2	0.2	5.9
Drug therapy	1.0	1.0	1.0	0.7	0.3	4.0
IRS	2.0	2.0	1.0	0.5	0.5	6.0
Bednets	0.5	0.5	0.4	0.2	0.1	1.7
Total	\$14.5	\$7.5	\$4.5	\$3.0	\$2.5	\$32.0

The investment includes equipment cost, development of the data flows and analytical framework, and initial operating supplies. The outcome aims to be a sustained reduction in the prevalence of the malaria parasite in both mosquitoes and the human host, a reduction in the burden of malaria and socio-economic progress in the community.

A continuing expenditure of around \$12.5 million per five years is projected to maintain the improved status. This compares with a 5 year cost for, for example, 100% bednets and 100% drug therapy, of perhaps \$50 million.

Role of data and performance metrics in cost effectiveness

The IMMC strategy puts data and its analysis for scientific purposes and management decision making at the center of the work. Experience shows that timely information and decision making can improve cost effectiveness in operations by an order of magnitude ... especially when applied in the community setting

IMMC ... the Consortium Members

The Integrated Malaria Management Consortium (IMMC) is a program of the University of Alabama, Birmingham (UBA) with National Center for Supercomputing Applications (NCSA) at the University of Illinois, Champagne Urbana. These institutions have world class credentials in malaria epidemiology and entomology and supercomputing applications.

IMMC is cooperating with the Transparency and Accountability Network (Tr-Ac-Net) who provide expertise in the cost accounting and management information aspect of an integrated program and provide a database approach to the analysis of cost effectiveness.

IMMC also includes a technical team drawn from the vector control community with expertise in the use of pesticides and all aspects of vector control using manual and mechanized techniques

including aerial application. Members of the team have US, African and other international experience.

IMMC cooperates and works with Africa based organizations including corporate business, local telecenters, local non-governmental organizations (NGOs), local community based organizations (CBOs), local faith based organizations (FBOs), local scientific research institutions (such as ICIPE and KMRI in Kenya), local Universities and other educational organizations.

These cooperating entities have the capacity to build capacity at the community level, within the local scientific community and at the national level to the extent that it is needed.

IMMC Priority Focus

The IMMC strategy aims to address the very many issues that constrain success not only in the malaria subsector, but in community development and in the broader health sector as well, such as:

1. the issue of sustainability;
2. the many issues about funding;
3. the issue of health sector infrastructure;
4. the issue of cooperation between implementing organizations;
5. the issue of private and public cooperation; and
6. the issue of capacity building.

IMMC therefore has a focus on:

1. establishing a framework for performance metrics that informs decision making;
2. facilitating access to all sorts of mosquito and malaria control interventions based on timely scientific management data;
3. using the knowledge derived from excellent performance information to advocate for and justify increased fund mobilization; and
4. building local capacity and training.

The IMMC strategy has an Adam Smith market orientation. Fund allocations should flow to intervention activities that are the most cost effective and deliver the most of social value. But in order for this to happen there has to be an adequate system of performance information. The IMMC framework for performance metrics provides this.

Management, Goals, Metrics

The Basic Management Cycle

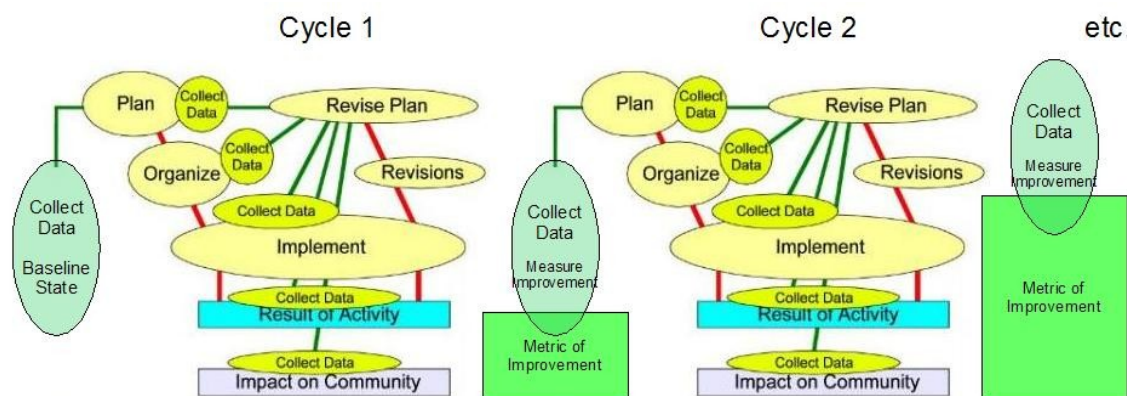
Good basic management practices apply in mosquito and malaria control as in any other area of economic endeavor. The management cycle needed for an effective integrated mosquito and malaria control program has three elements:

1. Collect data, do analysis;
2. Plan and organize;
3. Implement ... and measure and analyze
4. Revise and do again, over and over.

These are reflected in the following schematic:



High performance operations integrate data collection, analysis, planning, action, more data collection, more planning, more action in a perpetual process.



The ultimate measure of success is whether the change between the initial status and the post activity status has a value that (substantially) exceeds the costs. The above schematic shows this as a box “Metric of Improvement”. The activities produce their own results or outcomes, and in turn these have an impact on the community. The metric of improvement is mainly that of impact on the community and the constituents of the community.

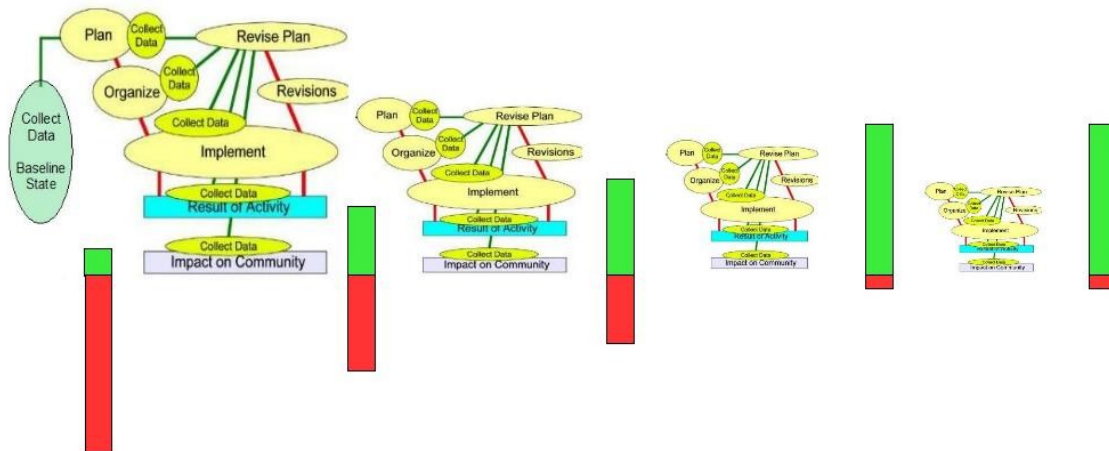
There at least two management questions that arise:

1. Is the impact on the community sufficient to justify the expenditure on the activities? and,
2. Are the activities costing the right amount given the situation and experience elsewhere.

The relationship between funds disbursed, interventions used and the results of these activities and the ultimate impact on the community is not simple. It is a complex multivariate situation with no one perfectly right answer.

Even though at the present the scientific understanding to optimize a comprehensive portfolio of control interventions is incomplete, there is sufficient information already known to be able to manage resources better than is presently being done, and the measure the outcomes and the results.

Compiling performance metrics everywhere from an ongoing planning, implementation, review cycle will yield better planning information. Over multiple cycles the aim is for the scale of the interventions to diminish and for the impact on community to get better and better, and the bad things to get smaller.



In this graphic the initial condition reflects a high socio-economic burden from malaria which over time diminishes, yielding a socio-economic improvement. Over time the amount of activity to improve the situation and sustain the improvement diminishes.

This is the essence of success and sustainability. In the long run the value of a good status in the community should be sufficient to pay for the cost of the essential ongoing activities that are needed to maintain the improved status.

Management Information

Management information is a key component of the management cycle. A useful definition of management information is the following:

“Management information is the least amount of information that enables a good decision to be made in a timely way.”

Because most of the information is being generated in a research mode rather than a management mode, most of the information being used in the present mosquito and malaria control industry does not have the characteristics of management information, but rather is characterized as being the most rather than the least, focused on scientific argument rather than decision, and are mostly late rather than timely.

In a typical decision making situation, the responsible person will use all the information that is available that is relevant to the decision. If things are going well, the question is how to make them better. If things are not going well, the question probably has a higher urgency and how to correct the problem. A good first question might be whether everything is going wrong, or just some things. Usually this question is not best answered by statistical analysis, but by someone with understanding of the operations to look at some of the detail data.

One of our Princeton educated professional African colleagues understood the concept very well and wrote as follows:

On Management Information

Let me see if I can understand this by simplifying it ...

1) Management information can be explained, in the most simple terms possible, by resorting to arithmetic to illustrate the issues. When you have a mathematical equation, such as $9+9=18$, or $5*6=30$, you have the components of the final result. You are able to determine how and why the result is 18 or 30. If you simply listed, 18 or 30, you would have no clue whether 30 is $3*10$, $15*2$, or $5*6$. Top down analysis of a situation, will end up blocked by the information that has been lost or aggregated. In this context, management information is simply the ability to drill down through data to find out what caused the data to be what it is. We need to have detailed information in order to make sensible decisions, which is at the heart of it being called "management information".

2) In order to understand what is happening, what is working and what is failing, one needs to capture data in a sensible way. Accounting tricks exist to change the way financial information looks by shifting certain data there, and other data here until it looks "good enough." Management information provides the tools necessary to reverse these shifts in order to ascertain the true picture. What makes life difficult, is that there is no one true picture. Everything is relative to the point of view one decides to look from. If you take a flat sheet of paper, it looks big when viewed from the top down, but when you turn it to show the thin edge of the paper, it suddenly looks very small. In this case, management information is being able to rotate the paper, in all directions, to see how small it looks from this point and how big it looks from that point. What we need to prevent, is people being able to fix the paper, and fix your position, so that you are unable to look at it from all the angles that you want. This is the goal of management information - to be able to look at the situation from as many possible angles as possible, in order to be able to make a sensible decision.

3) Due to the need to have results, or to make bad results look better, there is intentional hiding of information. People collapse data into components that cannot be further broken down or dissected. They also partition data into compartments that are hard to access from other compartments. If you cannot put the pieces of the jigsaw puzzle together, you cannot know what the picture is ... Much information is concealed this way. When you are in New York, you have a hard time figuring out how to get information out of a government office in a rural area of some African country; in fact, even when you are in the capital city of that country, you still have huge problems getting that information!

4) No condition is permanent, and the information that one needs to have available needs to take into account changes over time. Without knowing what happened before, or what happened after some initiative or disaster, it is next to impossible to make any informed judgment.

So in summary, management information leads to the ability to make decisions based on the availability of information instead of on politics, inexperience, or personal subjective beliefs. It is akin to science and engineering where decisions are based on facts, rather than in the arts, where they are based on opinion ...

What are the Goals? What are the Metrics?

IMMC Articulation of the Goal

The overall goal is to make malaria a rare disease ... even to eradicate the disease.

Progress towards this goal is going to be measured by the following:

1. the morbidity caused by malaria;
2. the work time lost due to malaria morbidity;
3. the mortality due to malaria;
4. the prevalence of malaria parasite in the human host;
5. the prevalence of the malaria parasite in the mosquitoes;
6. the private expenditures on malaria control; and,
7. the public expenditures on malaria control.

An underlying characteristic of malaria is that it is a parasitic disease, with the malaria parasite transmitted from person to person by the mosquito. The biology of the human being, the malaria parasite and the mosquito intersect in a complex manner, but one that is quite well understood by the scientific community. Based on this, sustainable success is only going to be achieved when the malaria control interventions reduce the prevalence of the malaria parasite in the community.

Progress towards just, equitable and efficient society means that limited resources should do the most good, in other words, that malaria control activities should be the most cost effective. Unless the program design achieves low cost, there can never be any hope for sustainability.

Goal is Totality of Socio-Economic Progress – not just Health

The way funds are allocated in the international relief and development sector suggests that broad socio-economic progress has a lower weight than quite focused malaria health issues. In a situation of resource constraint within malaria health, the overriding goal appears to be:

1. to reduce mortality due to malaria in children under five; and
2. to reduce mortality due to malaria among pregnant women;

and while these aims are laudable, they are insufficient.

What are the Metrics?

Observing the performance metrics that have been published and are easily accessible in the period since 2006, it appears that the dominant performance metrics are about:

1. coverage or reach; and, if applicable
2. use (as in use of bednets)

Effectively, the dominant performance metrics define the dominant goal, or goals.

In the IMMC initiatives the essential metrics relate costs, price and value in terms of:

1. Where we were;
2. Where we are;
3. How we got from where we were to where we are;
4. Where we want to be in the future; and,
5. How we are positioned get to where we want to be in the future.

The specific metrics are simply those that best reflect the goals that have been established.

The underlying concept is simply this:

“What gets measured, gets done.”

Institutional Framework

The Institutional Framework is Complex

The institutional framework is very complex. In the following section, some of this complexity is described, but it is still a gross simplification.

Some of the organizations, like the Government of the United States, are, in themselves very complex, and so are all the organizations to one degree or another.

The Malaria Health Sub-Sector

The malaria health sub-sector comprises mainly the official organs of government and the public sector, the academic and research community and non-governmental organizations (NGOs). The official development assistance (ODA) community, both bilateral and multilateral are the primary funder of anti-malaria programs, with substantial money now coming from private philanthropies and increasingly also from individual small donors. Even though the amount of funding committed to malaria programs, it is not clear whether or not there has been a commensurate reduction in the burden of malaria in Africa, and whether the resources are being used in the most cost effective way. The amount of funding that will be disbursed in 2008 is expected to be in excess of \$1 billion.

The theoretical framework for mosquito and malaria control has government ministries and agencies at the apex, with district and community level organizations like hospitals and clinics at lower levels in the hierarchy. In theory local and international NGOs would support this structure and provide an additional level of service. There are many organizations and branches of organizations in the international framework including:

1. Governments;
2. Government Ministers;
3. Inter-Government Technical Committees;
4. Bilateral Donor Organizations;
5. Multilateral Financial Organizations;
6. Multilateral Technical Organizations;
7. Major Philanthropic Organizations;
8. Major Universities and Research Organizations;
9. Key Suppliers;
10. International NGOs.

In theory, government ministries and agencies are funded by government through a budget process, and resources are allocated by the treasury and disbursed for use.

In practice, the government budget is funded in large part by international funding agencies, bilateral and multilateral, with donor driven conditionality. Over the years, for priority sectors like health, more and more of the international donor funding has been flowed through international NGOs rather than through government channels.

Organizations like WHO have attempted to bring a level of coordination to the disorganization by promoting the concept of "one program" both at the national level and on a global international basis.

A system of performance metrics has to be able to function and be useful in this very complex institutional environment. The purpose of metrics is to make it possible for analysts to be working with facts to the greatest extent possible, and for decisions to be based more on facts than merely opinions.

Complex ... but little at the Community Level

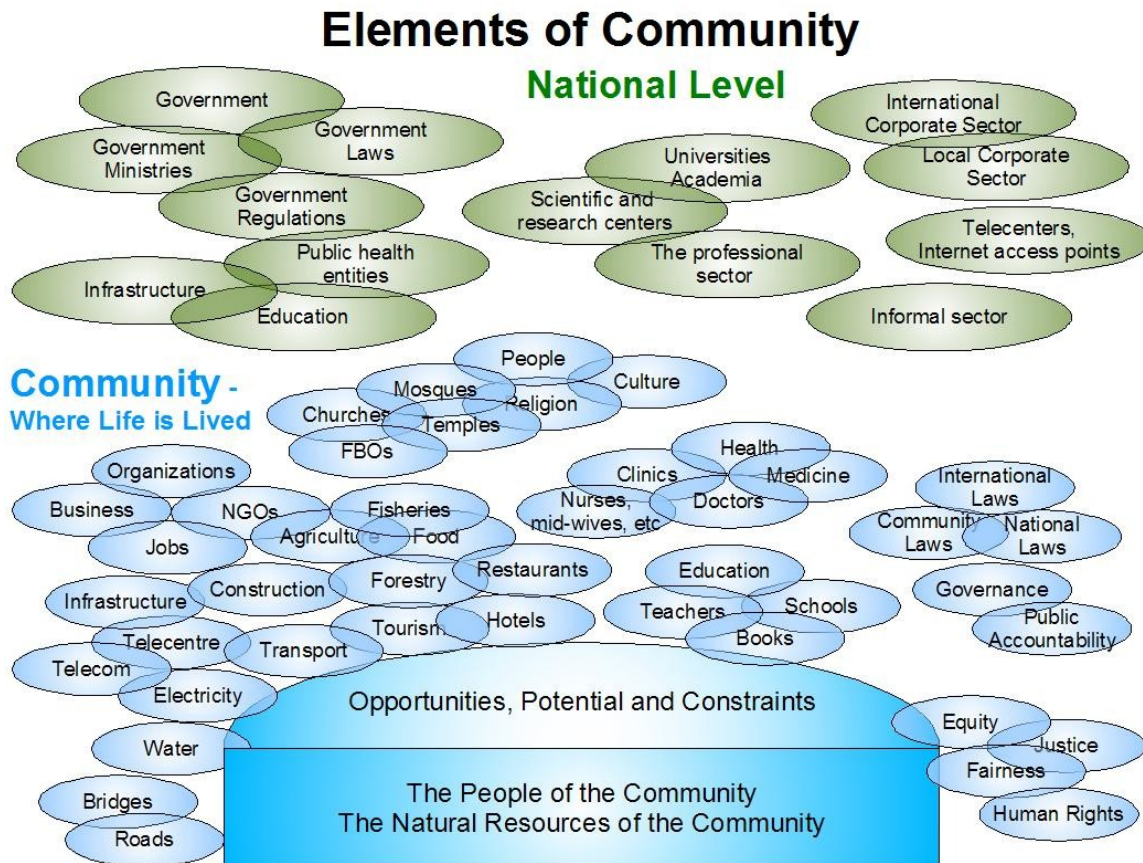
Looked at from the perspective of a typical remote rural community in a malaria endemic area, there is little evidence of much institutional activity about mosquito and malaria control at the community level. This is no different from most other government provided services supporting socio-economic development.

A community centric perspective produces a very different view of how activities are done, how resources are allocated and what constrains improvement. The community is, arguably the most important locus of life, so the activities for mosquito and malaria control should have a focus that includes:

1. Communities;
2. Community level organizations; and
3. Community level people.

Even though a community has very many elements, a community is quite simple compared to a national view. Though there may be many relationships, they are quite simple, and therefore, understandable. At the community level people have names, and are not merely part of a statistical pool. Activities are tangible, and accounting for costs and results is an exercise that everyone can understand.

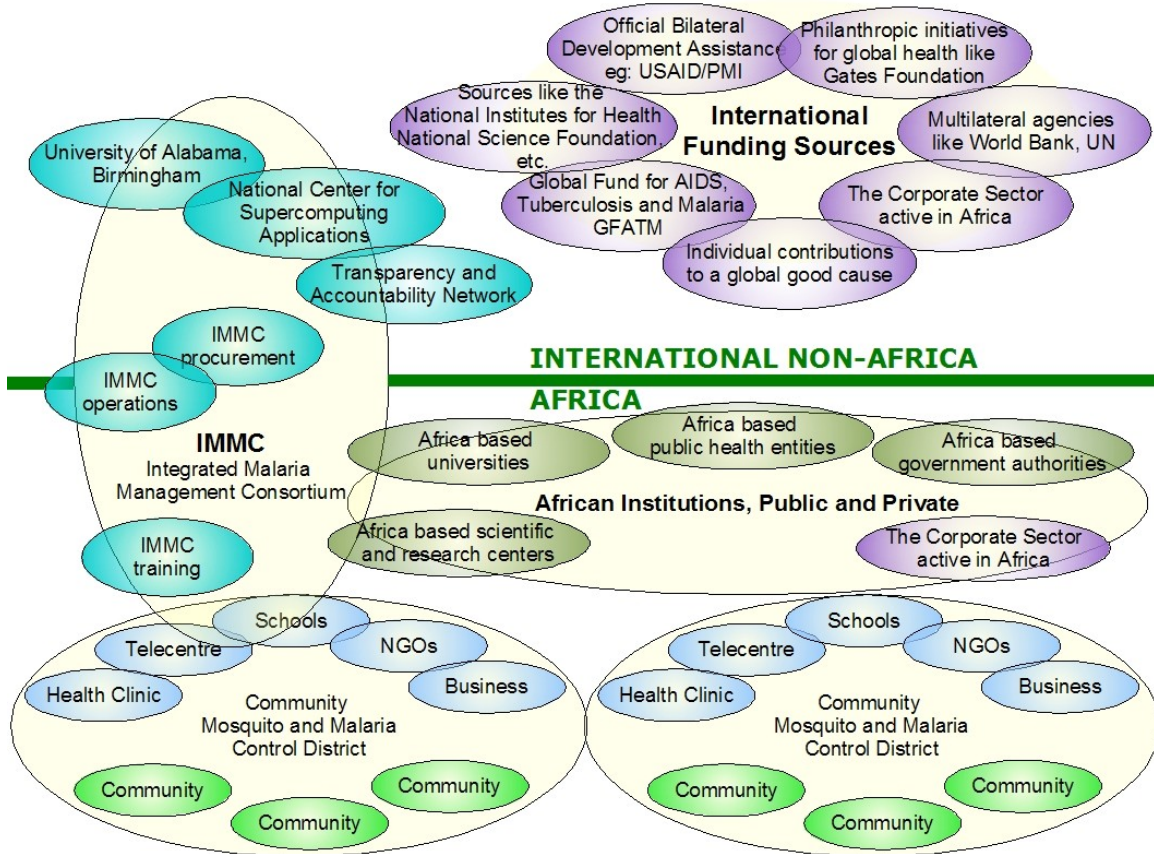
The following graphic shows the elements of community, as well as the elements at the national level. The community is where people live. The community is where progress can be made.



By the time community information is aggregated into national level information, much of the utility of the information has been lost. Women have 1, 2, 3, 4 or more children ... not 2.6 children. At the community level, when a child dies, the child has a name, and parents, and the child has brothers and sisters ... and it matters.

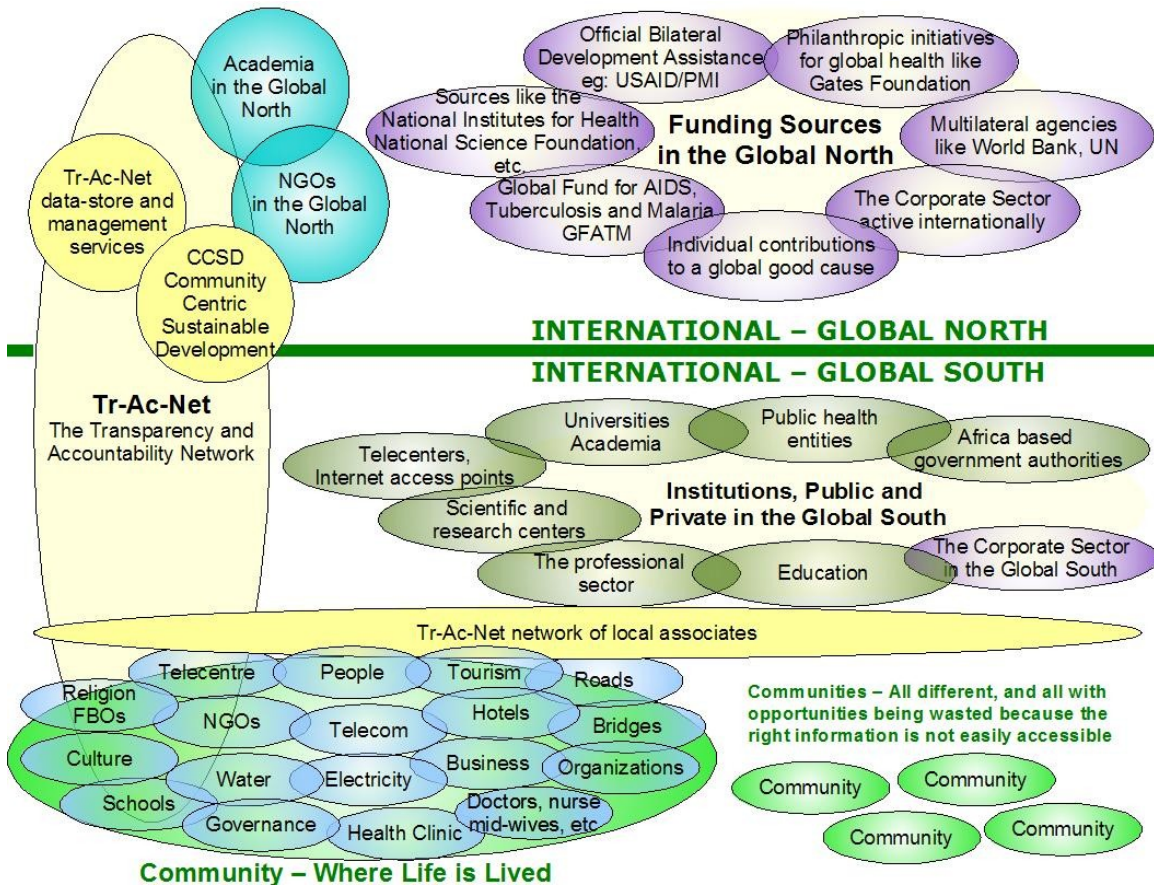
Linking community with the rest of the structure I

This is a view of community linked to the rest of the institutional framework, and how IMMC fits into the picture.



Linking community with the rest of the structure II

This is another view of community linked to the rest of the institutional framework. This time it is how Tr-Ac-Net and an information infrastructure can fit into the picture.

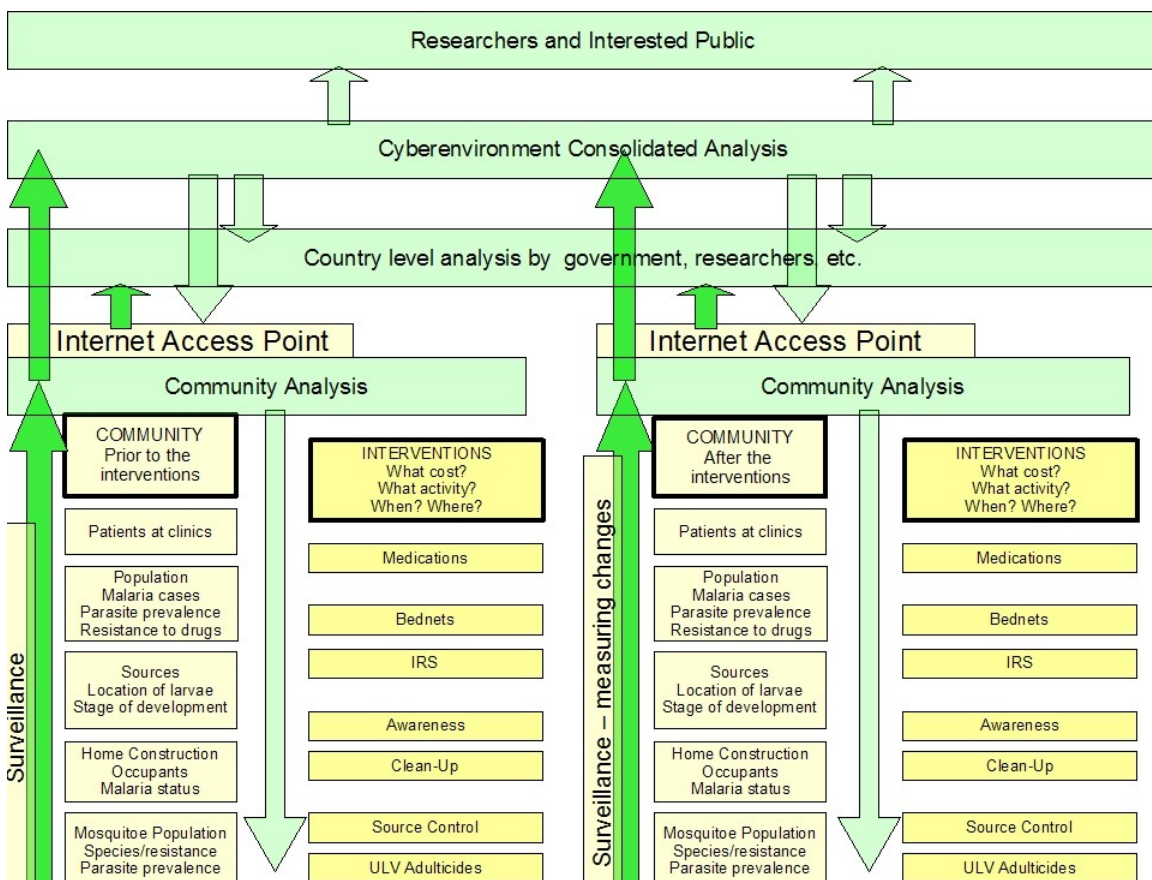


Data Flow I

Any planning and operational framework is incomplete without a system of management information. It is just as dysfunctional as a human being without a nervous system. The complex international relief and development sector operates with only very rudimentary management information, and it should be no surprise that the outcome has been poor.

The complex institution framework for malaria control is operating with very limited performance metrics. There are pieces, but not a complete framework. Most of the analysis data are derived from very small surveys and statistical manipulation, with very little of cost accounting, and even less of cost effectiveness analysis.

Data are most cost effective when there is one set of data that are capable of being used in many different ways. The following schematic shows how a single set of data can be used both at the community level for immediate operational decisions, for country level oversight, for scientific analysis and the interested public. The schematic shows the flows and demonstrates the importance of the timeline for data collection, analysis and decision making.



A lot of good data is far better than a little perfect data

A key concept for success in the context of integrated malaria management is that the goal is not to have perfect data, but to have useful data to facilitate good decisions that results in a cost effective reduction in the prevalence of malaria.

Data and analysis need to be in time

Data and analysis are only valuable when they are used to inform decision making. If the decision must be made and the analysis is not available, a decision will be made without the benefit of the analysis.

Data Flow II

With modern information and communications technology (ICT) it is now possible to move data very efficiently. The Internet provides a very powerful vehicle for getting data into the location where it is most useful. The following is a “simplified” information system architecture that gets data into a very large scale computing environment, and is included here because it is important to recognize that systems that are simple to use are often run by systems that are extremely complex ... and within their limits ... also extremely versatile and powerful.

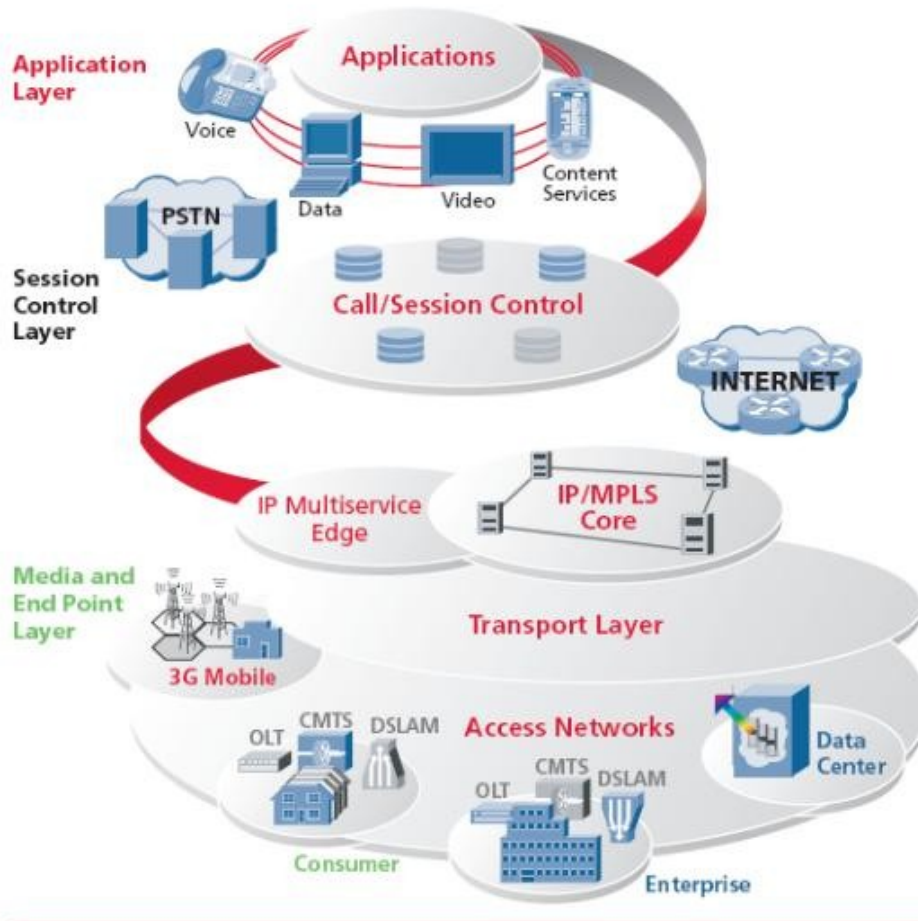


Figure 8 Simplified IMS network architecture

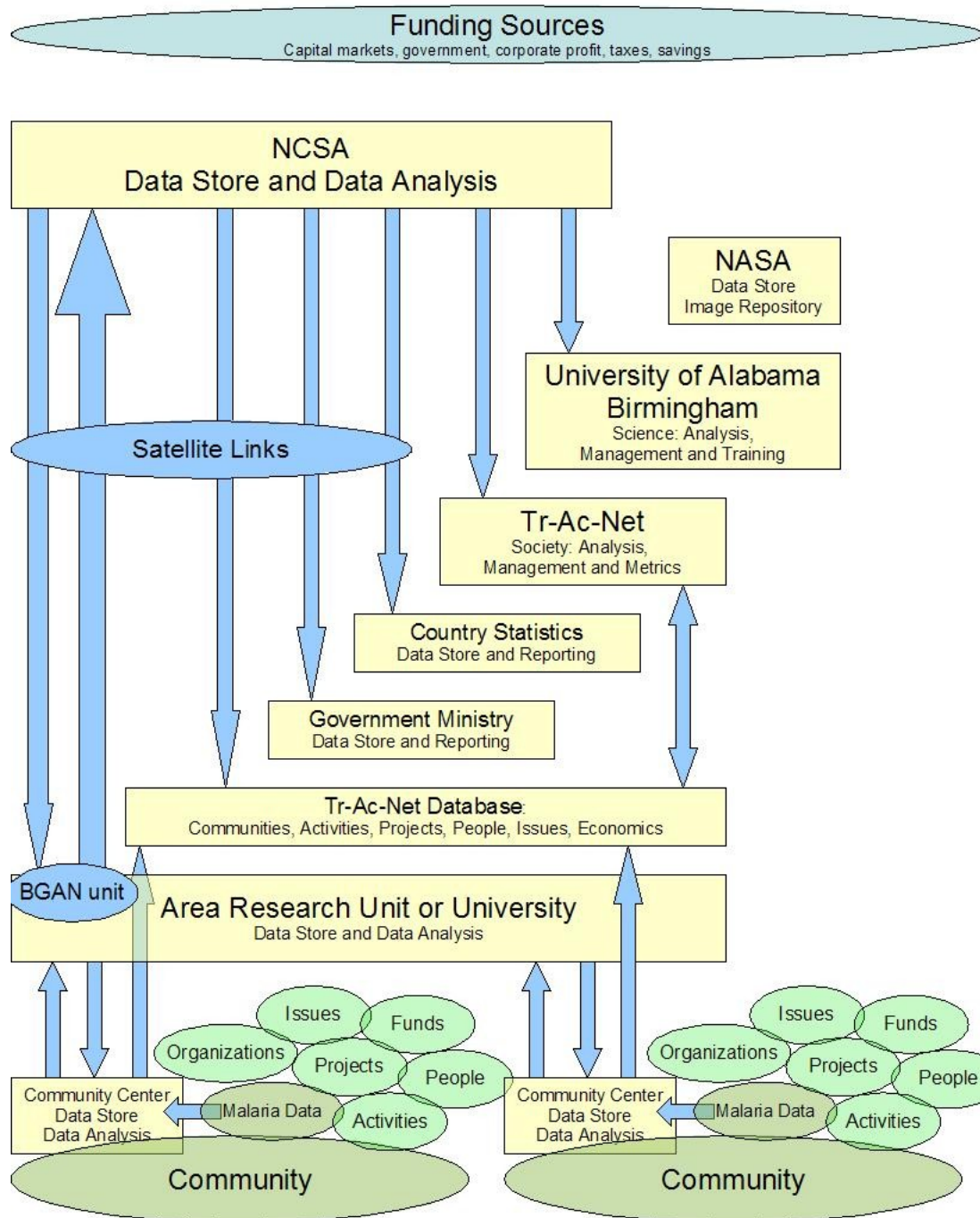
There are constraints to the use of the Internet, notably Internet access that is often not available in remote rural locations, and where it is available, the price of access is very high.

The availability of access to the Internet at an affordable price is a serious constraint on socio-economic progress in general and malaria control in particular. Accordingly the IMMC is researching alternatives for solving this problem either with the present controlling stakeholders and their technology or using some alternative technology and approach.

Data Flow III

The Tr-Ac-Net IMMC strategy is to cooperate with local service providers to optimize the capacity to move data where needed. This includes cooperation with existing telecentres that have been established in many parts of Africa often with donor assistance and need additional sources of revenue.

The following schematic shows how data can be collected, and management information and performance metrics organized building from the community up.



Science

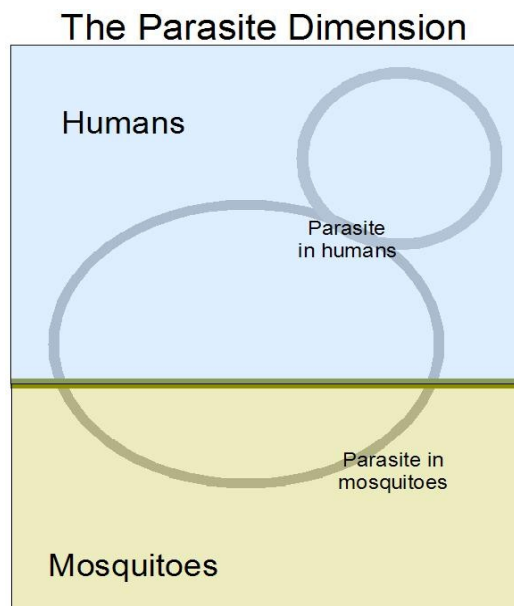
Science defines the Determining Factors

There are four factors that have to be taken into consideration:

1. The place;
2. The parasite;
3. The people; and,
4. The mosquito.

Progress will be made in the best possible manner when plans and interventions are based on deep knowledge about all of these.

There is a broad scientific knowledge about the interaction between, the mosquito, the human host and the parasite, but rather less about the behavior in any specific place. Yet it is the behavior in a specific place that is going to determine the optimum set of interventions and the optimum way to make progress and sustain progress.



It is known that the parasite moves from human to mosquito during a blood meal, and then back to another human some time later during a further blood meal. When a mosquito bites, takes a blood meal, there are several possible consequences:

1. the mosquito is non-malarial and the human host is non-malarial in which case the mosquito remains non malarial,
2. the mosquito is malarial and the human host is malarial in which case the bite does not change the situation,
3. the mosquito is non-malarial and the human host is malarial in which case the mosquito becomes malarial
4. the mosquito is malarial and the human host is non-malarial in which case the host becomes malarial

These are the behaviors that drive the malaria crisis, and challenge the mosquito and malaria control community.

Advantage of Integrated Malaria Management

The advantage of integrated mosquito and malaria management is simply that it is respectful of the underlying science and appears to be the fastest and least cost way of reducing the burden of malaria in Africa. All of the single intervention strategies are likely to be much more costly, much slower, more likely to create new resistance, and more likely to fail.

Most cost effective

Integrated interventions are most cost effective, especially in the long run. In large part they are the most cost effective because the various interventions are supportive of each other, and in less time than any single intervention, an integrated program can move to a much reduced rate of malaria, and sustain it at least cost.

Complementary Program

The IMMC program is complementary to all existing programs. The IMMC program is modular and can be added to any program that is already engaged in mosquito and malaria control interventions. This can be as little as simply incorporating data flows from an existing activity, to providing a full range of mosquito and malaria control interventions and training for a malaria affected area.

Sustainability

Nothing is sustainable in a resource poor setting unless it is low cost, valuable and affordable. The present malaria control regime is high cost, with unproven (in terms of reduction in malaria burden) and only affordable with very large external funding. While external funding is being mobilized now while malaria is being treated as a global priority, external funding cannot be relied on for ever. Accordingly, it is vital that a malaria control strategy addresses the critical need for cost effectiveness and the achievement of, not only reduction in morbidity and mortality but also the reduction in the prevalence of the parasite and the problems of reinfection and the potential resurgence of a malaria crisis.

A strategy for sustainability must also address the challenge training and capacity building so that there can be continuing excellent work done by local staff with a minimal external assistance in the future.

Scientific Data

The Tr-Ac-Net IMMC strategy is to pull data into a relational database where the data are organized for both scientific analysis and for cost effectiveness measurement.

The value of data increases with its accessibility and its use. Data are therefore used at the local level and the national level as well as on an international basis. The local data are used to make the best possible local decisions on an immediate basis, and these data feed into national research and national reporting systems.

In addition the data are used in the Tr-Ac-Net database to help assess cost effectiveness of the programs, and the NCSA multivariate analysis system. The database can track an almost unlimited amount of data including the following at the community level:

1. General - Socio-Economic
2. Entomology
3. Epidemiology
4. Mapping
5. Activity costing

These data systems are designed to be accessible to the interested public and researchers, and aim to provide information about program performance and socio-economic benefit being realized at the individual, family and community level. More broadly the Tr-Ac-Net database also facilitates documenting the broader socio-economic parameters of the community, and the organizations, people, activities, constraints and opportunities that the community can identify. Tr-Ac-Net uses the same MySQL open source database that is used by some of the largest web based in the world.

Accounting, Cost, Price and Value

Accounting

Accounting has been a part of social economy for all of history. Modern double entry accounting goes back more than 400 years, and accounting has been central to the success of both the old mercantile era and the more modern industrial revolution.

The genius of accounting is that at its essence it is very simple, and at the same time very powerful. The principles of accountancy have a universality that transcends local law and regulation so that the reality of cost, price and value can be expressed in a manner that is understood everywhere.

In the IMMC initiatives accounting has to generate information that relates costs, price and value in terms of:

1. Where we were;
2. Where we are;
3. How we got from where we were to where we are;
4. Where we want to be in the future; and,
5. How we are positioned get to where we want to be in the future.

Cost, Price and Value

Most accounting in the business world has a focus on cost and price. Cost and price interact to create profit. Generations of MBA students have been taught how to organize business so that there is a maximization of profit and therefore of corporate value as perceived by the analysts in the capital markets.

Value in the corporate sense and in capital market analysis has been a central factor in the behavior of corporate organizations for a very long time. It gained impetus in the 1990s when a consulting firm promoted EVA (economic value adding) as a methodology for improving the “value” of the corporate enterprise, even though it was little more than what had always been considered good accountancy and financial analysis.

Value in the broader socio-economic sense is more important, but rarely computed. The reasons are many, but among them are:

1. There is no universal view on how socio-economic value should be calculated; and,
2. Information about socio-economic value creation and destruction would be very embarrassing to much of leadership and major organizations

Cost is how much of resources are used to make the product or deliver the service.

Price is the amount that is paid in exchange for the product or service

The difference between price and cost is profit.

The value can be thought of as the maximum that would be paid for the product or service by a person thinking along rational economic lines.

Value adding, or value creation is the difference between value and cost.

Managing cost ... Managing value

The essence of cost effectiveness is managing cost and managing value.

Modern technology has been a great source of major improvement in cost reduction. The most well known example is probably Moore's Law in computer chip manufacturing where costs would halve and performance would double every 18 months. But this type of cost performance improvement can be seen all across the technology arena from heavy engineering to nano-technology.

Globalization has also facilitated cost reduction simply by paying labor lower wages for the same job. As long as quality of the product or service is not compromised, lower costs translate into higher profits. If the outcome is not high profits it can be much lower prices for the same goods or services.

The same basic ideas have not been used effectively in the international relief and development sector, including in the health sector and in mosquito and malaria control. Technology has not been used very effectively, and perpetual high cost in international staff is common in program design. This results in poor cost effectiveness and great difficulties in achieving long term sustainability.

Matching Cost and Value

There are many difficulties in planning, especially when there is a lack of relevant information and there is complexity in the processes involved.

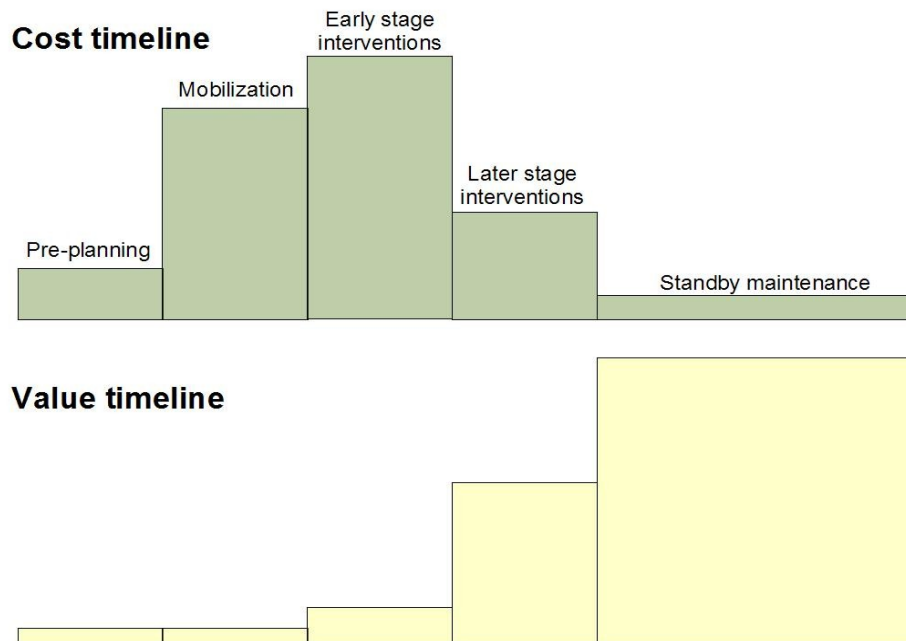
Better planning becomes possible when the process of planning is devolved and it is done at a smaller location where the complexities are easier to understand and everything becomes much more manageable.

The best planning is going to be done when there is a clear understanding of the relationship between costs incurred and the value of the benefits arising, but even this is made difficult because there is a different timeline for costs of expenditures and the value arising.

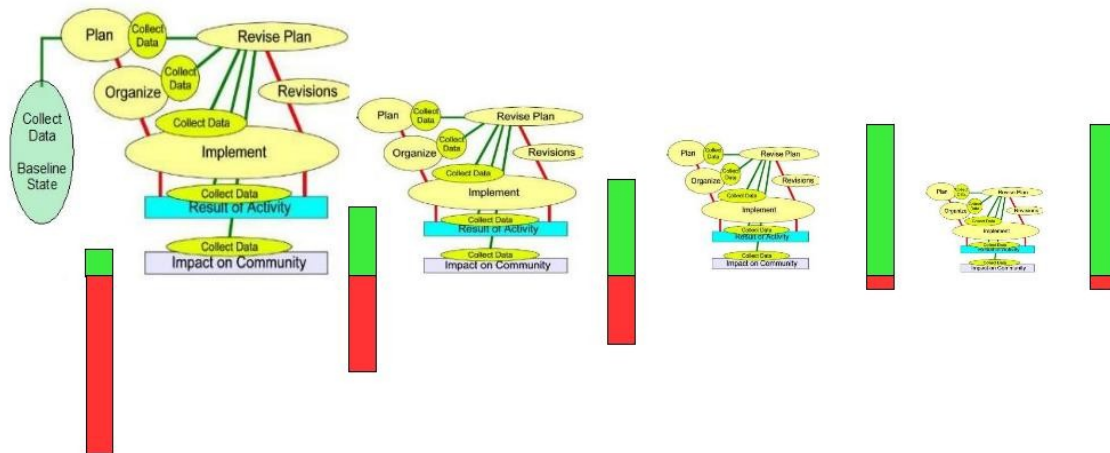
The cost and value timelines

The cost timeline and the value of benefits timeline are quite different. In integrated malaria management the costs and the value have something of the following profile over time. The following schematic shows costs and values profiles over a period of (say) 10 years. In a well designed program high costs at the start produce little immediate value, and lower costs later on maintain a high sustainable value. The very different profiles for costs and values over time makes planning difficult and adds to the difficulty of interpreting performance information. The non-linear characteristic makes it important to understand the behavior of costs as situations change.

Comparison of Cost Timeline and Value Timeline



The following is a repeat of the schematic presented earlier that relates the process of managing the operations with the results being achieved and the resources being used. Over multiple cycles the aim is for the scale of the interventions to diminish and for the impact on community to get better and better, and the bad things to get smaller.



In this graphic the initial condition reflects a high socio-economic burden from malaria which over time diminishes, yielding a socio-economic improvement. Over time the amount of activity to improve the situation and sustain the improvement diminishes.

Accounting: The Essential Financial Reports

Financial Statements

In the context of IMMC initiatives the financial statements should facilitate having easily understandable information about costs, price and value in terms of:

1. Where we were;
2. Where we are;
3. How we got from where we were to where we are;
4. Where we want to be in the future; and,
5. How we are positioned get to where we want to be in the future.

A complete set of financial statements comprises the following is a basic foundation for this information:

1. Balance Sheet;
2. Operating Statement;
3. Cash Flow; and
4. Any needed explanatory notes

Balance Sheet

A balance sheet is a report that shows the financial condition of the entity that is the subject of the report. It shows what assets there are, what liabilities there are, and the difference, which represents the ownership interest.

Within the accountancy profession the basic principles of balance sheet accounting is well established, and it is not very complex. It is a simple and very powerful tool for the measurement of progress. Lord Benson, when he was the Senior Partner at Cooper Bothers in London in the 1950s was asked to define profit in an English Court of Law and gave the following reply:

“My Lord, a profit is the difference between two balance sheets”

Over the years more and more laws, rules and regulations have been introduced that define how various items in the balance sheet have to be computed, and as more and more rules have been developed, there is less and less of the underlying principles of accountancy that drive the result.

The whole idea of “off balance sheet” assets and liabilities negates the whole idea of the balance sheet and double entry accountancy.

If several “balance sheets” are compared in a time series, it is very interesting to see changes taking place. The concept of comparative balance sheets can be used in the corporate business sector or it can be used in other settings such as to show progress emerging in a community. It is a way of creating a relatively simple metric in a situation where there are many feeds into the achievement of progress ... in other words this is a metric ideally suited to the complexities of development and the multiple interventions that go into an optimized malaria control program.

Operating Statement

In accounting, an operating statement connects two balance sheets. An operating statement is a summary of the costs and revenues that have taken place in the period between the opening balance sheet and the closing balance sheet. This is really the essence of double entry bookkeeping because every transaction, almost without exception, has an impact on both the balance sheet and the operating statement.

In other words, good operations translate into good results on the balance sheet.

Cash Flow

Many accountants use a cash flow statement as a part of the financial statements, even though it is not absolutely essential. The advantage of an explicit presentation of the cash flow is that it clarifies the presentation, and makes it much easier to understand the financial situation of the entity.

It is often said that a business can go on for years without having any profits, but it will not last long when it has no cash.

A Framework for Social Business Accounting

The framework that is used for ordinary business accounting can also be used for social business accounting. The same set of reports can be prepared using social business concepts of value instead of the ordinary business concept of price.

Accountants have been creative and logical in adding management and cost accounting to the field of general and financial accounting. Similarly it is possible to add social business accounting concepts.

Accountants have also been creative over the years in helping to prepare meaningful accounts from “incomplete records”. There is no reason why meaningful social business accounts cannot be produced from entities where the information has some element of being “incomplete”. This is not to say that “incomplete” is a desirable state, but it is not a situation that forces total inaction.

Social Business Accounting Statements

A complete set of social business accounting statements comprise the following:

1. Balance Sheet;
2. Cash Flow;
3. Operating Statement; and,
4. Any needed explanatory notes

A different set of relationships

In a social business setting the key is the definition of the goals, and some reasonable measures of how progress towards the goals can be measured. Whether or not the measure of progress is capable of being defined with great numerical precision is not of great importance, but there should be clarity about what needs to be measured.

The progress, as a state, can be incorporated into the balance sheet information. The information can start off with words, and can be turned into numbers in the future if that appears to be of analytical utility.

The activities being undertaken have costs. These costs are both cash costs that gets reported in the cash flow, and also the accrual version that is reported in the operating statement. The double entry of these transactions is reflected in the balance sheet.

Sources of funds to pay the bills, salaries, etc. is reported in the cash flow and operating statement. The double entry of these transactions is reflected in the balance sheet.

At this point there is a balance sheet that reflects the costs of activities ... and information, but not any numerical value about the progress being made in creating results of value. At this stage there is a way of “accounting” ... that is a way of giving an account of how much has been spent in order to achieve tangible progress, albeit at this stage not measurable using universally accepted units of measure.

The idea of standard costs and standard value

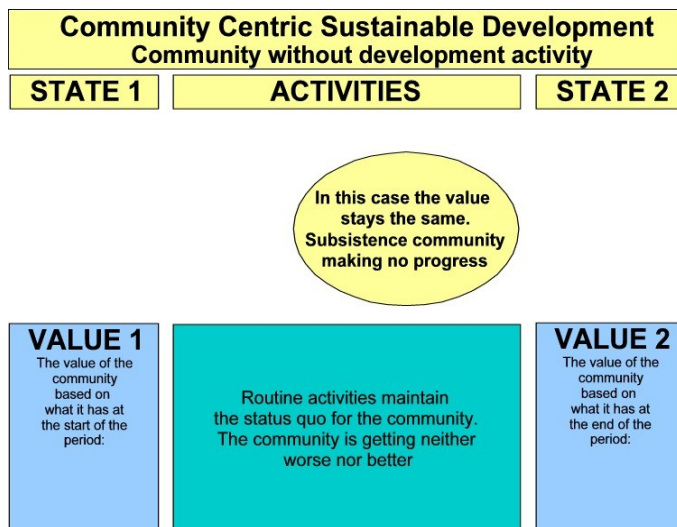
Cost and management accounts in the corporate setting use the concept of “standard costs” to help understand cost information in complex settings. In essence a standard cost can be thought of as the cost that an activity or output should have in theory, based on calculations. It is then relatively easy to see how the organization is performing relative to his standard simply by knowing the total costs of the section, and the quantity of these items that have been processed. It is a useful tool, and can be used quickly and very powerfully.

The same idea can be applied to value. If the goal is to reduce mortality ... what, in theory, is the value of saving a life?

Because saving a life can be considered to be priceless ... this metric quickly leads to throwing money at any and all projects that have the potential to save a life. With a social business accounting system, the dialog moves to what is the best way to save as many lives as possible. This is an important difference, and essential in the process of optimizing cost effectiveness.

Performance at the Community Level

The following graphic shows how social business accounting ideas can be applied in the community setting. Value 1 represents the start of the period and Value 2 the end of the period. In this first graphic the situation from time 1 to time 2 is stable:

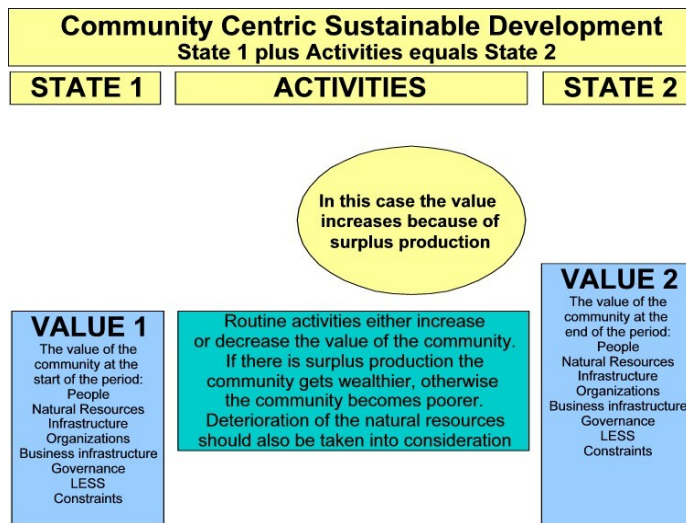


Stable

In a stable community the annual work produces enough for the community to maintain its situation ... not improvement ... and no deterioration. Value 2 is the same as Value 1.

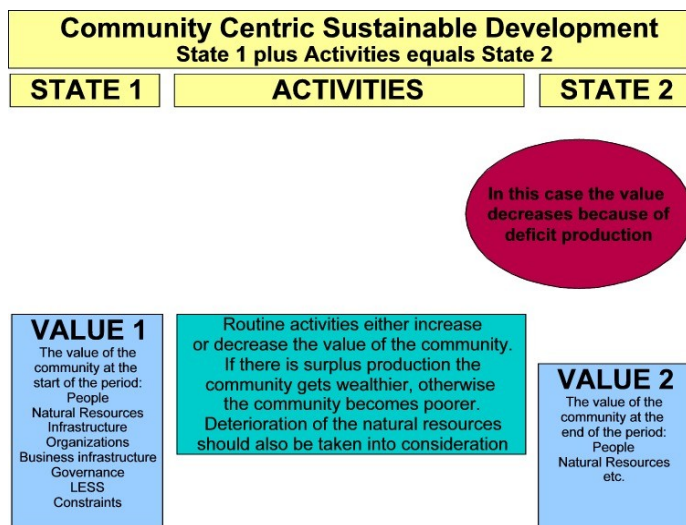
These following graphics show how the performance of activities during the period change the outcome at the end of the period relative to the beginning of the period.

Improving



If there is a good crop, the community can store its surplus crop and there is more at the end of the year than at the beginning. This is progress. Surplus can be monetized and the value can be stored in any number of ways. Value 2 is bigger than Value 1.

Deteriorating



If there is a crop failure, then there is less at the end of the year than at the beginning ... and this may be a crisis ... or it may be just a moderate loss of community wealth. Value 2 is less than Value 1.

In the long run, a situation like this is unsustainable

More on the Value Dimension

Value analysis

Good decision making is not about reducing costs to the minimum but getting the most value from using resources. The African socio-economic crisis results in large part from poor decision making and policies that have funded value destruction. Malaria interventions have most value when they reduce the burden of malaria and improve socio-economic condition. Data drives decisions. The interventions should be selected so that there is maximum value impact with the least cost:

1. socio-economic performance,
2. reduction in the malaria parasite in the mosquito and the human population,
3. total cumulative cost of the interventions,
4. achieving long term sustainable low costs.

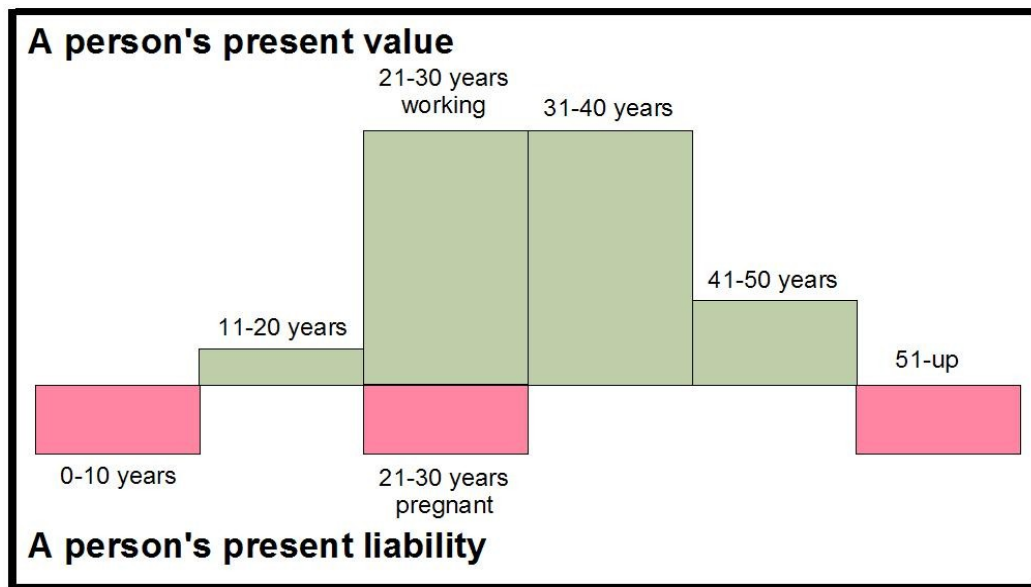
Value from a Community Perspective

Value from the community perspective may be different. Certainly all aspects of mortality have a big value, and the emotional aspect of mortality is huge. In any program that “saves lives” the value can be considered to be huge ... indeed it is big enough to justify the sloppiest of interventions.

But this “emotional” or “moral” value cannot be correlated directly at all with socio-economic value and tangible value related to wealth creation. A strategy that limits interventions to young children and pregnant mothers has “moral value” but tangible socio-economic value to the family and the community is not going to be realized.

Economic value is going to be realized when older children and all adults are included in programs and they suffer less from malaria induced morbidity. When these groups lose less work time, it is possible for socio-economic value to be created as these people do more work and produce things of economic value.

The following schematic shows how a person's present value changes over a life-span:



This is not to understate the value of “motherhood” and the importance of children. Of course, they both have unlimited value in the continuum of human survival ... but the present socio-economic value is a function of adult people's ability to work and be economically productive.

The Cost of Lost Production

The cost of lost production is a very tangible measure. When adults cannot work there is a very real loss of economic product, and in a society operating at the margin, this is a very important issue.

The value of lost production does not seem to be important when the labor is being paid for at very low rates ... and seems to be very high when the labor is expensive. The reality is, however, that labor becomes very important when the labor is in a subsistence environment where less labor translates directly into deteriorating well-being of the family and the community.

Some corporate organizations have come to realize that their corporate costs increase when their staff are affected by malaria. Eliminating malaria has a direct and favorable impact on their productivity and profits. They have also realized that the impact of malaria is not only detrimental in the case of the employee, but also in the situation where there is malaria in the family.

The Cost of Lost Tourism

Health risk is a strong deterrent to tourism. People will not pay good money for tourism where there is a risk of malaria or other disease. With Africa having such a great tourism potential, the

reduction of malaria is not only a health issue and a moral issue, but also an issue with great positive economic impact.

The Cost of Lost Investment

The international investment community is not going to invest in malaria endemic areas unless there is a very strong profit motive. The willingness of investors and staff to engage in building a corporate community is reduced by the prevalence of malaria.

Value from the Donor Perspective

All of the above computations of value are very different from what appears to be the value driver in the donor community.

Value is usually not specifically articulated. The donor perspective has to be deduced from the organizational behavior, but from this it is apparent that the donor perspective is that there is a very high value in preventing mortality, especially of young children and pregnant women.

It can be argued that the reason for this is that this is something that can be talked about, and nobody is going to challenge the wisdom of this. The idea that funds are being mobilized and activities are being paid for to reduce mortality of young children and pregnant women has great public relations value which is a key to fund raising and political advocacy.

However, whether it is the best measure of value is a question.

Value from R&D

Research and development (R&D), including vaccine, new drugs and new pesticide development, is expensive. R&D has great value when it is successful and the developments are deployed.

R&D should be subject to the same level of analytical rigor as anything else. The issue with R&D is to keep appropriate records of costs over a long time period, and relate these cost to the eventual benefit flows.

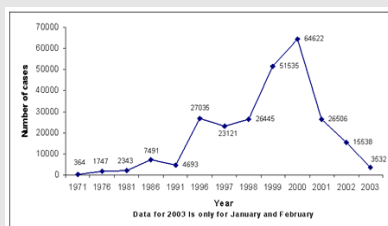
It is not likely to be the most cost effective compared to situations where presently available techniques are being used.

Making Reports Clear

Making Reports Clear and Unambiguous

A good report is one that is clear, complete and unambiguous. The data presented in the following examples are clear, but are incomplete and only tell part of the story. They send a message, but probably misinform.

Example 1



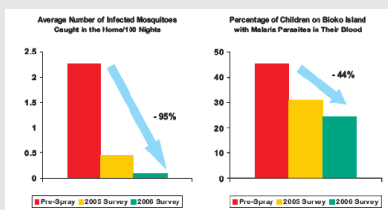
Experience from Kwa-Zulu Natal.

In this example the measure was low, then increased rapidly, and then decreased again. In this example the measure is the number of malaria cases in the area, which rapidly increased when the use of DDT was stopped, and then decreased again when DDT was reintroduced.

But these data are limited to case counts at clinics. What is happening in other areas?

There is no reference to cost. It is possible that DDT is not only very effective in reducing malaria, but might also be very cost effective as well.

Example 2



Experience from the Marathon Oil, Bioko Island

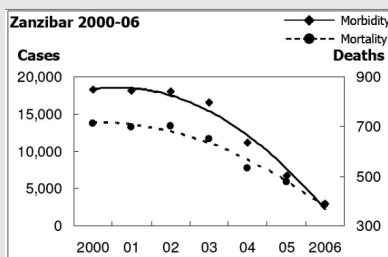
In this example, the graphic clearly shows change over three years. The left three year series shows the prevalence of malaria infected mosquitoes down by 95%. The right hand series shows the prevalence of malaria parasites in children down 44%.

But there is no indication of how much this cost.

There is no indication about the population involved, and the size of the program in terms of area.

The graphics do show progress ... but at what cost?

Example 3



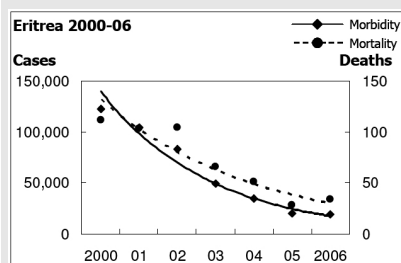
Experience in Zanzibar 2000-2006

In this example morbidity has declined by 77% according to the report and the graph, and this is a good outcome. But is it the whole story. This relates to measures at the clinic ... less malarial incidence results in less attendance at the clinic ... but what about those that do not have access to clinics.

Mortality is down by 75% according to reports ... but this is mortality among the young children subset.

The question about cost is not addressed. Is this the most cost effective way to reduce the malaria impact. Maybe it is, but the information is not presented. The main interventions were bednets and free delivery of ACT medication.

Example 4



Experience in Eritrea 2000-2006

The morbidity was reduced based on the number of visits to clinics by 63%.

The mortality was reduced by 85%.

A small survey of 2,300 households suggests that bednet distribution has reached 67% of the population in Eritrea.

There is no cost information included in the report that enables the cost effectiveness to be determined.

The Eritrea example is a simplification that shows progress, but adds little to understanding. At the national level there is the accomplishment that has been charted, but regionally within Eritrea there were areas that progressed well and areas that did not improve very much. Why was this? Was it because they were already malaria free, or was it because the interventions were ineffective ... important questions that should be guiding policy and program.

Behavior of costs

Costs vary depending on the circumstances

Costs vary depending on the circumstances. Good program design minimizes costs and maximized cost effectiveness. This is a central focus of the IMMC strategy.

Cost effectiveness is most easily optimized when there is good information about costs, without this information planning is merely a guessing game.

In the IMMC cost effectiveness model, the strategy has a focus on achieving low cost so that there can be permanent sustainability. Accordingly there is a need to understand how costs behave under varying conditions.

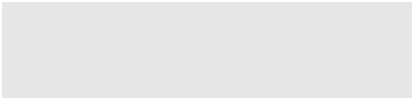
Labor costs

Wage rates

Labor costs are a critical component of cost. Expatriate staff costs may be 100 or 1,000 times the cost of local labor ... to some extent justified by the knowledge and experience of the expatriate, but the design of programs should include this important economic parameter.

In the IMMC approach, there is a component of capacity building and training. This makes it possible for the organization to be optimized for cost effectiveness and local staff to be training so that they are not only low wage, but also productive and able to do the work that needs to be done.

The Tr-Ac-Net metric for the labor component of cost includes a profile of labor cost by wage rate.



There is a caveat about low wages ... the goal is not low costs, the goal is high cost effectiveness.

About Data

Something About Data

Permanent data and transient data

The key concept in the management data is to differentiate between permanent data and transient data.

In accountancy, this is evidenced at some level by the accounting concept of balance sheet and operating statement, with the balance sheet representing the more permanent data and the operating statement the more transient data.

This is not, of course, very rigorous, since in a good accounting system both the balance sheet and the operating statement are the result of summing all the individual transactions.

In practical terms this translates into an ability to verify balance sheet reports more easily than one can verify transient operating statement transactions. This is a vital matter, because fraud and corruption can easily take place within the activities of an organization and the funding of these activities, but it can easily be detected if there is meaningful oversight of the results and the balance sheet that puts result on the record.

Data collection and the use of relational concepts

Data collection is optimized when the data are collected using techniques that are appropriate to the type of data.

It is valuable to get good permanent data. By getting high quality in the permanent data, everything becomes very much easier and the information rapidly gains credibility.

With high quality permanent data, transient data becomes easier to collect and can be related to data of substance.

Where the data are being collected for use in a relational analytical environment, the permanent data are all accessible to any transaction related to this permanent data. To use some practical examples:

1. All the information about a community is permanent, or at least permanent at a balance sheet date. All the activities in the community can be related to this community and analysis done about activities and results relative to this community.
2. Information about a specific location can be related whether it is the house and its construction, the people living in the house, the bednets being used in the house, the IRS that has been done, the malaria that they used to have, and the malaria that they now have.

Account codes and analytical codes

The power of relational analysis is maximized by the design of the analytical codes. This is the key to easy analysis, and relatively easy to do for a relational database. Frequently, however, it is ignored and easy analysis then becomes impossible.

Multiple use of data

The most cost effective data are data that are used in many different ways. There should ideally be one pool of data, and this one pool should be used in different ways for the specific analysis needed. Essentially the analysis is another view of the data.

In the IMM context local data is first used to help with local operational decisions, then is used within an operational management and oversight module that addresses cost effectiveness and performance issues, and finally is used for scientific research to help have a better understanding of the underlying science and more fundamental problems that might be emerging.

Surveillance data

There are several different types of surveillance data:

1. Building the knowledge base about the area,
 1. Use of satellite imagery can reduce the time and cost of establishing a basic understanding of the area,
 2. Combining this with ground truthing can validate the interpretation of the satellite imagery and give a sound basis for planning interventions and the associated continuing surveillance,
 3. Use of basic data collection techniques to add specific information needed for IMM interventions and the associated variable data updates ... but planned based on the initial knowledge obtained from satellite imagery. Note that this can help reduce the data collection time and costs by as much as 90%.
2. Getting data that changes rapidly ... within a daily cycle,
 1. Entomological data,
 1. About the adult mosquito population,
 2. About the larval habitats,
 3. About the weather conditions.
 2. Daily data about interventions,
 1. What interventions ...
 1. quantity and cost,
 2. expected and actual results.
3. Getting data that changes more slowly ... within a monthly cycle or a yearly cycle.
 1. Monthly summary of entomological data,
 1. About the adult mosquito population,
 2. About the larval habitats,
 3. About the weather conditions,
 2. Monthly summary about interventions,
 1. What interventions ...
 1. quantity and cost,
 2. expected and actual results.
 3. Epidemiological data,
 1. About the cases in the clinics,
 2. About the cases in the population at large,
 3. About the prevalence of malaria parasite in the human host.
 4. Socio-economic data,
 1. About the socio-economic condition of the community,
 2. About the socio-economic condition of the population.

Any technique for surveillance and data collection that works and is cost effective can be used. The use of labor intensive techniques can be more reliable than the use of more high tech approaches simply because the underlying infrastructure is not universally available. Paper based data collection in combination with local data entry into an electronic file may be the best way to optimize the data collection.

Data that are already being collected may be a good foundation for the data collection being described here. Maybe there is everything that is needed already being collected ... or maybe there are some elements that are missing or not in an appropriate format.

The progress of technology for data capture will be monitored carefully, and included in tests where appropriate and there is the potential for more cost effective and more sustainable data collection.

Information About the Community (of the community and its population)

Information about the state has two characteristics:

1. It is permanent data that changes rather slowly; and,
2. The changes to these data are a very powerful metric for progress, or lack of.

Information about the state includes all that is material:

1. What community or communities are in the area;
2. What organizations are in the area;
3. What are the normal economic activities;
4. About the people ... demographics, age profile, socio-economic profile;
5. About the housing;
6. About the health status;
7. About the health infrastructure;
8. About mosquito situation and habitat.

The ultimate goal is to improve the socio-economic situation in a community by reducing the burden of malaria.

Collecting data ... gaining knowledge about a community is an essential part of being able to assess socio-economic improvement and progress about the burden of malaria

Much of the community information is permanent information. This can be compiled initially, and then only updated from time to time as things change.

The basic information relates to:

1. The location of the community;
2. The size of the community in terms of people;
3. The size of the community in terms of the number of houses;
4. The main economic activities of the community;
5. The socio-economic situation in the community;
6. The health status of the community;
7. The health infrastructure in the community;
8. The organizations active in the community;
9. Key people in the community.

Capacity

There must be an information component that shows the local capacity for socio-economic progress in appropriate terms. This must be driven by community priorities and perspectives.

Knowledge of the community health infrastructure, the availability of personnel, the availability of medications and medical supplies are all important inputs to optimizing interventions activities. Good planning cannot be done without this base information.

Information About Activities

Most metrics in the international mosquito and malaria control sector are related to activity and not much about result.

Almost all the data seems to have a focus on how much has been done, rather than on the results that have been achieved.

This seems to be very much the case in the Zambia program where metrics are being facilitated by the PATH/MACEPA organizations.

At the community or area level, information about the interventions includes:

1. What interventions are being done;
2. Who is doing the interventions;
3. What is the cost;
4. What is the amount done;
5. What is the impact;
6. What is the value.

Information is needed about all the activities being undertaken:

1. Community organization;
2. Community awareness training and education;
3. Vector control - area clean up;
4. Vector control - source control, larviciding
5. Vector control - adulticiding
6. Medical - clinic and hospital visits
7. Medical - drug treatment
8. Personal protection - Interior residual spraying (IRS)
9. Personal protection - Long lasting insecticide treated bednets (LLITN)
10. Personal protection - Other options (coils, airconditioning, etc)

Cost accounting

There are many ways to approach cost accounting ranging from ad-hoc cost studies to fully integrated cost accounting systems that post costs to individual cost accounts. There are many ways to get the data, but the key thing is that people using the data should have a clear understanding of what the data presented represents, and how the information would change under different conditions.

When cost accounting is missing, management information is compromised, and decisions cannot be optimized. Good cost accounting is simple and it is powerful. There is no good reason for not knowing clearly what things cost. A good start is simply a list of money spent, and some data about what the money was used for and what was accomplished by spending the money. This is not complicated, and the fact that it does not always exist is a disgrace.

In accounting, experience shows that when there are missing data, there is usually also missing resources. When there is no cost accounting, standards of performance are always less than optimum ... good things go unrecognized and bad things are allowed to continue.

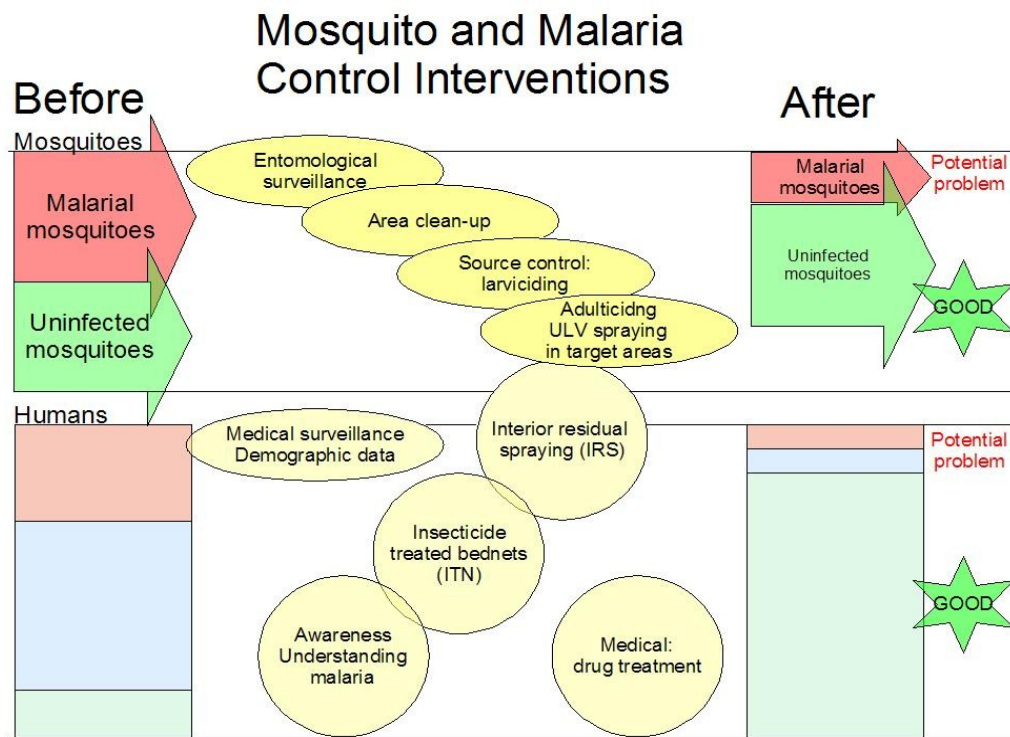
Cost information is rarely obtained using statistical methods. One favored method is to do a theoretical costing based on engineering and science, and then to compare the results of this unit costing with the aggregate performance of the unit. This technique shows quite accurately how inefficient and operation is relative to what is theoretically possible, and is often an early warning of lack of fiscal control and possible financial misfeasance.

Integrated Mosquito and Malaria Control

Before, After and the Intervening IMM Interventions

In a good system there is a continuum between operational and management information. They are different views of the same information, with one informing the other. For example: the data at a management level may show that the mosquito vector is getting out of hand and there is a need for adulticide ULV fogging, while the operational data will be precise enough to define where the fogging should be done, how it should be done, and when it should be done. The information for this is the same, but in much more detail.

The following graphic summarizes the various interventions involved in integrate mosquito and malaria management. The primary goal of reduced malaria burden in society is shown in green, in the human section ... before and after. The related goals, the reduction of parasite in the human host and the reduction of parasite in the mosquito population are also shown. Between before and after there are a portfolio of possible mosquito and malaria control interventions.



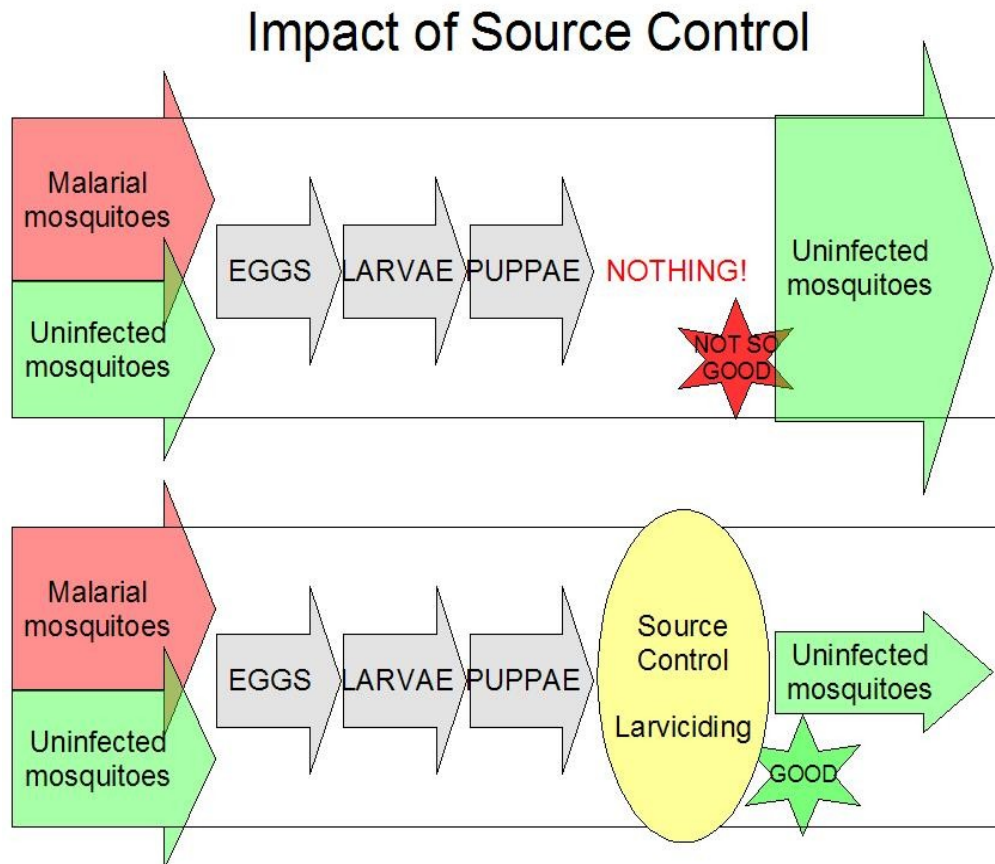
Best performance is for the costs of the interventions to be the lowest possible for the maximum of improvement or progress towards the ultimate goal of reduce malaria burden in the community. The science of each of these interventions is quite well known. Rather little is yet known about the optimum way to combine these interventions for best performance.

Impact of Source Control on the Mosquito Population

The malaria population can be very favorably impacted by source control. The following schematic shows how the population of mosquitoes can be substantially reduced by active source control.

With no source control the mosquito population stabilizes at a level that is governed by general environmental considerations, of which the weather is one of the most important. Mosquito populations can increase very rapidly when environmental conditions are favorable. Though the mosquito is uninfected initially, this changes very rapidly where the prevalence of malaria in the human population is high

With source control the population of mosquitoes can be reduced significantly.



Source control is an intervention that is cost effective when there is good data collection and the community knows what it is doing both from a scientific point of view, but also based on geography and spatial information.

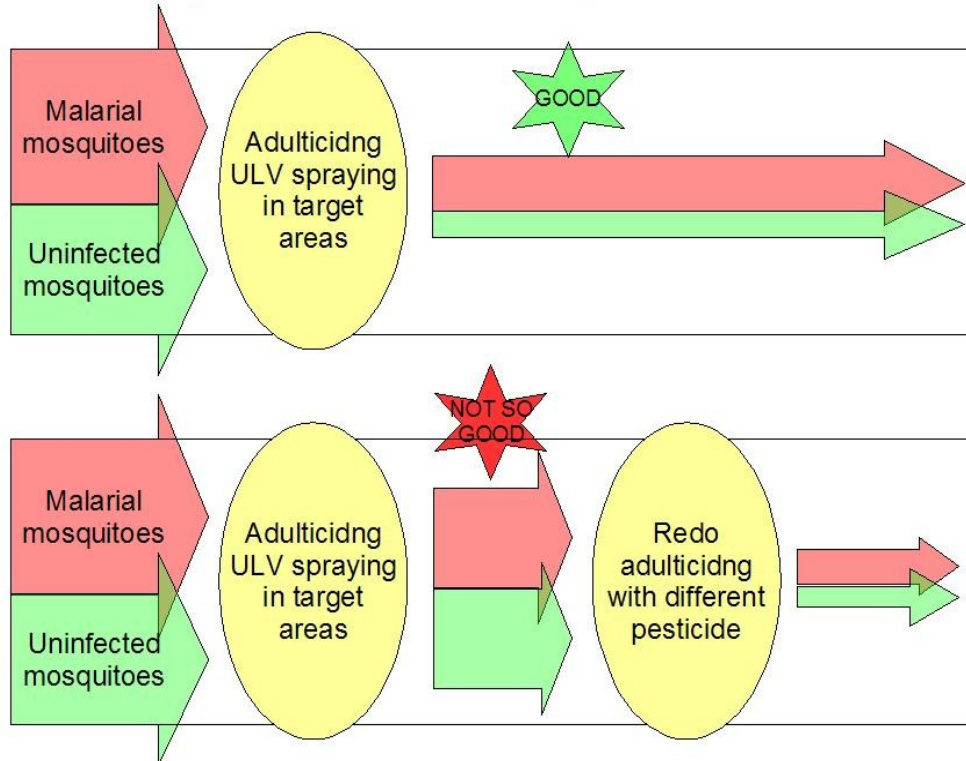
Note that the biggest costs are the expatriate staff and the chemical and biological agents. These costs are much reduced when there is good data about where larviciding should be applied and whether it is being effective.

Impact of Adulticiding on the Mosquito Population

When there is an abundance of adult mosquitoes, the use of adulticiding will reduce the mosquito population.

The following shows two situations. In the first case the adulticiding is successful and mosquitoes are killed and the population is reduced. In the second case there is resistance to the first chemical used, so the procedure is repeated using a different chemical treatment.

Impact of Adult Mosquito Control



The cost and intermediate result of adulticiding suggests that this should be a significant part of integrated malaria control interventions. On its own adulticiding is going to have little impact on the ultimate goal because there will be rapid reestablishment of the mosquito population and because there will also be rapid reinfection of the mosquitoes with the parasite.

The use of adulticiding might, however, be a very powerful factor in accelerating the impact of other interventions, specifically the medical treatment and the larviciding, and in combination give an optimized performance.

Large scale adulticiding has been used frequently in the USA where there is concern about vector transmitted disease (such as West Nile Virus) and the specific source control information is not available. As soon as specific spatial information is available, the vector control reverts to source control using larvaciding at locations that are not specifically identified.

Mosquitoes' Impact on the Human Host

Human Host Impact on Mosquitoes

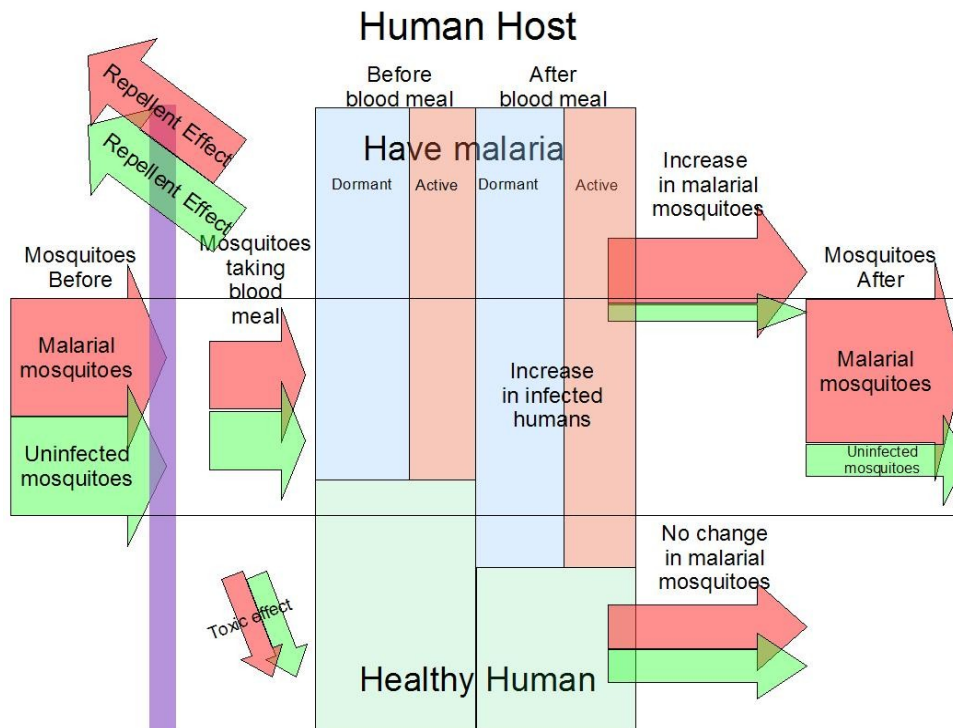
The following schematic shows the dynamic of the mosquito / human host interaction.

With an abundance of mosquitoes and a high prevalence of malarial mosquitoes the prevalence in the human host increases.

With a high prevalence of malaria parasite in the human host, the prevalence in the mosquitoes increases.

Efforts to limit contact between the mosquito and the human host helps to reduce the mosquito bites that transmit the parasite from person to mosquito and from mosquito to person.

This is not easy to do with a high degree of effectiveness for all the times the mosquitoes may be looking for a blood meal. Both bednets and interior residual spraying (IRS) are interventions that aim to limit the transmission arising from mosquito bites.



Bednets operate by having a repellent effect, a barrier effect and a toxic effect.

IRS operates by having a repellent effect and a toxic effect

There are reports that bednets and IRS have a community impact that goes beyond the individual benefit when there is a high penetration of bednets or IRS in the community.

The behavior change in the mosquito as a result of these personal protection interventions is not being studied yet, even though it is highly likely that there will be substantial changes if the availability of easy blood meals is constrained.

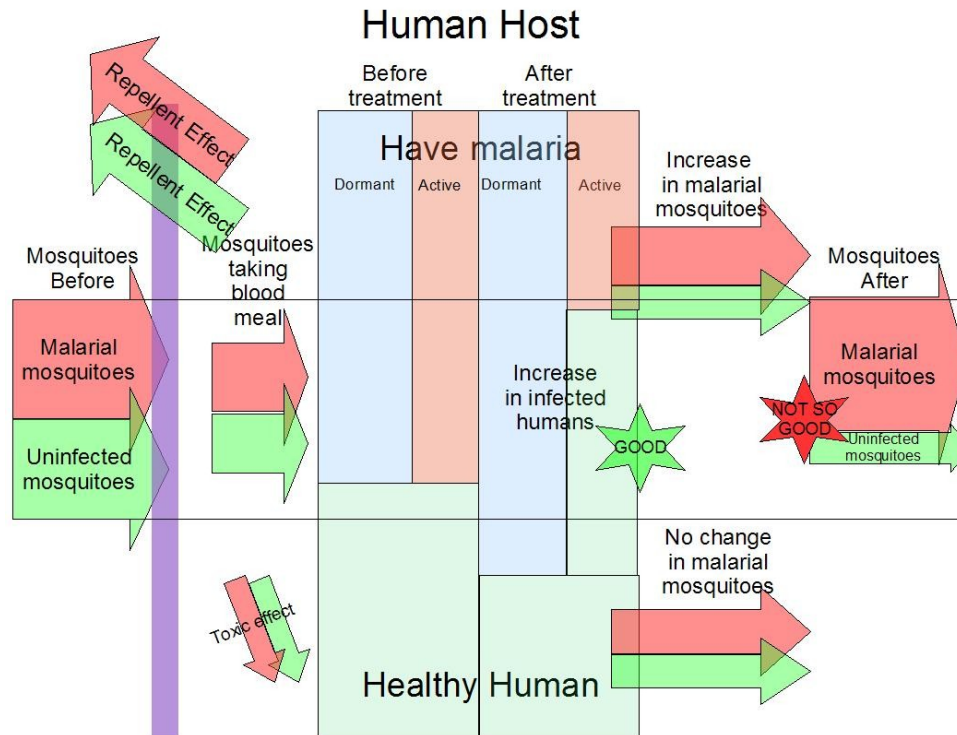
Without strong intervention, the norm is for the malaria parasite to be in equilibrium at a high prevalence level in both the human host and the mosquito.

Impact of Case Treatment

The impact of case treatment on the human host in a malarial setting is to reduce the malaria in the human host. This has three dimensions:

1. Morbidity is reduced
2. Mortality is reduced
3. Prevalence of malaria in the human host is reduced

Large scale treatment of the human host can have a beneficial impact on these three dimensions, but there is no impact on reinfection by malarial mosquitoes. This means that nothing is going to change unless either there is a vaccine or there is widespread use of an effective prophylaxis.



In combination with other interventions, the use of malaria case management to reduce the prevalence of malaria in the human host has advantage.

In situations where malaria is endemic, but locally eradicated, as in Darwin, Australia, the use of all interventions to control the spread of malaria from an infected visitor is total. Medication is used to remove the parasite from the human host, and vector control measures are used to ensure that no malarial mosquitoes will live to pass on the parasite to others.

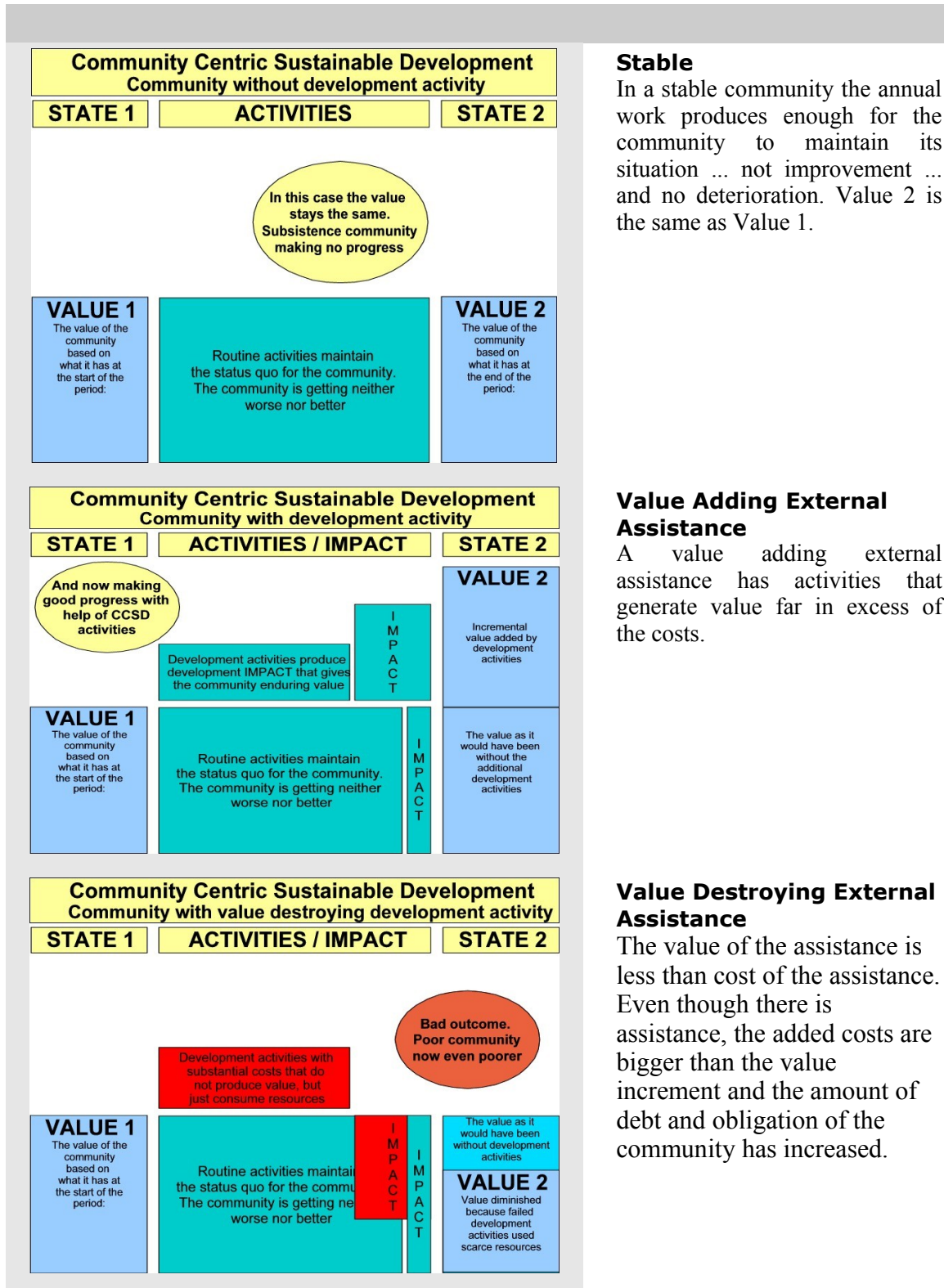
Information About the Results

At the community or area level information about the results comparing the situation as it was with the situation that has been achieved:

1. Time series on mortality due to malaria;
2. Time series on morbidity due to malaria;
3. Time series on lost work time due to malaria;
4. Time series on malaria cases at the clinic / hospital;
5. Time series on mosquito population;
6. Time series on parasite prevalence in the human population;
7. Time series on parasite prevalence in the mosquito population.

Performance at the Community Level

The following set of graphics show how a community progresses from the start of a period to the end of a period ... with Value 1 representing the start of the period and Value 2 end of period:



Stable

In a stable community the annual work produces enough for the community to maintain its situation ... not improvement ... and no deterioration. Value 2 is the same as Value 1.

Value Adding External Assistance

A value adding external assistance has activities that generate value far in excess of the costs.

Value Destroying External Assistance

The value of the assistance is less than cost of the assistance. Even though there is assistance, the added costs are bigger than the value increment and the amount of debt and obligation of the community has increased.

Data Collection

The Basics

What Data are Needed

Every fact that is going to be important in decision making is needed. Broadly this breaks down in the following sections:

1. Information about the area
2. Information about the interventions
3. Information about the results

The general theme about information needed for decision making is that it should include:

1. Cost of the activity
2. Description of the activity
3. Amount of the activity
4. Impact of the activity
5. Value of the activity

This translates into the need to collect data that will make it possible to produce reports showing these matters.

IMM specific information

There is other information that has a very direct impact on IMM planning and IMM activities. There is both permanent information and information that changes very quickly. The key data about all these elements should facilitate preparation of time series such as the following:

1. Before and after data for time and place
 1. Human Population
 1. Size of population
 2. Clear of malaria
 3. With malaria parasite – no fever
 4. With malaria parasite – fever
 2. Mosquitoes
 1. Size of population
 2. Clear of malaria
 3. With malaria parasite
2. Intervention data for time and place
 1. For each intervention
 1. Amount of activity
 2. Cost of activity

For those engaged in day to day operations, the data needs to be available quickly, while for some scientific analysis the data are needed in time series over a long period of time.

Spatial information

Spatial information ... maps ... are a critical part of the information needed for IMM planning and the management of operations.

Some of the characteristics that need to be taken into consideration include the following:

1. Where are people that are host to the malaria parasite located: where do these people live, where do they work, where do they congregate together, where do they travel to,
2. Where are the sources of mosquitoes,
3. Where do the mosquitoes travel and other details of their behavior including when they travel and how they behave relative to homes, people and animals,
4. Where are infected mosquitoes located,
5. What mosquito and malaria control interventions have been done: when and where.

Everything has a spatial characteristic, and from a cost effectiveness and performance perspective, it is likely that spatial information can be the most valuable in ensuring that IMM is

low cost and sustainable. Mosquito and malaria control has a strong spatial characteristics that have a very large impact of control results. Accordingly spatial information and mapping are a very important part of cost effective high performance integrated malaria management.

Satellite imagery makes it possible to accelerate learning about any location, limited, of course, to those locations where satellite imagery is available.

Time Series Information

In addition to mapping that shows the simple spatial dimension of the data, there also needs to be an ability to understand the changes that occur over time about a specific place and a specific characteristic of the data.

Time series information is also critical in the measurement of progress. The goal is to have progress, and to do this as fast as possible, and in ways that are cost effective and with a minimum of undesirable side effects. All of this is best done in a data environment where there is good time series information.

Local People Collecting Local Information

In order for data collection to be cost effective, local people have to be collecting local information, and they must be doing it using low cost techniques.

No one data collection approach is likely to be universally optimum. So much depends on the training and experience of the people in the community, and the practical issues of access to information technology and communications infrastructure.

A hybrid system involving both manual forms and electronic systems will usually be the way forward.

Collecting cost information

Cost information should be available from the accounting section of entities involved, but this may not be the case.

If there is a need to do data collection in support of costing, then the basic technique should be to use a simple register of the resources used. This can be a text description, with the amount used. If information about costs is available, that is very helpful. In general all the information possible about what was done, how much did it cost is useful. If complete notes are maintained, then there is essentially a “book of original entry” ... a “day book” ... or a “journal”.

Often cost data collected in this manner will be a lot more informative than a computer print-out of an “account” where all identity with reality has been lost in the course of computerization and subsequent processing.

There will be issues of access to cost information. There is not much culture of sharing this information in many places, and this has resulted in poor decision making at one level, and very large scale fund misappropriation as well.

Data Collection

Analysis of Satellite Imagery I

Image 1



Satellite imagery is a very efficient and cost effective way of getting rapid knowledge about an area. With modern technology it is possible to get images with a resolution of under 1 meter, a level of resolution that makes it possible to do preliminary first phase planning without time consuming and expensive land mapping.

Image 1 shows the area around Monrovia, Liberia. The map covers around 50,000 acres of which some 15,000 acres is marsh, and very close to human habitation.

Ground surveillance will confirm whether the whole of the marsh is habitat for mosquito breeding, or just limited areas.

Image 2

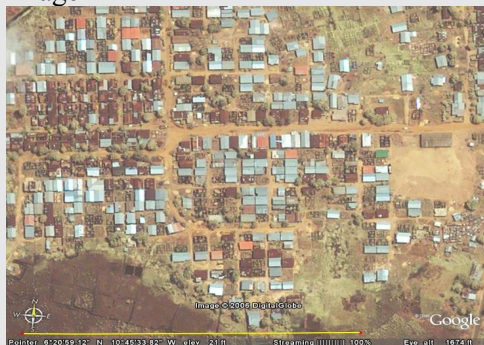


Image 2 shows individual houses in a section of Monrovia. Images of this sort enable plans to be made for surveillance and for intervention.

With good knowledge about the spatial distribution of malaria in the community it is possible to plan effective interventions that can be very much lower cost than blanket coverage and much more valuable in terms of results being achieved.

Some of the characteristics that need to be taken into consideration include the following:

1. Where are people that are host to the malaria parasite located: where do these people live, where do they work, where do they congregate together, where do they travel to;
2. Where are the sources of mosquitoes;
3. Where do the mosquitoes travel and other details of their behavior including when they travel and how they behave relative to homes, people and animals;
4. Where are infected mosquitoes located;
5. What mosquito and malaria control interventions have been done: when and where.

Data Collection

Analysis of Satellite Imagery II

Image 3



Image 3 is of Stone Town and its outskirts in Zanzibar. It is supplied by QuickBird and incorporates data from both the visible and the near-infra-red (NIR) spectrum. A grid based matrix has been overlaid.

Image 4



Image 4 is another example showing built up area and an area close by that could be a significant source of mosquitoes.

In addition to mapping that shows the simple spatial dimension of the data, there also needs to be an ability to understand the changes that occur over time about a specific place and a specific characteristic of the data.

The Tr-Ac-Net IMMC database provides some functionality that addresses the challenge of time series analysis in all its spatial dimensions.

Data Collection

Community Information

Identification of the community	Collecting data ... the most important part of the IMM program. With data there can be analysis, and with analysis understanding and good decisions to ensure the most cost effective results.
Where is it?	
What is it like?	There is a need to know a lot about the community:
About health	<ol style="list-style-type: none">1. The population:<ol style="list-style-type: none">1. What age profile ;2. What sex mix;3. What socio-economic status;4. What educational status;5. What health status.2. About the economic activities:<ol style="list-style-type: none">1. What agriculture (jobs);2. What industry (jobs);3. What services (jobs)3. About potential of the community:<ol style="list-style-type: none">1. What is possible; and,2. What is not.4. About constraints;<ol style="list-style-type: none">1. Financial;2. Organizational;3. Knowledge;4. Politics, Governance;5. Etc.
About malaria	
	There are all sorts of other questions that will emerge as soon as there is a good base of data and analysis that can be used for research and the development of knowledge.

Data Collection

Entomology



Collecting data ... the most important part of the IMM program. With data there can be analysis, and with analysis understanding and good decisions to ensure the most cost effective results.

There is a need to know a lot about the mosquito:

2. The the mosquito population:
 1. What species;
 2. What sex;
 3. What parasite status.
2. About the potential sources:
 1. The presence of eggs, larvae, pupae;
 2. The life stage of these;
 3. The interventions; and,
 4. The results of the interventions
3. About potential resistance:
 1. What works; and,
 2. What does not.

There is a need to know a lot about the geography:

1. About the weather;
 1. About impact on mosquito population
2. About mosquito movements:
 1. About what a mosquito does where
3. About people movements:
 1. And how does this impact the malaria transmission

There are all sorts of other questions that will emerge as soon as there is a good base of data and analysis that can be used for research and the development of knowledge.

Data Collection

Medical

Field survey



Collecting data ... the most important part of the IMM program. With data there can be analysis, and with analysis understanding and good decisions to ensure the most cost effective results.

There is a need to know a lot about the health status of people.

Data should be collected from clinics and hospitals. These data will show something about the malaria situation among people that come to the clinics and hospitals, but only this.

Data must also be collected to show what is happening among the population that have not come to the clinic.

A data collection regime needs to be established that feeds information about sickness into the IMM data flows without the use of a remote intermediary like the clinic or hospital.

Community centric information flows are an essential for this, and could be based at either a school or a telecentre.

There are spatial data considerations that are very important. It is likely that good spatial information will make it possible for control interventions to be less costly and more effective.

There are also considerations of season, date and time that can also make a difference in how interventions are managed for most effectiveness.

The question of mis-diagnosis must be addressed. There has to be training so that staff know what is needed to identify malaria. Training must be done well, and staff must be appropriately remunerated.

Data Collection

Costs

Transactions

Collecting data about costs is very basic.

1. What is the unit cost?
2. How many are being used?
3. Multiply and the cost amount is now known.

Collecting costs about people cost is also very useful. The basics are the same, though sometimes, indeed frequently, the pay rates are not common knowledge:

1. Who is working?
2. How long?
3. How much are they being paid?
4. Multiply and the cost amount is known.

Recording the data

Recording the data is also very basic. Write the key information down, preferably in ink and in a book, not a loose piece of paper.

In addition to the interesting data that describes the transaction or activity and the cost also add in the key information needed for reference purposes later on. This includes things like:

1. Where?
2. When ... data and time?

These books have been used in accountancy for a very long time. They are referred to as “day books” or “journals” and are also referred to as “books of original entry”.

Data from these books can be copied to an electronic database from time to time and made part of a cost analysis framework. Some “research” will have to be done along the way to make sense of all the information, and to make it complete. Most of the data are known, the challenge is to get all the data together in a single framework so that the information is meaningful for analysis.

Some information is quite sensitive, such as pay rates and benefit packages, and the like. Though they are sensitive, they are also important to understand since the cost of activities is very much a function of the cost of people.

Integrated IMM Activities

There are many possible interventions for mosquito and malaria control. Each intervention can make a contribution to mosquito or malaria control on its own, but in an integrated approach the combination is much more cost effective and much more likely to succeed and set the stage for sustainable success. The reason there are so many intervention relates to the complex biological science where there is interaction between the human, the parasite and the mosquito vector.

The integrated approach was originally used by Col. Gorgas during the construction of the Panama Canal about 100 years ago. His integrated approach had a focus on the human, the habitat and the mosquito. A similar set of interventions is the basis of the IMMC's approach which has four main areas:

1. Community activities;
2. Vector control;
3. Medical; and,
4. Personal protection.

Within these four areas there are a many different activities, addressing all aspects of the mosquito and malaria dynamic:

1. Community: control and coordination
2. Community: awareness and education;
3. Vector control: community clean up;
4. Vector control: source control;
5. Vector control: adulticide ULV spraying;
6. Medical: case management: drug therapy, drug prophylaxis;
7. Medical: parasite prevalence reduction;
8. Personal protection: interior residual spraying (IRS);
9. Personal protection: bed-nets (ITN).

In addition IMMC is committed to capacity building and training for sustainability that includes interventions as needed as follows:

1. Community training
2. Scientific training in cooperation with local universities and research institutes
3. Scientific training in cooperation with international universities
4. Accounting and management information

The IMM approach is less expensive because data helps to improve decision making and get the most effective set of interventions used, rather than merely using anything and everything based merely on bureaucratic mandates and procedures. This is a systems approach that has been advocated by management experts for decades, and is routinely practiced in the best organizations in the world.

A systems approach is equally applicable in the relief and development sector and in the specialized activities of mosquito and malarial control.

In an integrated program, the expectation is that there will be an exponential improvement over a single activity approach. There is a multiplier effect when interventions are combined in a manner that is mutually supportive to disrupt the transmission cycle and make the improvement permanent.

Human resource costs are optimized when the majority of the staff are local, well trained and there is strong oversight and management data. There is exponential improvement when there is widely shared knowledge and experience.

The effective use of management information alone can improve performance significantly, probably by as much as 100%, perhaps significantly more.

IMM - Community

Community

There are many things that a community can do to lower the burden of malaria.

Serving to Coordinate in the Community

Community knowledge and community priorities are critical, as well as understanding what is possible, and what organizations and resources can be deployed to make an impact.

Community Education and Awareness

For the effort to be worth as much as possible, needs to be improved knowledge about malaria in the community, and especially the role of the mosquito in the transmission of malaria, and the community as a whole in making this transmission possible.

Community Clean Up for Vector Control

Many initiatives need external expertise and funding, but community clean up can be done with nothing more than local community effort.

Community

Community Level Control and Coordination

Do control and coordination at the local level.	<p>Vector control in the United States is organized at the community level using Vector Control Districts. The first of these was established almost 100 years ago, and they have been active ever since.</p> <p>The typical vector control district has a thorough knowledge of the area and is in a position to make use of whatever vector control intervention is likely to be the most effective. This can be source control using larvicides or it can be ULV fogging with adulticides.</p> <p>While much of the work in the USA is related to nuisance pests, there has been a new urgency for effective vector control to arrest the spread of West Nile Virus.</p> <p>The same organizational concept would be of great value in malaria endemic areas.</p>
Local information is the best information	<p>Local surveillance, local data and local analysis should inform decision making about local action to reduce the virulence of the vector and help to focus interventions where they can be of greatest use.</p>
Information that is used is good information	<p>If the local information is also the primary information that is used for operational management and control, then these data will be operationally accurate, and can become a good foundation for additional scientific analysis in a multi-variate setting</p>
Local coordination	<p>The local coordination can be done in any way that suits the local community, including cooperating with existing civil organization, or a school, religious organization, or a telecentre. The goal is to have the community be the key agent for success, and to have a reliable link with the global IMMC program so that there can be easy exchange of ideas and help with programs and resources.</p>

Community

Education and Awareness

Teaching about malaria	Increased individual and community awareness of mosquitoes and their role in the transmission of malaria, and the importance of treatment is very important. The community needs to know:
What it is that causes malaria.	<ol style="list-style-type: none">1. about how malaria is transmitted, and2. about ways to control the mosquito population,3. about how to use bednets to reduce incidence of malaria,4. about the ways to keep mosquitoes away from the house,5. about the advantages of interior residual spraying,6. about how to recognize the symptoms of malaria, and
How to protect against malaria	<ol style="list-style-type: none">2. about how malaria can be treated.
How the malaria interventions work	<p>With better knowledge of these matters, the community becomes empowered to take control of many of the factors that have an impact of the malaria status of their community.</p> <p>In order for a malaria management program to be successful and sustainable there is a critical need to get the community involved and running as much of the program as possible. In a situation where the malaria level has been reduced almost to zero, it is possible that everything can be done in the community with little external inputs.</p> <p>Community awareness and clean up of the environment is a first stage in reducing the mosquito population. Eliminating standing water of all types will reduce the breeding places and help keep the mosquito population near the human population under control.</p>

IMM – Vector Control

Control of the Mosquito Population

Control of the mosquito population can be accomplished in these ways:

1. Source control by elimination of breeding places;
2. Source control using larvicides ; and
3. Adulticiding using ULV fogging.

Vector control is central to success

Malaria transmission is reduced if the mosquito vector is controlled. The mosquito can be best controlled before it flies while it is still in the larval stages. There are larvicides that are effective and safe. With good data, source control interventions can be very precise, the use of larvicide optimized and cost minimized.

Clean Up

Area clean up and elimination of breeding places can be very helpful. It does not need to be done everywhere, but should be done close to human habitation.

Source control

It is best to control mosquitoes before they are dispersed. This can be done with source control that addresses the population while it is immobile.

Adult Mosquito control – ULV spraying

Aerial and ground fogging using adulticides are techniques that are very relevant in a strategy that aims to have rapid results and be sustainable. It is a standard practice for pest control in the USA, but rarely used in the control of malaria in Africa.

Vector Control

Community Clean Up

Old buckets



Area clean up does not cost much money, but does require effort and understanding.

Awareness of the causes of malaria and the importance of keeping potential breeding sites under constant surveillance, and taking timely action to stop mosquitoes emerging as flying adults.

Discarded tires



Surveillance data will also identify locations of breeding places that result from a variety of wastes, such as automobile tires and discarded containers of all types that collect water. All of these potential breeding places can be cleaned up and will result in a reduction in malaria producing sources.

It is sometimes said that every “hoof mark in Africa” is a potential breeding place for mosquitoes, and to the extent that this is a challenge, it need not impact success of an integrated malaria management program because it can be handled within the context of local community clean up, or, if needed, an appropriate externally funded interventions.

Man made structures

Surveillance data will identify places where mosquitoes breed that can be eliminated by habitat modification. Poor design of structures and the area where construction has taken place often create excellent habitats for breeding mosquitoes. These situations need to be identified and modifications made, in the main to eliminate standing water.

Water barrels



Vector Control

Source Control

Larvaciding



Source control reduces a mosquito population by killing the mosquito in the larval stage. At this stage the pest is immobile and concentrated, and carefully targeted intervention can be very effective.

The key to cost effective source is accurate knowledge of where the sources are located and the stage of development of the larvae population.

Mechanized system for larvaciding



Source control reduces the population of locally produced mosquitoes that are responsible for transmission of vector-borne pathogens and associated nuisances to human and animal populations. Killing mosquitoes at their sources, when they are in the larval stages and concentrated, immobile and accessible is the key to a cost effective program. The interventions focus on reducing the incidence of adult females, both vector and nuisance species to tolerable levels. Other measures supplement this primary intervention.

Truck larvaciding

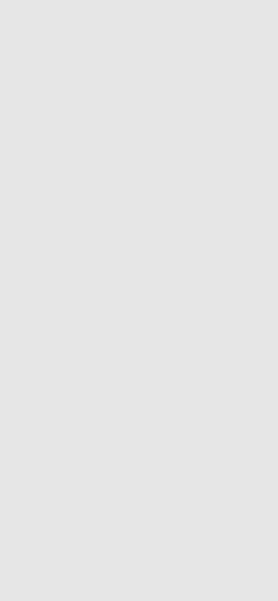


Larval elimination is the most effective and reliable way to control a mosquito population especially when directed at the young larval stages before they become more dispersed in the environment. The application of insecticide when the larvae are most concentrated in the habitat also reduces the amount of insecticide needed which has the dual effect of reducing potential environmental contamination as well as reducing costs.

Abatement plans for Anopheles, Culex and Aedes mosquito species depend on the pattern of annual and seasonal (dry and rain) rainfall and the incidence and distribution of the immature stages of the mosquitoes. In the IMM program data about weather are collected and included in the IMM cyberenvironment model. Anopheles and Culex species have time limited estivation and/or latency capabilities in the adult, larval or egg stages and cannot remain dormant during dry periods, it is imperative to locate and manage the water filled harborages that provide sustainable habitats during these times. These “seed populations” are the sources for the enormous increases in population densities that occur when the rainy season begins and aquatic habitats become numerous.

Eggs of the Aedes species are capable of surviving for long periods of time on soil withstanding dry conditions and hatch into larvae when flooded. Some container inhabiting aedine species survive in artificial or natural containers and natural precipitation or man-made means provide water for hatching.

The population density of mosquitoes is directly related to weather



conditions, especially precipitation (irrigation), temperature and relative humidity. Monitoring these key climatological conditions can provide the necessary information to predict which sites will be producing mosquito larvae and when. These parameters coupled with a knowledge of sub-surface water (water table) can provide additional information on where and when to begin mosquito larval control applications.

A mosquito abatement area must be large enough to encompass the sources of mosquito vectors and pests it is to manage. The boundaries of mosquito control operations should be established by the affected communities taking mosquito science into account. In most circumstances a distance of 500 meters from human habitation is a default guideline. Larval habitat surveys should be done within this area to locate any larval breeding sites that would be a source of mosquitoes. The flight range of an *An. Gambiae* mosquito is considered to be 500 meters, though some will travel longer distances, especially with a favorable wind.

Vector Control

Mosquito Control ULV Adulticiding

Examples	Description
<p data-bbox="230 331 467 373">Aerial application</p> 	<p data-bbox="516 331 1380 478">ULV fogging can be done using aircraft or ground fogging equipment. In the right circumstances, aerial application is very cost effective, and can have a major impact on the speed that the mosquito and malaria disease is brought under control.</p>
<p data-bbox="230 604 467 646">Manual fogging</p> 	<p data-bbox="516 604 1380 835">Where the mosquito population is out of control, it can be reduced rapidly and at low cost using aerial ultra low volume (ULV) spraying. This technique is used in the USA to control mosquitoes where West Nile Virus has been located, or merely to control “nuisance” mosquitoes. ULV is very cost effective for large areas that are difficult to access. ULV spraying creates very small droplets that attach to the hairs on the mosquito. This intervention provides for a quick knock down of the mobile adult population. Pesticides used today like Dibrom are safe but very toxic to mosquitoes.</p>
<p data-bbox="230 947 467 989">Cost effectiveness</p>	<p data-bbox="516 947 1380 1150">While mosquito population control is best controlled by controlling at the larval stage before they fly and disperse, modern ultra-low volume (ULV) spray technology makes it very cost effective to control flying mosquitoes. Chemicals such as Dibrom are used extensively in the United States for mosquito and vector control and the modern spray techniques available are very effective and very low cost. The cost can be as low as \$2.50 per acre treated, and the per-capital cost very low depending on the population density.</p> <p data-bbox="516 1178 1380 1409">Also important is that the impact of ULV spraying is very fast. If an area is correctly sprayed tonight, the mosquito population will be significantly lower next morning, usually a reduction of more than 80%. If the reduction is less than this, there is a resistance problem that needs to be addressed, and changing to a different family of insecticides and respraying will probably deliver a reduction in the mosquito population.</p> <p data-bbox="516 1436 1380 1633">In areas where mosquitoes have a very favorable habitat, a permanent reduction in the mosquito population is going to be difficult. It is possible that source control referred to above can help bring the population of mosquitoes under control permanently, but a substantial mosquito population is likely for the long term.</p> <p data-bbox="516 1661 1380 1829">The challenge is more to reduce the population of malarial mosquitoes, than to reduce the total population of mosquitoes. When this happens, it goes a long way to break the perpetual cycle of parasite transmission from human host to human host through the mosquito vector.</p> <p data-bbox="516 1856 1380 1892">The big role for ULV is to reduce the population of mosquitoes</p>

long enough for the other interventions to impact the prevalence of the malaria parasite in the human host and in the mosquito population.

Modern aerial ULV application of pesticides is very cost effective. A large area can be treated very quickly at a very modest cost. A typical price for ULV spraying in the USA is around \$2.00 per acre, with a big part of that the pesticide cost.

The cost depends a lot on the volume of work that the applicator is doing. While the pesticide cost is variable, almost all the other costs are incurred based on elapsed time, especially for a deployment in Africa. A single plane can probably treat in the range of 1 million acres a month.

(5,000 acres per hour * 10 hours a day * 20 days a month)



Modern ULV navigation equipment allows the pilot to program the GPS onboard computer so that the spraying will treat all the area as required without drift into other areas. The area of potential high mosquito population is identified and a possible area to be treated laid out. With modern GPS equipment it is possible for the aircraft navigation system to be programmed so that spray is accurately delivered to the target area taking into account airspeed and wind over the ground.

IMM - Medical

Medical Treatment Strategy

Medical care is expensive. Though there has been a massive increase in the capacity of the medical experts to address the science, there has not been the same progress in building an effective local or a global medical system.

Case Management for Active Malaria

With limited resources, the activities have been directed to segments of the population that are considered to be at risk, such as young children and pregnant women, and though this results in reduction in mortality of these vulnerable groups, the overall effect on morbidity in the vast build of the population is small, and the economic situation is not improved.

Drug Therapy to Reduce the Malaria Parasite Prevalence

Drug therapy and drug prophylaxis are costly and increasingly ineffective. As long as there is endemic malaria and massive reinfection, medical treatment as a standalone curative treatment cannot be expected to produce sustainable progress. Accordingly, a role for malaria drug therapy should be to reduce the parasite prevalence in the human host population as fast as possible.

Strengthening Health Care Infrastructure


Treatment capacity is constrained by the health system infrastructure in the broadest sense:

1. the physical plant
2. the availability of trained staff
3. the availability of drugs and medical supplies

Accordingly this needs to be a component of a sustainable program.

Medical

Case Management for Active Malaria

Example	Description
Young children	Drug therapy is increasingly compromised by resistance to the low cost drugs like Chloroquine and more recently Fansidar.
Pregnant women	As long as there is endemic malaria and massive reinfection, medical treatment as a standalone curative treatment cannot be expected to produce sustainable progress.
Working adults 	<p>Quinine, Choroquine - Medication has been used for many years. Initially it was quinine that served to minimise the fever due to malaria. For a very long time the drug Chloroquine was used both as a prophylactoc and as a treatment, but over the years, malaria has become resistant to chloroquine and it is no longer effective.</p>
Remote villages	<p>Fansidar - Fansidar became the preferred treatment in the 1980s as chloroquine resistance became widespread, but it is more expensive and not easily affordable by the majority of the affected population.</p> <p>Artemesin Combination Therapy - Artemesin Combination Therapy (ACT) has been developed and is now the preferred treatment, but it is again more expensive than Fansidar.</p> <p>Rapid development of resistance is facilitated by rapid reinfection and the need for repeated treatments. Another factor is the poor diagnostic performance, with widespread use of malaria drugs being used for other ailments.</p> <p>Malaria is a deadly disease for children and pregnant women, and some types of malaria are also deadly for everyone. Malaria in all its variations is a debilitating disease for everyone. Accordingly, the treatment of malaria has been made a priority.</p> <p>Medical treatment of active cases is a high priority in the health sector, but the issue of resistance is a major concern. Where there is perpetual reinfection, and the treatment is limited to the existing drug therapies, there is absolutely going to be resistance development, and most likely quite rapidly.</p>

Medical

Drug Therapy to Reduce Malaria Parasite Prevalence

Surveillance



Drug therapy

More surveillance.

Drug therapy to reduce parasite prevalence

Medical treatment that addresses the active malaria bout should be supplemented by medical treatment that addresses the parasite that is simply hosted in the human subject.

A bite from a non-malarial mosquito is not the start of transmission when the source of a blood meal is not host to the malaria parasite. The bite is a nuisance, but the bite is not dangerous.


Medical treatment to reduce the prevalence of the malaria parasite in the human host is a key part of an integrated malaria management regime.

Medical treatment that helps to eradicate the disease is very much more cost effective than medical treatment that only addresses a presently active bout of malaria, that will reactivate in a matter of weeks, and perhaps many times in a single year.

The data are not clear yet, but the simple model for an optimized program suggests that a geographic focus with multiple interventions can move towards elimination of the malaria parasite in the community in months not years ... and of course, the long term cost of this approach is very much better than anything else.

Medical

Strengthening Health Care Infrastructure

Examples	Description
 <p>Government budget</p> <p>Donor funding</p> <p>Staff remuneration</p> <p>Staff training</p> <p>Physical facilities</p> <p>Drugs and Medical Supplies</p>	<p>The health care infrastructure is usually underfunded from the government budget. This has multiple consequences:</p> <ol style="list-style-type: none"> 1. The facilities have not been built, 2. If they are built, they are not staffed 3. If they are staffed they do not have adequate medical supplies 4. They are not suitably maintained ... things like the cold chain are not functioning and medications get spoiled. <p>The optimum strategy for strengthening health care infrastructure is for it to be done based on community needs for all health services, rather than simply doing something based on donor funding for malaria.</p> <p>There are many components of a comprehensive plan, but planning can be facilitated if there is good community level information</p>

IMM - Personal Protection

These techniques are most widely used

Though the techniques are the most widely used, it is not clear that they are the best in terms of cost effectiveness.

If low cost is the goal, then a program that has a focus on protecting a part of the population is advantageous. But the cost effectiveness of this may or may not be optimum, and the data are not readily available to make this determination.

Interior Residual Spraying (IRS)

Interior residual spraying (IRS) is an effective way to reduce malaria transmission. It has been used in many locations, and always with good results. It is especially effective when DDT is used.

Bednets (ITN)

Personal protection using bednets has been the most popular of anti-malaria interventions in recent years. A very large proportion of the increase in funding has been allocated to bednet distribution.

Other Personal Protection Techniques

Many techniques are used by people with wealth in order to limit their exposure to malarial mosquitoes. These are very expensive, and it is a waste of resources to be spending on these initiatives when a good public policy could practically eliminate the malaria.

Combination is Best

It is being increasingly acknowledged that interior residual spraying (IRS) and bednets together are more cost effective than either on its own. Data to prove this would be interesting. It is also possible that the most cost effective is when all possible interventions are used in combination with a carefully designed data collection and analysis system.

Personal Protection

Interior Residual Spraying (IRS)



Safety



Multiple actions

DDT

Interior residual spraying (IRS) is a well established way of reducing malaria transmission. There are a multiple actions that affect mosquito behavior and survival. The repellent effect is perhaps the most important, because this keeps mosquitoes away from the human source of a blood meal.

If the mosquito does bite and gorges itself on a blood meal and alights on the treated surfaces, the toxic action will kill the mosquito and stop onward transmission of the parasite.

Personal protection using interior residual spraying (IRS) of the home is a proven way of reducing the impact of the mosquito vector on people in the home. There are several ways in which IRS impacts on the mosquito and malaria:


1. By the repellent effect which helps to keep mosquitoes out of the home,
2. By the toxic effect which kills the mosquito when they try to rest on the treated surfaces, as they would do after a blood meal. This operates along the following lines:
 1. In the event that the mosquito was not malarial before the blood meal the human subject will not become infected, but if the mosquito is malarial before the blood meal the human subject will be at risk of infection,
 2. If the human subject is host to the parasite before the blood meal, then the IRS toxicity will stop the mosquito transmitting the parasite to others.

The use of DDT as the chemical agent for IRS is the most cost effective. DDT has a high repellent effect, is toxic to mosquitoes and remains effective for a long time. The effectiveness of DDT lasts perhaps as much as twice as long as other chemical agents. There are some mosquitoes that are resistance to DDT, but this resistance does not seem to apply to the repellent effect. In terms of cost effectiveness DDT appears to be several times better than other chemicals, being a less costly chemical, requiring less frequent application, and having a bigger impact on the malaria prevalence in the community.

IRS should, of course, be conducted with trained personnel who know and practice safety. The environment should be monitored to confirm that there is no undesirable environmental impact.

Personal Protection

Insecticide Treated Bednets (ITN)

Example	Description
	<p>Bednets are the most well-known of the possible anti-malaria interventions. They are being presented as being very effective, but the data are weak.</p> <p>Modern bednets are impregnated with insecticide and keep mosquitoes away not only physically but also by chemical action. For the past several years personal protection using an insecticide treated bednet has been a widely used intervention. There are several styles of bednet and a variety of chemicals are used. Not all the the chemicals being used have been approved for use by the WHO and/or UNICEF.</p>
 <p><small>Figure 1. The nets from all houses in a Tanzanian village are given their annual re-impregnation free of charge by a nurse from the health centre. Photograph taken by T.J. Wilkes.</small></p>	<p>The main goal in many of the programs has been to get young children who are at the highest risk of dying as a result of a malaria bout to sleep under a bednet and be protected. The result of these efforts seems to have been positive in that it seems that less children are dying of malaria in the critical first year, or even two or three, but it is less clear that children as a whole are growing up to adulthood. The possibility is that children survive initially, but subsequently die because malaria is so prevalent in the society at large.</p>
	<p>Another group being targeted for bednet use are pregnant women who are also highly vulnerable to malaria. Again, the reports suggest that sleeping under a bednet reduces the incidence of malaria for the person involved, but this does not translate into less malaria in the community as a whole, and is probably unsustainable for the individual when they are no longer in the vulnerable group of pregnant women.</p> <p>The cost of a bednet varies from around \$2.00 to around \$10.00, but it is not clear that these numbers relate to the same item, and the data are not easily to be found that show the makeup of costs. A “per year” cost of using a bednet is sometimes stated to be around \$4.00 per person per year.</p> <p>Protection derived from using insecticide treated panels</p> <p>One of the behaviors associated with some insecticides is a repellent effect, which keeps mosquitoes away and stops them taking blood meals. The technique has been used on an experimental basis with success.</p>

Personal Protection

Other Techniques

Example	Description
	Exposure to mosquito bites can be reduced by many different techniques. Some of the approaches are expensive and therefore limited to the wealthier members of society.
Air conditioning	Living in air-conditioned space is one way to reduce exposure to mosquitoes ... but it is an expensive option and only available to a very few.
House construction	House construction can make a big difference to the number of mosquitoes seeking blood meals in the house
Insecticide sprays	Using insecticide sprays is another way. These are also expensive, and they have potentially bad side effects both to the people exposed to the insecticides and to the environment. Many of the sprays commonly used in malaria endemic areas are banned from the EU and the USA because of their dangerous potential.
Coils	Burning insecticide treated coils keeps mosquitoes away from possible blood meal targets.
Traps	In some situations mosquito traps can help reduce the level of mosquito bites.
Appropriate clothing	Wearing appropriate clothing that covers the legs and arms also helps keep mosquitoes from reaching a blood meal.

Capacity Building and Training

Key to sustainability

Physical Infrastructure and Material Supplies

If the physical infrastructure is adjusted to satisfy the needs of the community, there can be a long term benefit that continues into the future. The key is to make what is needed for malaria also be suitable for all other health issues.

Human Capital

The most important part of capacity is the human capacity, and accordingly the IMMC approach has a high priority on training and giving opportunity so that human capacity can be enhanced and become productive in support of progress.

Capacity Building and Training

Physical Infrastructure and Material Supplies

Community focus	IMMC approaches the challenge of physical infrastructure and material supplies from the community focus.
What there is ...	The baseline information is about what facilities and resources are actually available in the community or nearby to service the community.
What is needed ...	Another level of baseline information is about the facilities and resources that are needed by the community, and how these compare with what the community actually has. This shows the deficit (or perhaps a surplus) between what is available and what is the need.
What is needed for all health issues	The IMMC approach is that health is very much broader than just malaria, and it is health capacity building and training that should be embraced, not just the subsector of malaria ... in other words, facilities that are good for malaria, are good for many other health interventions.
Long term value for the community	More important is that the facilities that help to achieve success in reducing the burden of malaria can be used subsequently to address other diseases of importance in the community.

Capacity Building and Training

Human Capital

Training ... to make the human resource productive and valuable	The biggest resource for socio-economic progress is human capital. The demographics of Africa are a huge challenge and an opportunity. Perhaps as much as 70% of the population is under 20 years old, but this population is not well enough educated and the opportunities for them to be productive are not well developed.
Training ... the basics	Training is an essential for human capital expansion ... but training that is both basic and valuable. The basics make it possible for an individual to start the learning process.
Training ... to do work that needs to be done	The IMMC approach to training is to make it possible for people to do something useful and of value as soon as possible. The approach is practical, professional and technical and driven by what a community needs to be done more than by the curriculum that results in a certificate.
Training ... the continuing process	In the IMMC approach, a person never ends their process of learning ... nothing is a dead end. Everyone should always have the possibility of learning more and doing more that is valuable to the community. The IMMC approach aims to optimize learning and value from the start to the end of the process.
Sustainability	Where work is valuable ... there is the possibility that it can be paid for and the community can benefit not only when some external funding is available ... but when the community must pay the costs.

Participants in IMMC for Mosquito and Malaria Control

IMMC brings together an unusual mix of participants so that the consortium has all the expertise needed for an integrated program that can operate effectively in a variety of real-world situations. The key participants are the following:

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