

IMM

INTEGRATED MALARIA MANAGEMENT

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



An Integrated Malaria Management Strategy for the Eradication of Malaria in Africa incorporating Community Analytics (CA) March 2009

http://www.tr-ac-net.com/DBpdfs/TANpres0009_IMM.pdf

Contents

Section I Executive Summary

Background

The CA Management Dimension

The IMM Technical Dimension

The Benefit from IMM with CA

Section II The Role of Community Analytics

Introduction

Community Analytics (CA)

Integrate Malaria Management (IMM)

The value of integrating CA with IMM

The Management Cycle

The basic management cycle

Making key metrics simple

Measuring performance

Handling Complexity

Society is very complex

... but less so at the community level

Getting to clarity

Data, Dataflows, Data Collection and Data Storage

Something about data

Dataflows

About data collection

Use of satellite imagery

Analysis and Reporting

Making reports clear and unambiguous

Endnote

Section III The Integrated Malaria Management Interventions

Background

The Goal

A New Era for Malaria Control

Science

Managing Malaria ... with IMM

A data centric process

Parasite transmission through mosquito bites

Multiple interventions

Data

Data ... About the community

Data ... Spatial information about malariology

Data ... Use of satellite imagery

Data ... Entomological surveillance

Data ... Medical ... patient statistics and screening

Data ... About weather ... role of water

Data ... Performance ... Cost and operational efficiency

Data ... Performance ... Impact, value, cost effectiveness

Management

Organization, financing and sustainability

Management ... Strategic Oversight

Management ... Local Control and Coordination

Community

Community ... Awareness

Community ... Education

Community ... Strengthening Health Infrastructure

Vector Control

Vector control ... Community clean up

Vector control ... Source control ... larvaciding

Vector control ... Mosquito control ... ULV adulticiding

Vector control ... Interior residual spraying (IRS)

Medical

Medical ... Case management for active malaria

Medical ... Treatment to reduce parasite prevalence

Personal Protection

Personal Protection ... insecticide treated bednets (ITNs)

Personal Protection ... other techniques

Research

Research ... Intervention optimization

Research ... vaccine research

Research ... drug research

Research ... pesticide research

Research ... Mosquito biology

Research ... Parasite biology

Analysis and reporting

Examples of monthly reports

Endnote



IMM

Integrated Malaria Management

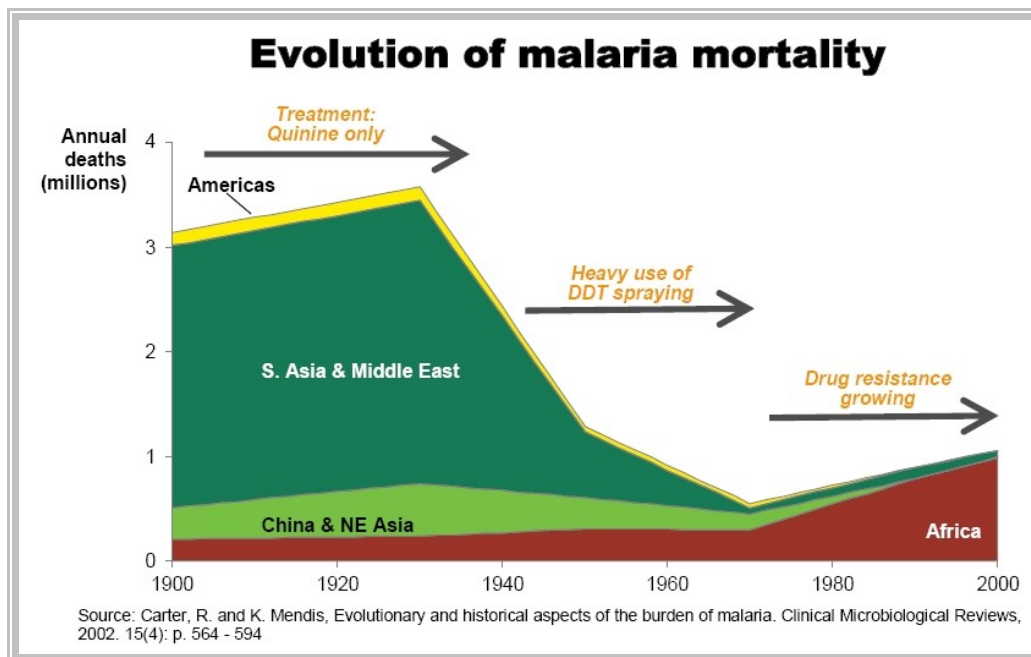
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Section I

Executive Summary

Background

A strategy of Integrated Malaria Management (IMM) reduced the burden of malaria in tropical areas a hundred years ago which enabled workers to complete the Panama Canal after several prior failures, eliminated malaria is a medical crisis in the United States, and then brought down the burden of malaria around the world during the period 1935 or thereabouts to 1970. The success of malaria control programs in the past is shown in the following graphic from the World Health Organization (WHO) Roll Back Malaria (RBM) Global Malaria Action Plan (GMAP) released in 2008.



This graphic shows that there was great success in reducing the burden of malaria, and that, with the exception of Africa, malaria is a much lesser burden now than it was 80 years ago.

In the 1970s there were major changes in the funding priorities for the international aid agencies and there was the Rachel Carson scare about excessive use of pesticides ... which had validity in the use of persistent chemical toxins in agriculture ... but resulted in the US banning DDT use, the subsequent avoidance of DDT around the world and very bad outcomes for malaria health.

There are many causal factors that account for the deterioration in the malaria situation over more than three decades, and especially in Africa. These include the emergence of resistance to widely used drugs like *chloroquine*, deterioration of public health infrastructure, widespread low quality and counterfeit drugs, low priority for health funding, etc.

Since 2000 there has been significant media attention to the African malaria crisis, and the outcome has been very much increased international commitments of funds to fight malaria and the emergence of a new community of people and organizations engaged in various aspect of the malaria industry.

Since the year 2000, the simple media message about the malaria crisis in Africa has been that 3,000 children in Africa die every day from malaria.

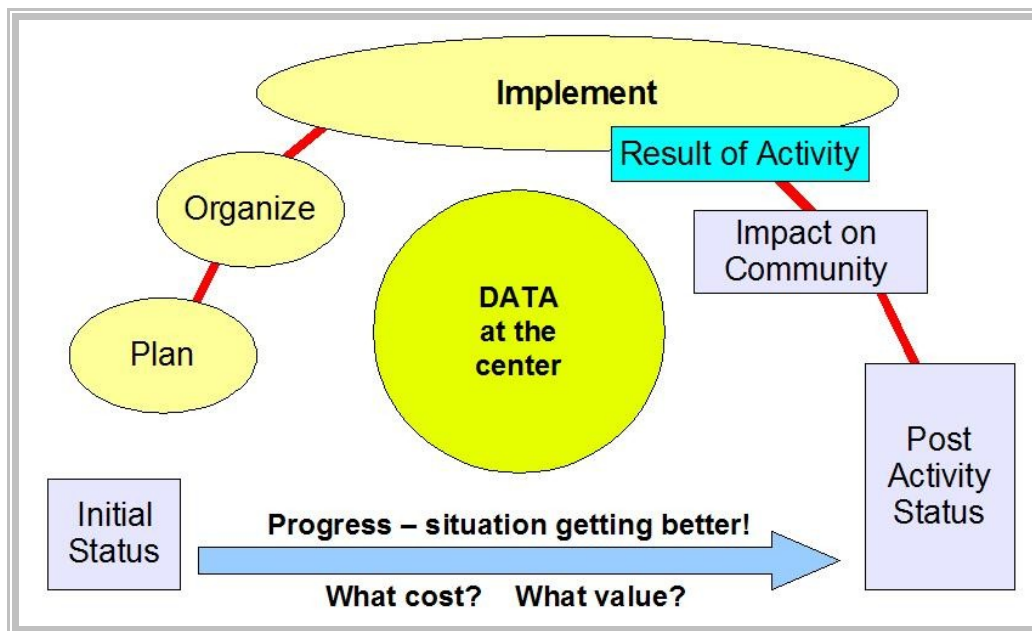
Annual funding was around \$100 million in 2000, and is reported to have been more than \$1.5 billion in 2008. This is a major turnaround, and a great achievement ... but the impact of this funding seems to have been rather modest relative to the funding disbursed. There is a chronic lack of easily accessible clear information about what has been done and what has been the impact ... costs seem out of control and the reduction of malaria burden rather modest.

The aim of Community Analytics (CA) and Integrated Malaria Management (IMM) is to have a full range of metrics about what needs to be done, how best to do it, and the resulting performance.

The CA Management Dimension

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

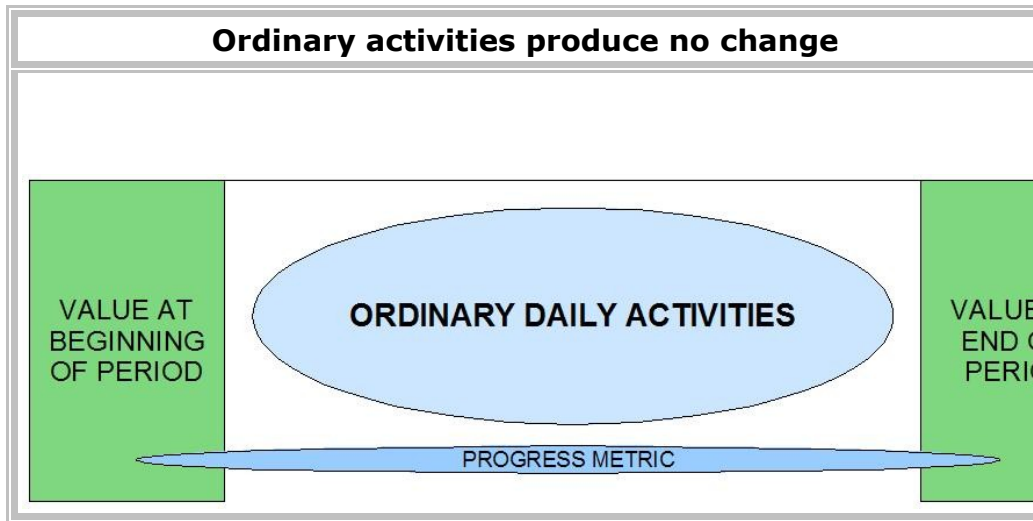
Community Analytics (CA) is a system to collect and use management information so that good decisions may be made in a timely way. It is a system of score-keeping. Data is at the center of the CA system.



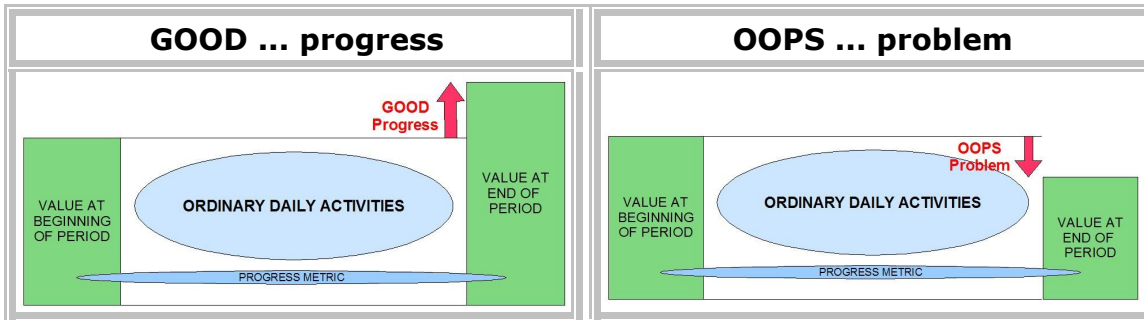
CA is a community centric system. Academic surveys may show what has been achieved ... or not ... but rarely have data that may be used in ways to inform operating decisions. The data in the CA system is used both to optimize the way operational activities are carried out, but also are used to provide for oversight and to carry out large scale cross community studies.

CA treats the community as the reporting entity. The data are as simple as possible ... the transactions as small as possible, as many as possible and as clear as possible. Progress is measured by the change in key parameters over time ... how the progress is achieved is a second

step. In the immediately following graphic ... the value of the community at the beginning of the period is the same as it is at the end of the period ... the community has gone about its business for the period, the time has gone by, but nothing has changed.

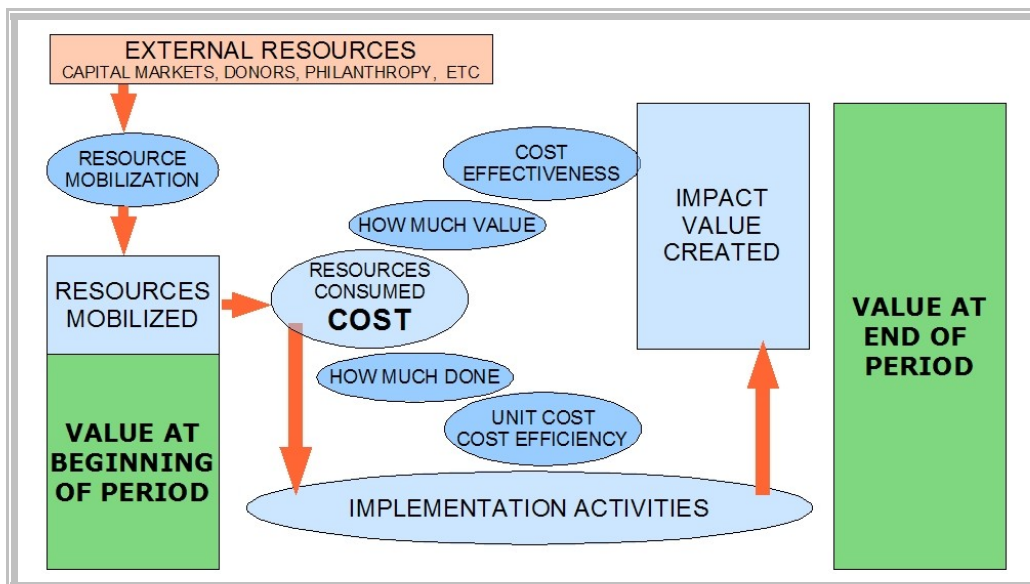


In these next graphics ... in once case there is progress ... and the other there is a problem.



Data about the daily activities is not needed in the CA system in order to be very clear about progress ... whether it is progress or problem.

Performance is not only about progress ... but the cost of achieving progress. The following graphic shows two key measure (1) cost efficiency and (2) cost effectiveness.



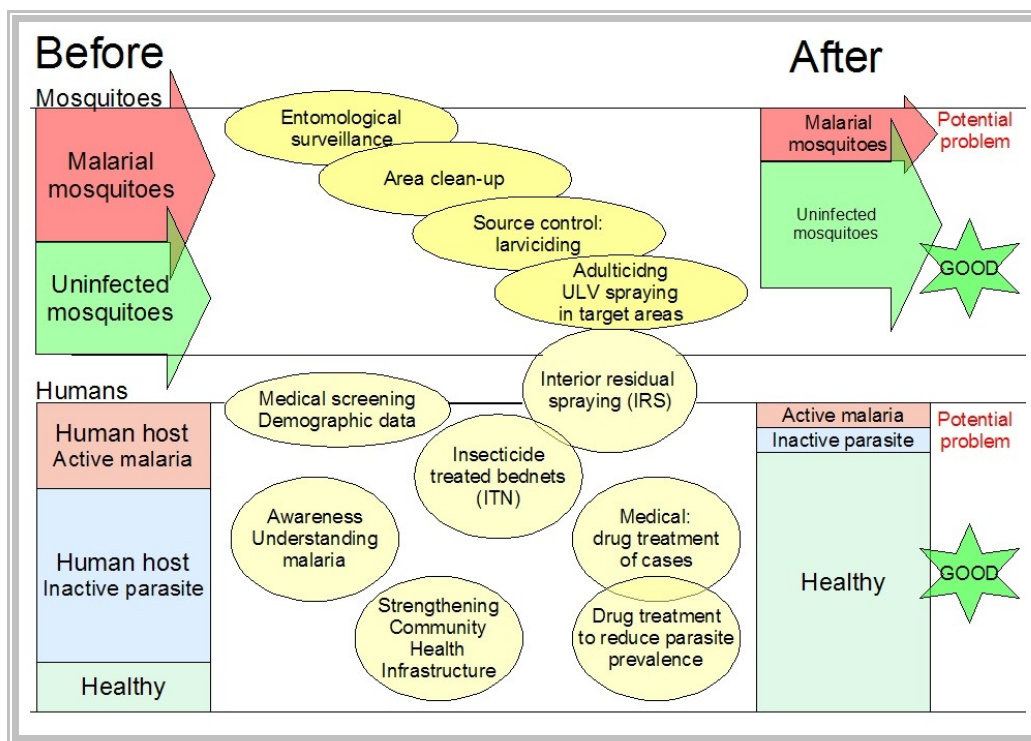
There are three key numbers within CA: (1) cost; (2) price and (3) value ... and it is cost and value that are the most important. This is in contrast to for profit analysis where cost and price are the most important, because they determine profit. CA helps to understand the cost of activities ... and whether there is cost efficiency ... as well as whether there is value impact from the activities.

In summary ... CA is a system to measure ... neutral, clear, reliable data.

“What gets measured gets done”

The IMM Technical Dimension

The IMM application of CA has data at the center of decision making ... and includes all possible mosquito and malaria control interventions. Data are the key determinant of what is done. The before and after situation should reflect change in both the mosquito population and the human population ... a reduced proportion of infected malarial mosquitoes and a reduced proportion of humans infected with the malaria parasite.



Good health translates into a reduced burden of malaria within the population. A good strategy and good decisions optimize the cost efficiency and the cost effectiveness.

An integrated program has many components ... and it is not fully understood what works best in any specific situation. What is clear, however, is that single intervention strategies are less effective, and most likely to accelerate the emergence of resistance.

What is known about the behavior of mosquitoes and the behavior of the malaria parasite suggest that there are opportunities for improved cost efficiency and cost effectiveness by optimizing activities for each specific location and using spatial and temporal data to determine performance at intervals from daily, to monthly, and to annually. Using IMM best practice (IMM-BP), it is reasonable to achieve a sustainable state much sooner than is envisioned by the WHO-GMAP.

The Benefit of IMM with CA

The benefit of IMM with CA is that there is an integrated system of metrics so that performance is continually monitored and optimized. The benefit of doing this has been demonstrated over time in every sphere of economic endeavor and will work in the health sector as well. This requires that the goal is articulated as being the reduction of the burden of malaria ... a value to the beneficiaries ... rather than merely to have disbursed funds or carried out activities.

Management using relevant data often results in performance improvement that is twice as good as it was with limited management information ... some situations it is possible for performance to be an order of magnitude better. The potential for order of magnitude improvement is probably present ... and this is objective.



IMM

Integrated Malaria Management

Section II

The Role of Community Analytics

Introduction

Community Analytics (CA)

Community Analytics (CA) is a system of data collection and analysis, based to some extent on the established techniques use in corporate accountancy and macro-economics, but with a focus on the micro-economy of the community. CA measures socio-economic performance in a comprehensive manner and serves as a system of “scorekeeping” for the community that is rigorous, easy to understand, independent and reliable.

The system of scorekeeping used in CA includes the concepts of costs and revenues that result in profit, as well as the idea of cost and value creation that result in socio-economic progress.

CA has been simplified by having a focus on the community where economic activities and their impact are easy to observe ... but CA is not simplified by the use of small surveys and advanced statistical models that derive results that may or may not reflect reality, and rarely are useful in getting actionable management information.

CA is a modular system. The focus of CA is the community and the socio-economic activities that have an impact on the community. Health is a key aspect of community well-being including the role of malaria.

CA is also an independent system that aims to operate without requiring the support of any one actor. All may participate ... but the system works even when major actors choose to remain uncooperative.

Integrated Malaria Management (IMM)

The goal is eradicating malaria and sustaining it. 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) is an approach that controls both the mosquito and the malaria parasite. This integrated approach reduces the prevalence of the malaria at least cost. Scientific data and management information makes it possible to make decisions so that the scarce available resources are used in the best possible way.

There are three components of IMM:

1. Scientific data and management information;
2. Health infrastructure, capacity building and training; and

3. Mosquito and malaria control interventions.

Health infrastructure, capacity building and training are the critical elements that make it possible for the program to be sustainable in the long run, and most cost effective in the short run.

Mosquito and malaria control interventions include the following:

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

IMM has data and its analysis for scientific purposes and management decision making at the center or the work. The history of IMM shows that timely information and decision making improves cost effectiveness in operations by an order of magnitude.

The Value of integrating CA with IMM

Integrated Malaria Management (IMM) is a process that integrates the science of medicine with the science of entomology with the operations of the health sector and community organizations. Community Analytics (CA) is a system for keeping score ... essentially independent and objective ... and committed to the idea that all economic activity should make least use of scarce resources to achieve the most socio-economic benefit.

When there is score-keeping, the playing of the game is improved ... when there are all the statistics about how well the game is being played, the players improve their individual performance, and the players work as a team. Without score-keeping, anything goes, and results are second rate or worse.

Individually, there is some very good material ... but in isolation rather little is accomplished and the impact is small. Put together, however, it is likely that the various possible interventions can be coordinated so that there is great impact ... and sustainable progress.

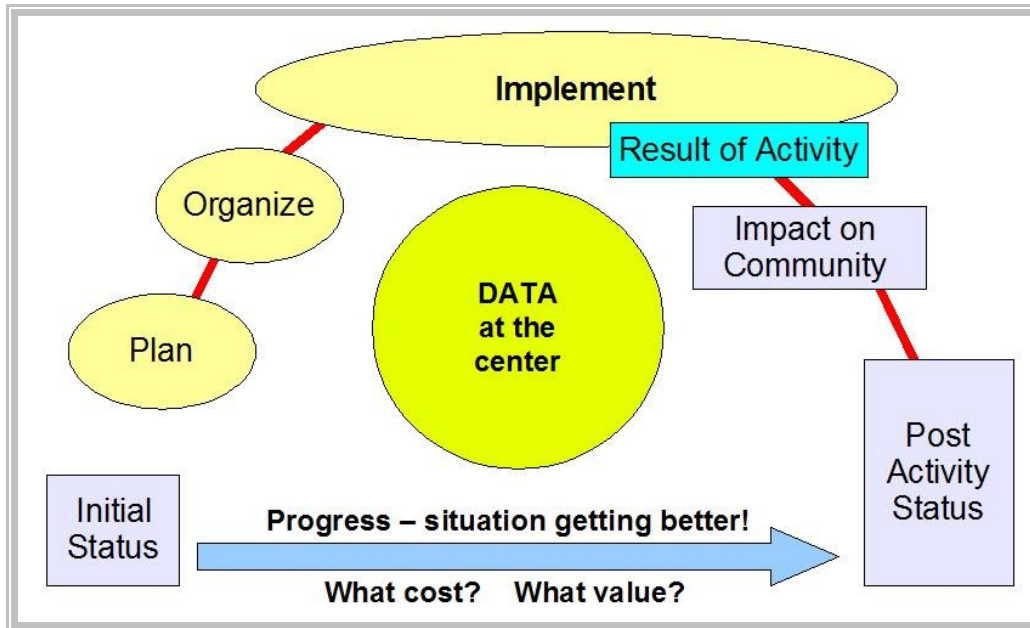
The Management Cycle

The basic management cycle

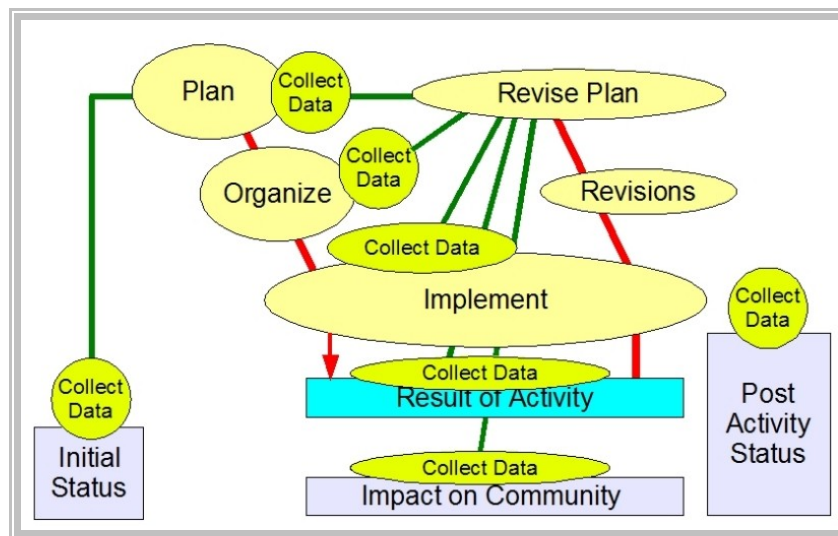
CA has data as the central focus. Data are needed to develop management information which is central to the process of management ... the management cycle.

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

This is a simple representation of the CA perspective of the management cycle.



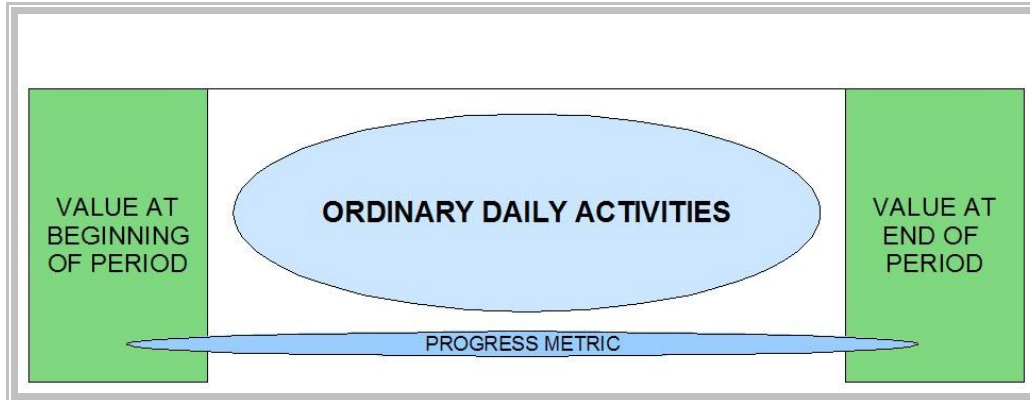
The management cycle has three elements ... repeated over and over again: (1) Collect data, do analysis; (2) plan and organize; and (3) implement ... and measure and analyze. These are reflected in the following schematic. Everything has a data component.



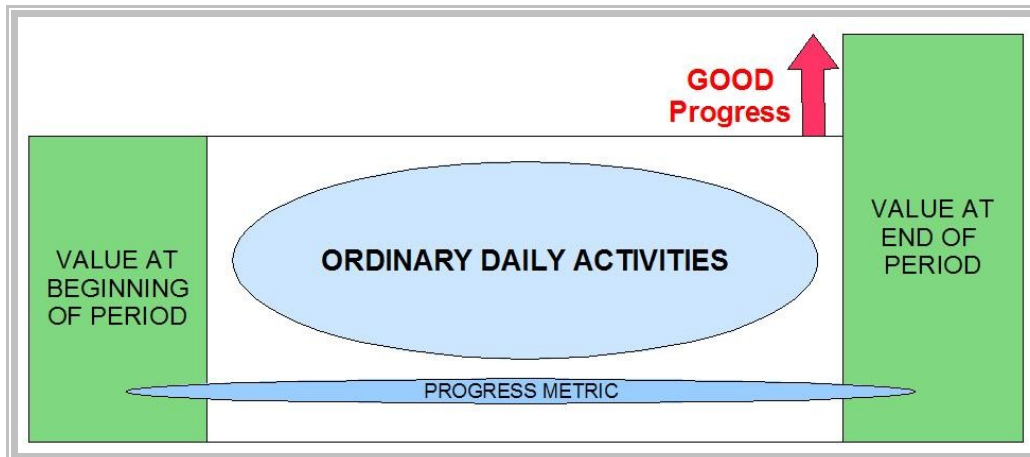
Making key metrics simple

CA's primary metric of progress is very simple. Is the community better now than it was in the past? This is not a complex idea, and there is no reason why there cannot be quick, easy and useful data about this.

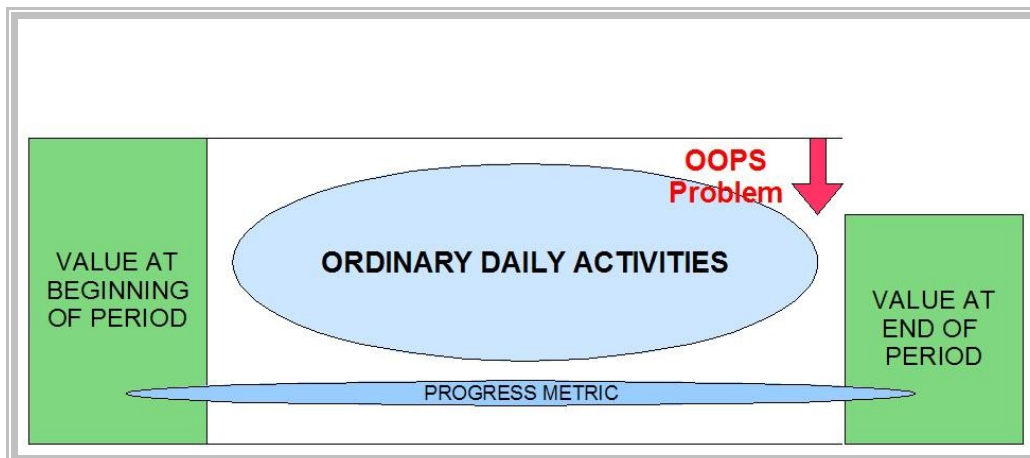
In the image below, the value of the community is the same at the end of a period as it was at the beginning ... ordinary daily activities produce what is consumed ... it is a stable situation.



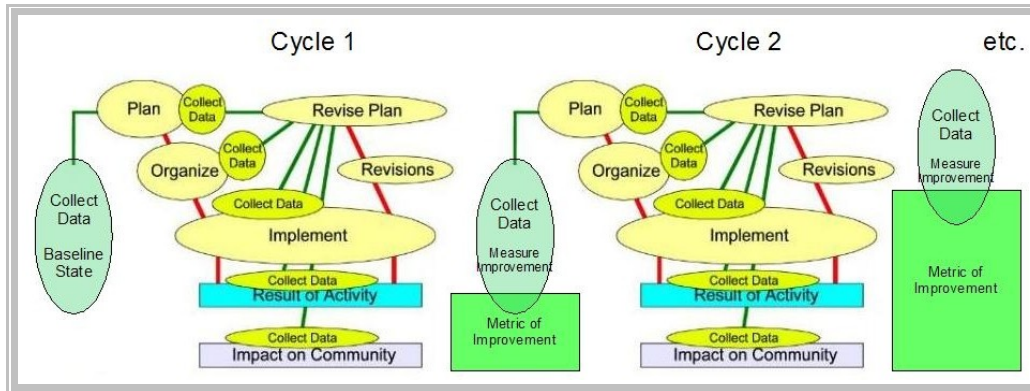
In this next case the value of the community is more at the end of a period than at the beginning of the period ... ordinary daily activities produce more than is consumed. It is progress ... it is a good situation.



In this last case the value of the community is the less at the end of a period than at the beginning of the period ... ordinary daily activities produce less than is consumed. It is a problem ... a bad situation.

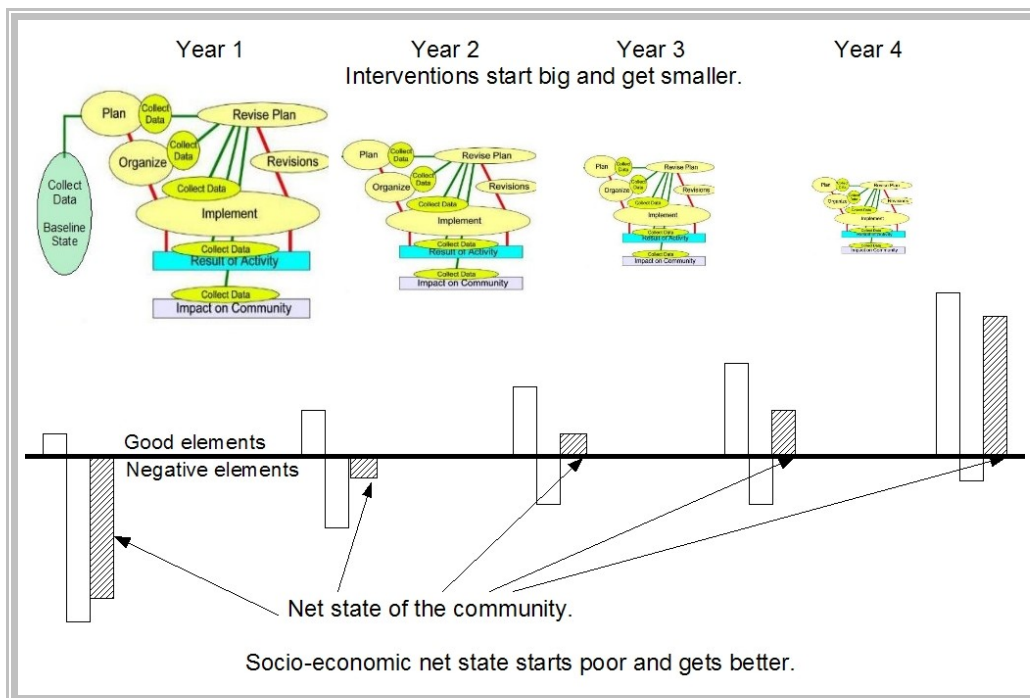


High performance programs integrate data collection, analysis, planning, action, more data collection, more planning, more action in a perpetual process.



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 the impact on the community and the constituents of the community measured as value adding.

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. The following depicts this graphically over a four year cycle. The interventions start big and get smaller while the net socio-economic state starts poor and gets better.

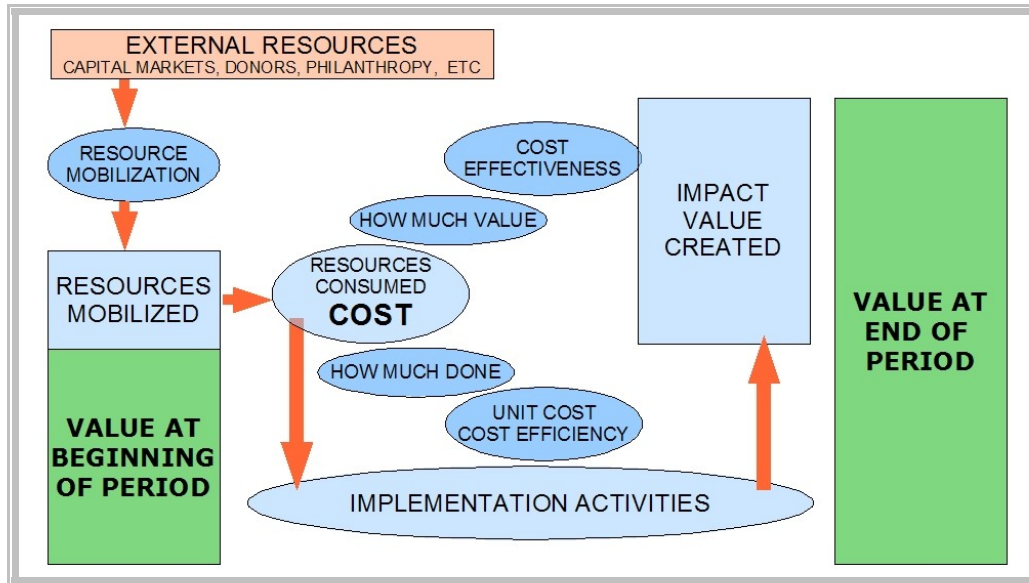


In this graphic the initial condition reflects a high level of socio-economic burden which over time diminishes, yielding socio-economic improvement. Over time the amount of activity to improve the situation and sustain the improvement diminishes.

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 ... and repay any external funding required in the initial program stages.

Measuring performance

The CA metrics measure progress, and they also measure performance. They are related, but they are not the same. This graphic shows some of what needs to be measured:



Costs: How much did it cost?

Knowing how much something costs is pretty basic. It is appalling how little data about cost is reported, and how little information about cost is understood and appreciated by people with responsible jobs. Because there is so little understand of cost ... cost gets used to justify bad practice of all sorts. Understanding cost and cost behavior is central to the CA system of metrics.

Cost efficiency ... how much should it have cost?

Cost efficiency is the simple idea of comparing the actual cost with what the cost should have been. This is a powerful way of getting control of operational performance.

What it should have cost is a technical question. The cost that it should be can be calculated based on what needs to be done and the prevailing costs. The cost in one place can be compared to costs in other places. The cost now can be compared to costs in a prior situation.

Cost effectiveness ... how much value for the cost?

Cost effectiveness is the more complex idea of relating cost to the value of the accomplishment. The idea is simple in theory, but becomes more difficult as the problems being addressed are more complex. CA uses techniques to get an overall idea of cost effectiveness, and then goes into more detail to assess the way different initiatives contribute to progress. This may require multi-variate analysis of the datasets where there are multiple interventions being used.

The core of CA metrics is the goal of having fund allocations flowing into intervention activities that are the most cost effective and deliver the most of social value. The Tr-Ac-Net/IMMC cooperation using the CA framework for performance metrics provides the basis for this to become the norm.

“What gets measured gets done”

Cost behavior

Understanding the behavior of costs is the key to making program performance optimum. Matching the behavior of cost with all the other dimensions of operational performance makes it possible to get better results than might otherwise be expected. While elementary analysis is often based on simple relationships, efficient cost accountancy shows how low costs can be matched with high impact values for best results.

Value

The measurement of value has a large subjective component ... but it is still possible to have some useful measurement. By using the concept of standard value ... a concept rather similar to standard costs ... it is possible to compare different programs and see how one program performs relative to another.

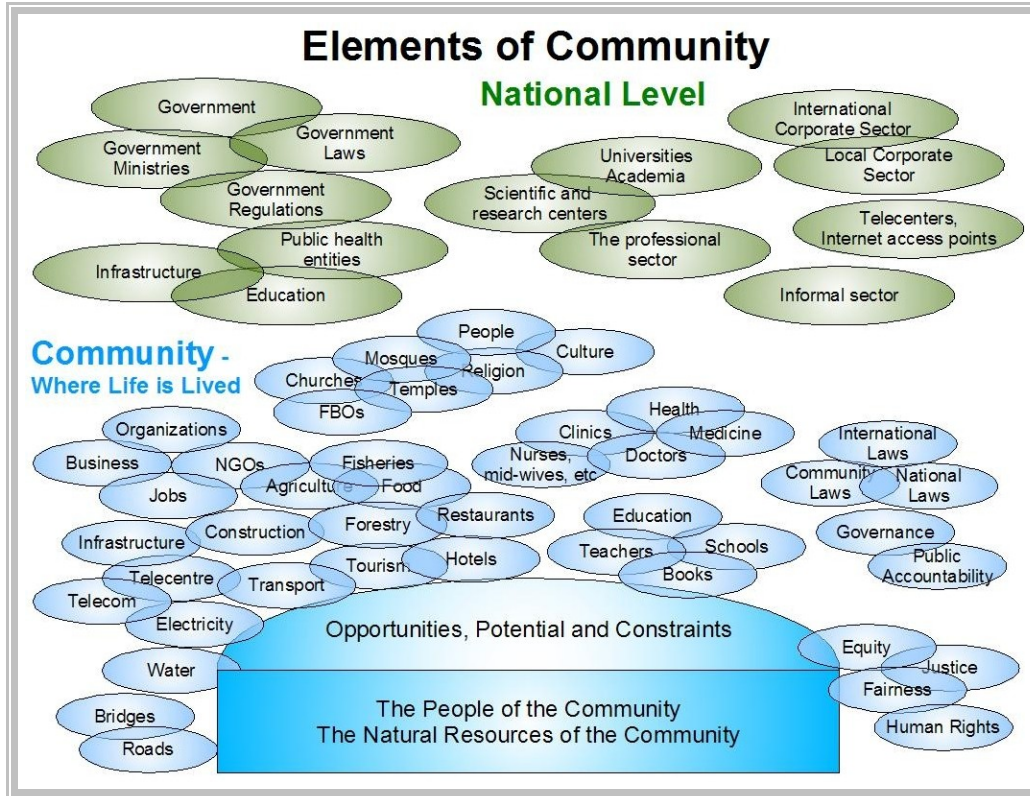
In the case of malaria control programs, the goal is to reduce mortality and morbidity. By having a table of standard values it is possible to report that one approach had more value relative to the costs than another.

The perception of value differs from place to place, and also changes over time. The changes are ongoing. Values change over time because of the evolution of society. The CA set of standard values makes it possible to start a process of understanding value perception better, and also to make value adding the goal of economic interventions.

Handling Complexity

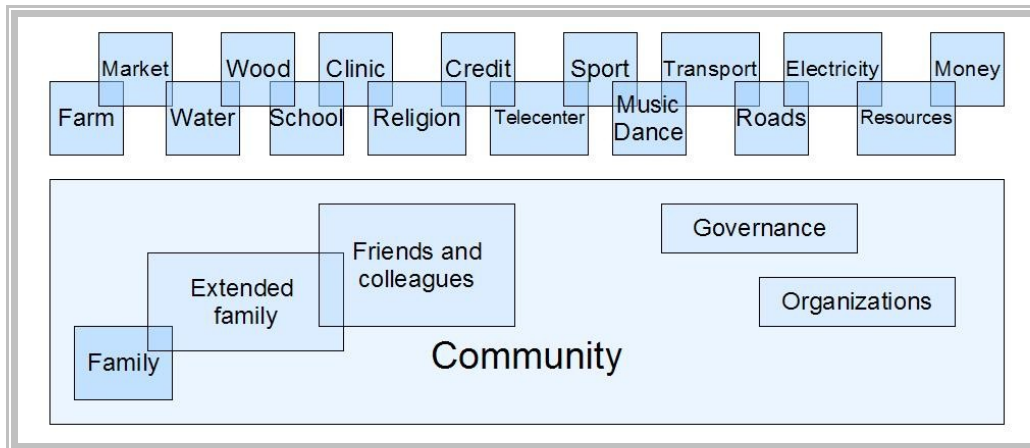
Society is very complex

The institutional framework is very complex. The following graphic shows some of this complexity ... in a very simplified manner. There is complexity at the national level and the international level (not shown) and all sorts of complex detail at the community level.



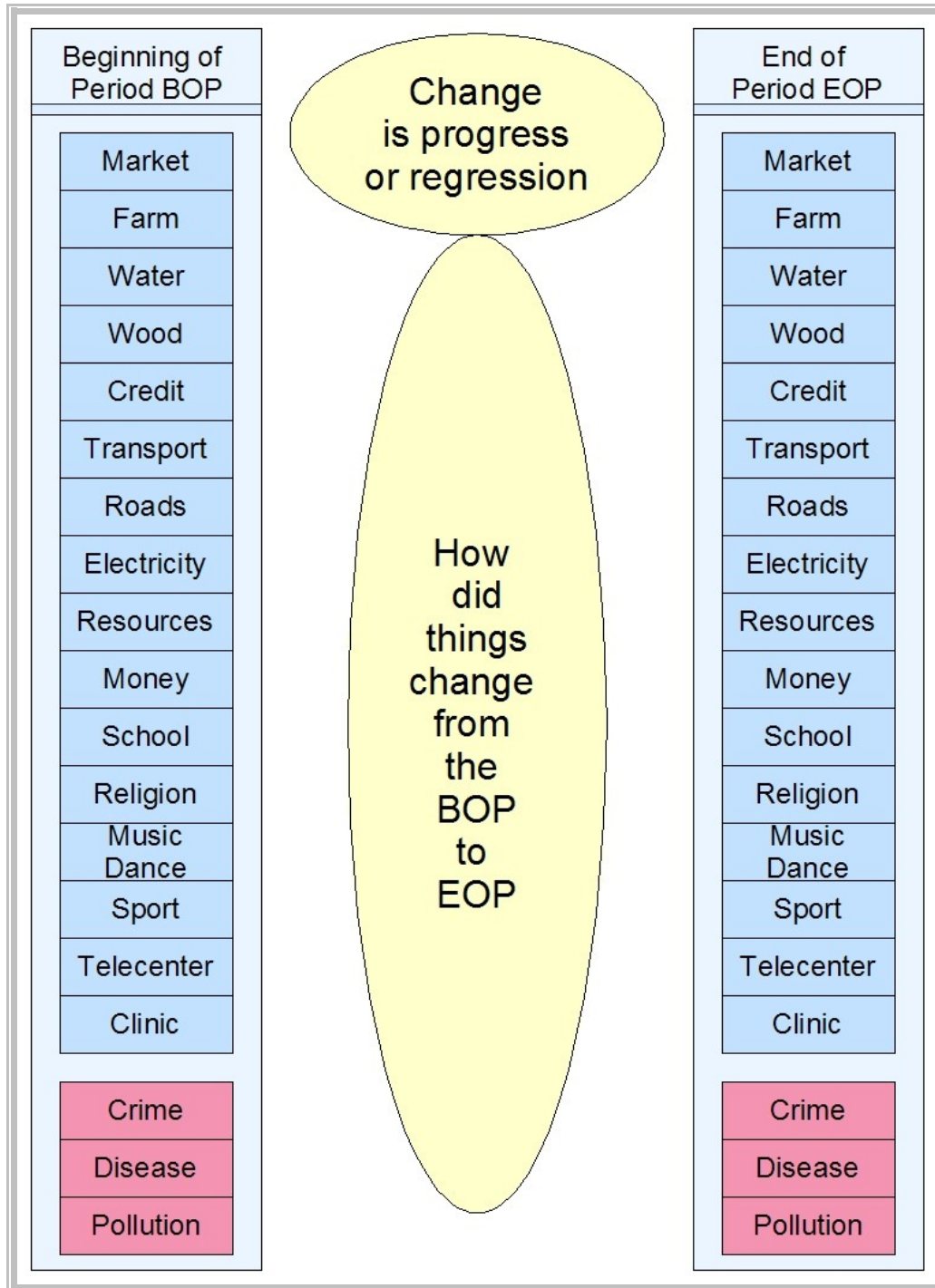
... but less so at the Community Level

The community is where people live ... and a lot easier to understand.



Even though a community is simpler ... it is still quite complex, but this complexity can be understood. Though there may be many relationships, they are relatively 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 with interest can understand. The community is where progress dynamics are easier to understand and where measurement has more clarity.

The community centric perspective produces a very different view of how activities are done, how resources are allocated and what decisions are best. Community is where there can be accountability. The community is, after all, the most important locus of life, so quality of life impact can be monitored and measured. The CA construct for measuring progress ... the changes in the socio-economic state of the community from the beginning of the period to the end ... applies to every aspect of the community along the following lines.



Progress is measured by how these many different things are getting better. Less crime, less disease, less pollution is better. More sport, more telecenters, more clinics is better. The elements are not limited to the set shown ... any item that is important can be measured in this way.

Data, Dataflows, Data Collection and Storage

Something About Data

Permanent data and transient data

Data may be characterized as either permanent data and transient data. Permanent data changes slowly, while transient data is changing all the time. For example the name of the town and its location are permanent data, while the current weather is changing all the time and is 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.

What Data are Needed

CA is a system that has community ... a place ... as the core of data collection and analysis. All the data are linked to time and place. Every fact that is going to be important in decision making about the community 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.

Program specific information

CA is a modular system. Part of the system uses data that are program specific. Program specific data is based on experience of the program, the science and the experience. 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.

Account codes ... 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.

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

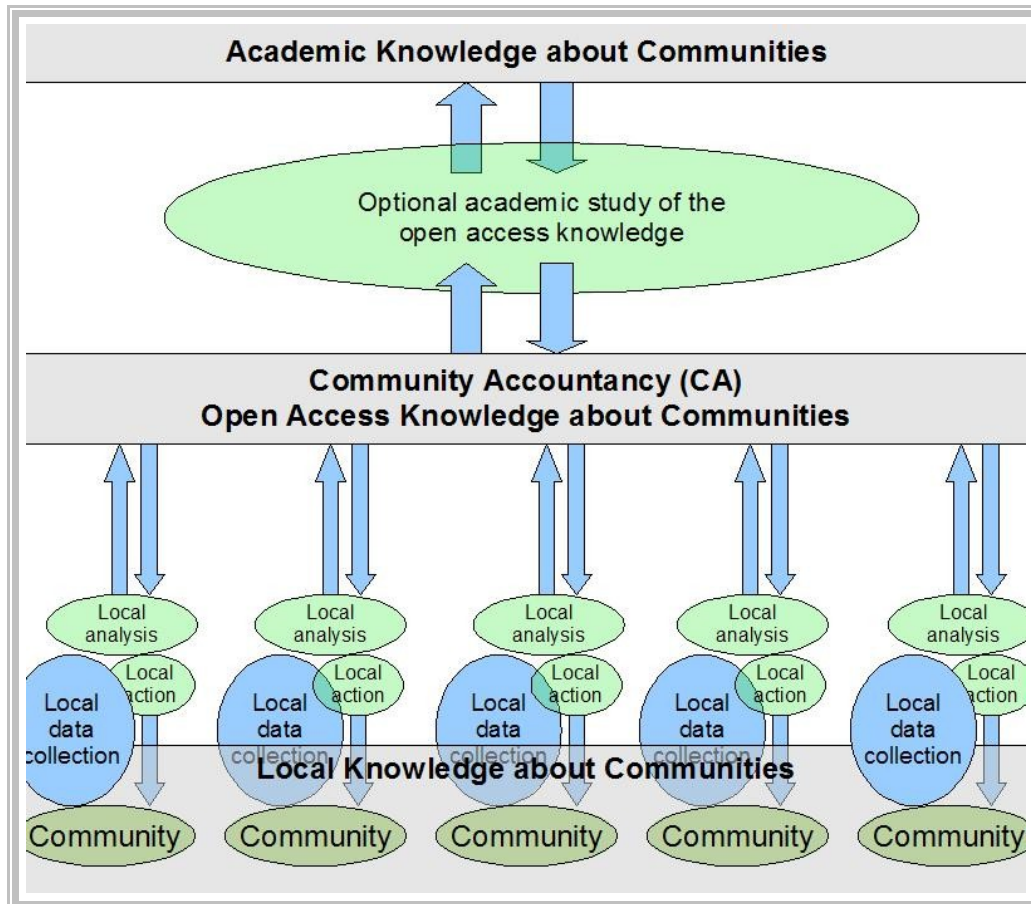
A key concept for success in the context of integrated malaria management is to have data that have meaning. The goal is not to have perfect data, but to have useful data that facilitates good decision making and helps in achieving a cost effective reduction in the burden of malaria.

Dataflows

A functional planning and operational framework needs a dataflow system and management information. Without these, it is as dysfunctional as a human being without a nervous system.

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.

The following describes in simple terms how CA data about community is collected and used. Data are most cost effective when one set of data are capable of being used in many different ways ... in this case at both the local level and the academic or scientific level.



The key goal of data collection is to have data that are useful and help improve performance.

Local data collection ... local analysis ... local action is the cycle that improves performance most directly and most quickly.

Having the data also used at a "higher" level facilitates oversight and the sort of monitoring that can be used to identify the need for corrective action by the analysis of much larger sets of data. At a higher level there can be analysis that identifies "best practice" and issues that are impossible to identify with local analysis alone.

Data Collection

Cost effectiveness of data collection

Data collection always has a cost ... but does not always have a value. Good cost effectiveness of data collection requires as low a cost to do the work as possible and only collecting data that are going to be useful.

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.

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.

Data that are used are almost always right ... data that are collected and never used are often wrong and useless

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.

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

Use of Satellite Imagery

Satellite imagery is a very powerful and cost effective way of getting an overall understand of the topography of 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.


There has been rapid development of satellite imagery over the past twenty years. There was a time when high resolution images were only accessible to military and security operations, but the technology is now being widely used for general commercial purposes at affordable prices. Initiatives like Google Earth are helping to make the use of satellite imagery an essential step in cost effective data collection.

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 powerful analytical capability of computer technology may be used to great effect.

There have been rapid changes in IT economics, and it is likely that this will continue. Mobile phones have both data and analog capabilities, and this enables both text or data transmission and image capture and transmission. It is unclear how much of these technologies can be deployed immediately, but it is clear that rapid change is happening.

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.

While satellite imagery makes it possible to accelerate learning about any location, limited, of course, to those locations where satellite imagery is available ... there is a big role for on the ground mapping. Using local staff it is possible for this to be cost effective and for the results to be excellent.

<p>Image 1</p> 	<p>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.</p> <p>Ground surveillance will confirm whether the whole of the marsh is habitat for mosquito breeding, or just limited areas.</p> <p>With good knowledge about the spatial distribution of mosquitoes and the spatial distribution of malaria in the community it is possible to plan effective interventions that can be very much lower in cost than blanket coverage and much more valuable in terms of results being achieved.</p>
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<p>Image 2</p>	<p>Image 2 shows individual houses in a section of Monrovia. Images of this sort enable plans to be made for surveillance and for interventions. The</p>
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interventions may be interior residual spraying, source control or verification that bednets are available.

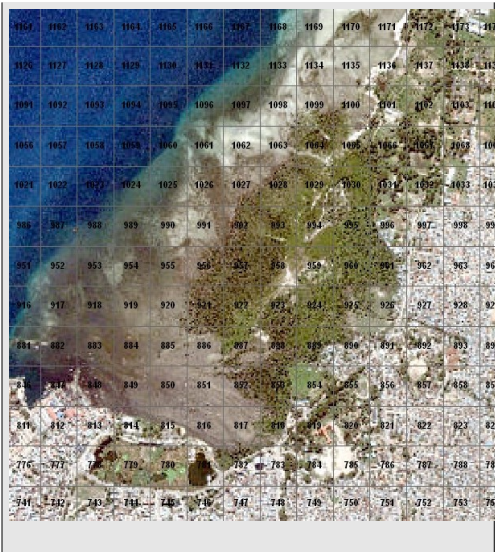
The level of malaria control activity should be based on knowledge of the community and the impact of malaria in the community.

The importance of data cannot be over-emphasized, but as well as data there is the importance of decision. The data are not an end in themselves. Data always have a cost ... but data only have value when the data are used and decisions are made. Data are part of the management process and without beneficial results the data are not doing their job.

The satellite and aerial photograph imagery is available from different places at different prices. Some imagery is available free from sources such as Google Earth ... some is available commercially from organizations like QuickBird.

<p>Image 3</p>	<p>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.</p>
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<p>Image 4</p>	<p>Image 4 is another example showing built up area and an area close by that could be a significant source of mosquitoes.</p>
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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.

A database provides the functionality that addresses the challenge of time series analysis with many variables.

Storage

Key issue

For many reasons data that are essential to transparency and accountability, and for the effective management of performance are rarely collected and easily accessible. This is one of the big issues that makes accountability impossible.

Data Analysis and Reporting

Reporting must be clear and unambiguous

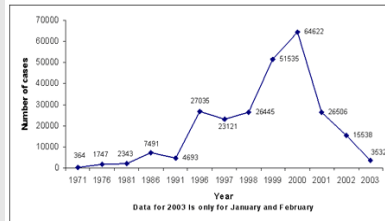
A good report is one that is clear, complete and unambiguous. The data presented in the following examples are unclear and only tell part of the story. They are constructed in a way that provides misinformation. The data must be organized so that this type of analysis is easy.

Time series

One of the most basic forms of analysis is the time series. While it is possible to do advanced statistical manipulation ... crude but simple and clear time series tables and charts work very powerfully as well.

Examples of simple time series

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.

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.

There are many different time periods that may be used. The choice depends on the natural characteristic of what is being measured.

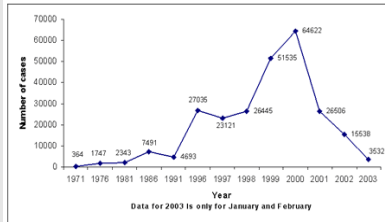
- ◆ By hour ... to show what happens at different times during a 24 hour period
- ◆ By day ... to show what happens from day to day
- ◆ By month ... to show changes month by month including seasonality
- ◆ Year on year ... to show how things progress over the longer period

Value chain

CA makes use of the idea of value chain analysis. What appears as a success, may have negative impact on other parts of a value chain.

Examples of value chain analysis

Example TO COME

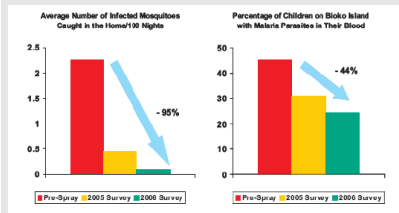


In

There are many different time periods that may be used. The choice depends on the natural

Clear but ambiguous

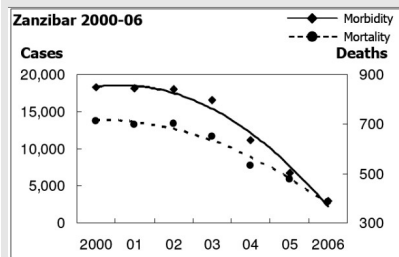
Example 1



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 2

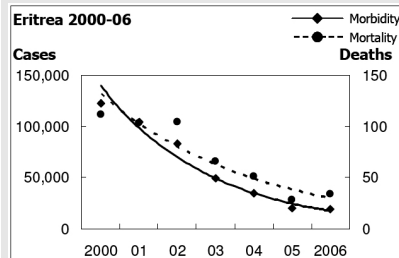


Experience in Zanzibar 2000-2006

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 3



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.

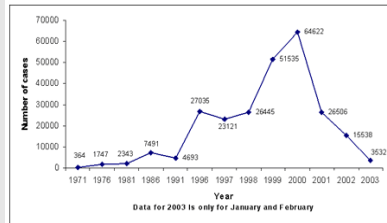
This example is a simplification that shows progress, but does not explain why or at what cost. At the national level there is progress but regionally within Eritrea there were areas that progressed well and areas that did not improve very much. Why was this? Was it because they were already malaria free, or was it because the interventions were ineffective ... important questions that should be guiding policy and program. There is no cost information included that shows cost effectiveness.

Reports must be informative

The scale of the available resources has grown substantially over the past five years. Management information and the associated reports should be showing what has worked and what has not.

Examples of interesting information

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.

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.

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.



IMM

Integrated Malaria Management

Section III

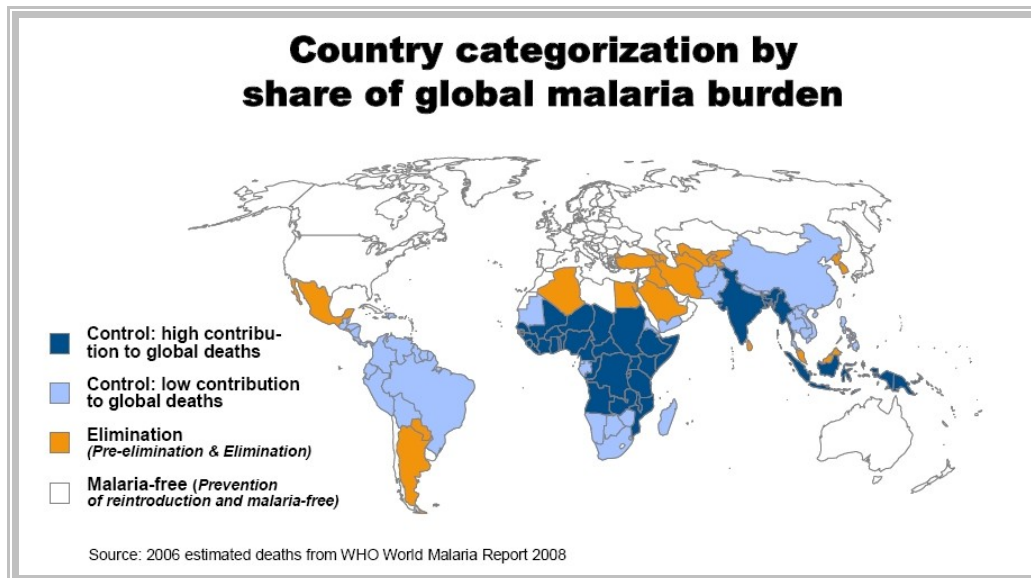
The Integrated Malaria Management Interventions

The Goal

The goal is to reduce the burden of malaria as fast as possible, as cheaply as possible and as safely as possible

Most malaria burden is in Africa

In broad terms, the distribution of malaria round the world is well known. Africa is the location for most malaria deaths, and it has also been the least served over the past several decades by malaria control programs. The following map shows the distribution of the global malaria burden.



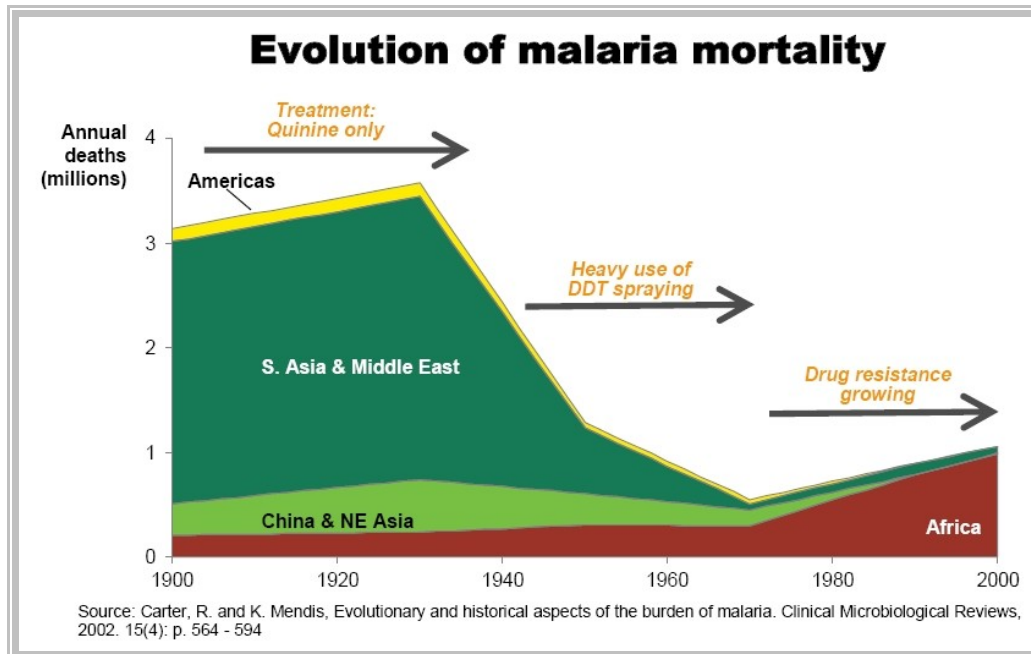
Near eradication of malaria has been done in some parts of the world, but not in Africa where it remains a major health crisis and contributes seriously to poor socio-economic performance. Much of the work done in the past in Africa has been expensive and ineffective.

Malaria is not an intractable problem

Malaria has been known since ancient times, and was prevalent not only in the tropics, but also in temperate climates. In the temperate climates of Europe the malaria burden diminished as organized agriculture spread but it was not until the early 20th century that malaria became better understood and vector control was introduced to limit the transmission of the disease. The success of Colonel Gorgas's malaria control program during the construction of the Panama Canal is well known. It comprised vector control, personal protection and treatment ... an integrated approach.

Vector control districts were established in the United States early in the 20th century because of the high prevalence of malaria in the country.

The following graphic shows how successful malaria control was in the period from 1935 to 1970 ... according to WHO-RBM that included this image in their Global Malaria Action Plan of 2008.



This summary data shows that there was great success in reducing the burden of malaria, and that, with the exception of Africa, malaria is a much lesser burden now than it was 80 years ago. These data suggest that old techniques for malaria control were very successful, and that there may be important lessons from this era.

The malaria situation in Africa is shown in the above graphic as deteriorating from 1970 to the year 2000. The trend of malaria mortality in Africa may be significantly mis-stated due to the appalling lack of reliable data. There has been an improvement in the dataflow of health information which means more mortality is reported. It is known that there has been a decrease in the effectiveness of the most widely used anti-malaria drug *chloroquine*, and malaria control interventions were underfunded ... but what this aggregate information does not show is that there have been successful programs in Africa to reduce the malaria burden in specific locations where good integrated malaria management practices have been used.

A New Era for Malaria Control

Since the year 2000, the simple media message about the malaria crisis in Africa has been that 3,000 children in Africa die every day from malaria.

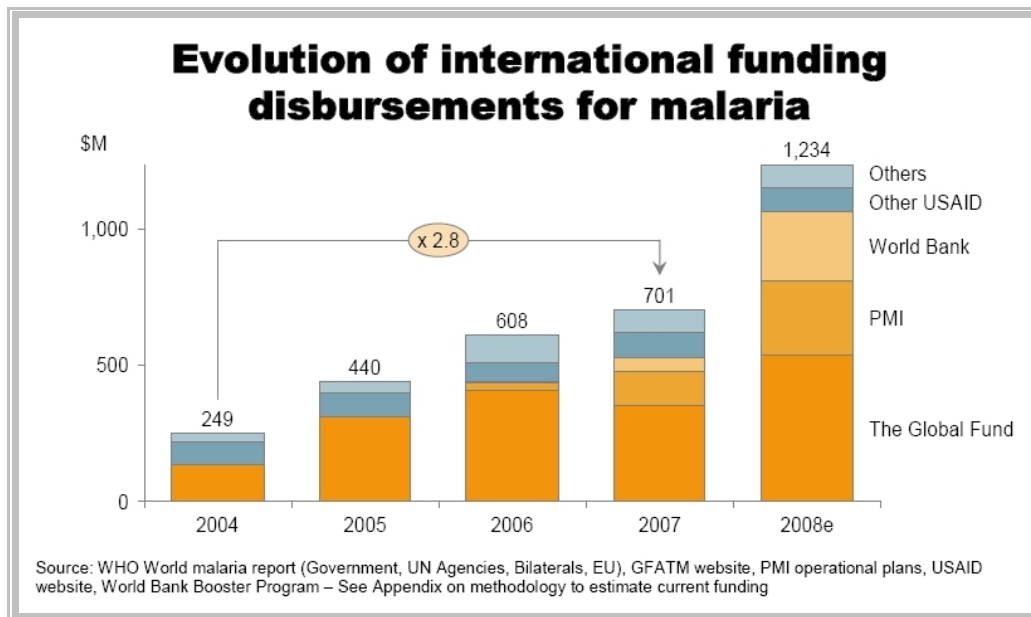
Since 2000 there has been significant media attention to the African malaria crisis, and the outcome has been very much increased international commitments of funds to fight malaria and the emergence of a new community of people and organizations engaged in various aspect of the malaria industry.

Part of the message in recent years is that there are now new technologies that make it possible for malaria to be controlled effectively. This is largely mis-information. As described above, the burden of malaria was reduced by an impressive amount in the period 1935 to 1970 and more progress was constrained because (1) there was a US initiated ban on the use of DDT, which while appropriate in agriculture was wrong for malaria health; and, (2) there was a lack of funding for malaria control in Africa with almost every government in Africa financially constrained.

Malaria control funding growth

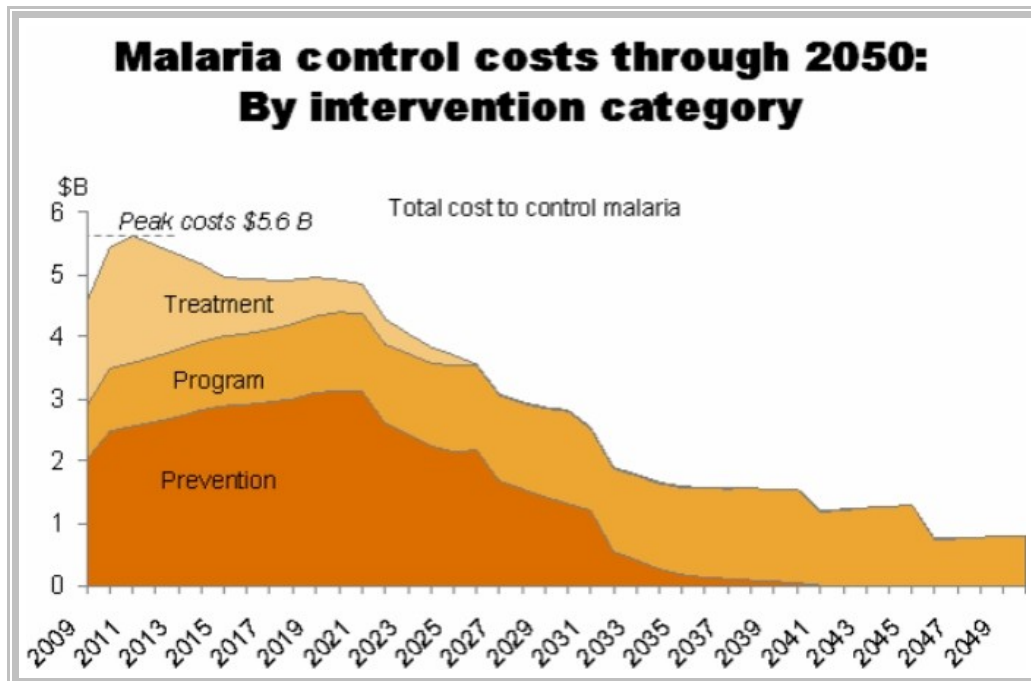
The available international funds for malaria were less than \$100 million in 2002, and the amount disbursed in 2008 is reported to have been in excess of \$1.5 billion. The reports of progress in reducing the prevalence of malaria and reducing the malaria burden are, however, inconclusive. The methodology for measuring performance and providing actionable management information is seriously flawed.

The following graphic from a WHO-RBM publication shows the expansion of the funding used for malaria over the period 2002 to 2008. The increase over this time period and the absolute size of the fund flows in 2008 are impressive.



Future cost projections

WHO experts are projecting even larger funding requirements in the future averaging around \$5 billion a year until 2020. The following is from the WHO Global Malaria Action Plan.



The WHO projection has program expenditures on malaria continuing at a rate of \$1 billion a year more or less until mid-century. An IMM strategy aims to have faster results and lower costs ... and bases this on the potential for data driven malaria interventions to be far more cost effective than the broad thematic one approach fits all strategy that was used as the basis for WHO's projections.

Managing for impact

Though the scale of the funding has increased by an impressive amount, the impact of this spending is unclear. The measurement regimes are flawed in many important ways: (1) there is a heavy reliance on small surveys; (2) there is a lack of longitudinal comparative data; (3) there are cost reports without impact, and impact reports without costs; (4) there are impact reports without adequate intervention information; and so on.

One serious issue is the use of intervention coverage as a proxy for impact. This is particularly pernicious in the case of the bednet malaria control intervention. Rather small studies made by bednet manufacturers have shown reduction in the level of malaria when bednets are used ... which is reasonable approach when a modest number of bednets have been distributed and there is a need to justify an expansion of the program. However after many millions of bednets have been distributed and there is little data that clearly show that the bednets are reducing the prevalence of malaria, there is a serious systemic problem of data collection, analysis and reporting.

Another unresolved question is that where there has been a reduction in the prevalence of malaria, the data do not show what was the cause of the reduction. In many cases where reduction in the prevalence of malaria has taken place, there have been multiple interventions. There has been enough activity that well designed data collection and analysis would have permitted multi-variate linear regression analysis that would have helped to clarify the relative effectiveness of different approaches.

We do know, for example that using all the available interventions will rapidly reduce malaria prevalence in a community ... we also know that this approach is not affordable for most places

where malaria is a problem. We do not know with 100% certainty what is the least cost way of reaching a low level of malaria burden in a society.

Admiral Ziemer, Coordinator of the President's Malaria Initiative (PMI) has said that in an emergency, it is important to act even before all the data about performance are available ... citing the example of "man-overboard" in the navy ... but he has also said that getting performance metrics is essential and appropriate in an ongoing program.

The IMM strategy puts data at the center, and organizes around what the data suggest are the best ways forward. Experience suggests that a data centric program can be substantially less costly ... much more cost effective ... than programs that make less use of detailed data for decision making.

Malaria is not like measles ... bednets are not universally needed in the way vaccinations are needed. There needs to be attention to the human, the parasite, the mosquito the habitat and the (health) infrastructure. The best results are going to be achieved when all of these elements are taken into consideration.

Science

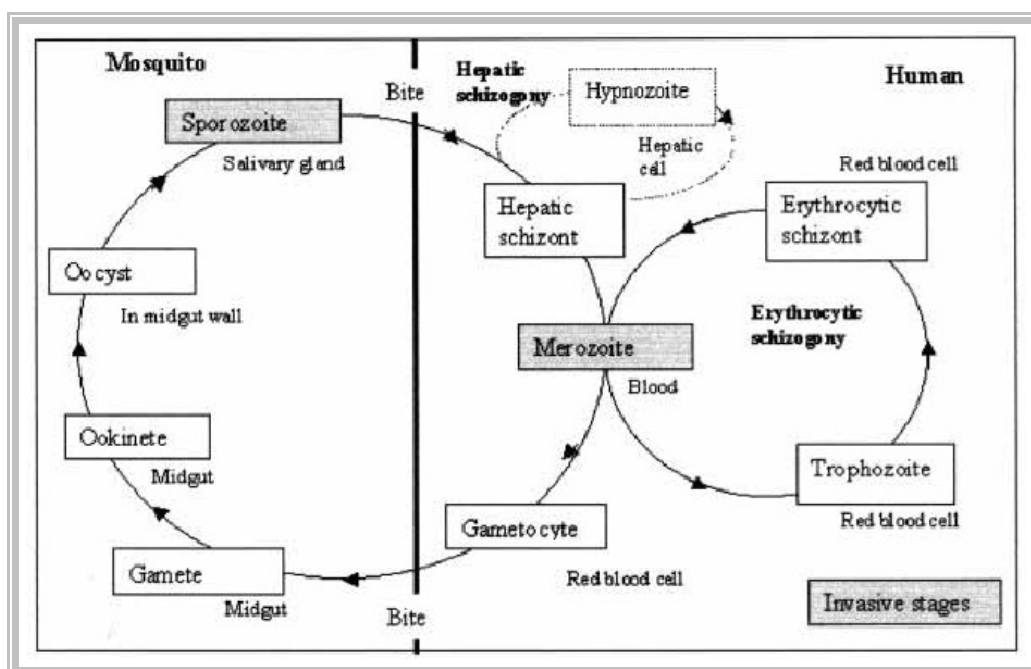
Malariology

Malara science ... malariology ... comprises many different branches of science. To achieve effective malaria control, all the relevant sciences need to be incorporated into the programs that are deployed. Science should not get in the way of management, and management should not ignore the science. Worse, scientific research should not be used as a replacement for management ... they are different functions.

The best possible progress will be made when plans and interventions are based on deep knowledge about the science involved. It is science and technology that is the underlying basis for costs and effectiveness of malaria burden reduction interventions.

The malaria parasite

There is a broad scientific knowledge about the interaction between, the mosquito, the human host and the parasite. This is a simple schematic showing the passage of the parasite through its life-cycle through the mosquito and the human host.



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

This is the process that drives the malaria crisis, and challenges the mosquito and malaria control community.

The medical science of malaria

The treatment of malaria has been possible for a long time ... quinine based formulations have been used for about a century. Over time, these formulations have become less effective because of the emergence of resistance.

New drugs have been discovered that treat malaria, including artemesin based combination therapy (ACTs). There is ongoing research to find new drugs, and to find ways to reduce the potential for resistance.

Resistance is a major concern. Resistance emerges when a drug is used over and over again and there is an incomplete cure. In the case of malaria, there may be a complete cure within the one patient, but the disease emerges again from an untreated person with malaria, and transmitted by the mosquito vector. Where there is re-infection ... eventually there will be resistance.

Vaccines have been developed for many diseases. However, up to now there has not been the development of an effective vaccine for malaria.

The presumptive treatment of malaria is commonplace in resource poor settings, and this accelerates the emergence of resistance. Effective methods for the reliable diagnosis of malaria is a way to improve treatment and reduce the risk of resistance.

Entomological science and malaria

If you manage the mosquito ... you manage malaria. Malaria is transmitted by a mosquito ... and knowing the behavior of the mosquito makes it possible to control the transmission of malaria.

The life cycle of the mosquito is well known. Less well known is exactly the behavior of the mosquito in a specific setting ... and without this it is impossible to make the best decisions about mosquito control.

Mosquito population control may be done in several ways, notably (1) by source control such as larvaciding which kills larvae; (2) by spraying that kills the adult mosquitoes while they are flying or exposed; and (3) by cleaning up the environment so that there are less breeding places. The cost effectiveness of source control depends a lot on the data that are available and the timely deployment of the control intervention in the right places at the right times.

Reducing mosquito bites also depends on knowledge of mosquito behavior. The bednet puts a barrier between the human and the mosquito making access to a blood meal more difficult. An insecticide treated bednet may be toxic to the mosquito and kill it, or it may serve to repel the mosquito. Similarly interior residual spraying (IRS) may kill the mosquito when it rests on a sprayed surface, or it may repel the mosquito so that it does not come into the house.

Pesticide chemistry

The resistance of mosquitoes to pesticides is a concern, but resistance management is not usually a part of uncoordinated malaria control programs. Good practices in the use of pesticides reduces the risk of the emergence of resistance.

It is well known that there are significant differences in the behavior of mosquitoes from place to place, but we know very little about specific places so that we can predict behavior and optimize interventions for cost effectiveness based on these data.

Behavioral science

The behavior of people should not be ignored. There is a lot that people can do to reduce their risk of contracting malaria.

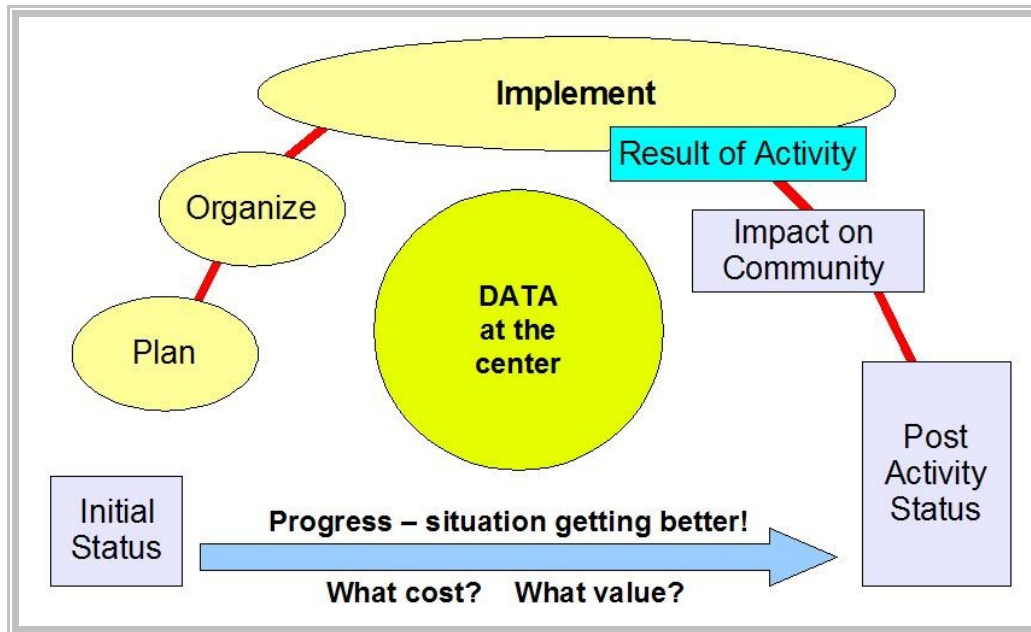
Management science

The role of data is central to success ... but cost effective availability of data requires data management systems that exploit technology and draw on ways to make the best use of data.

Managing Malaria with IMM

A data centric process

In a good system there is a continuum of metrics that inform decisions all the time. Data are at the center of everything.



The idea that data is at the center has already been described. In this sector some of the elements of the data system are described in more detail. In a previous section, the basic elements of the the science of malaria are also described.

The purpose of data is to know what is going on in this specific place and at this time. With this knowledge it is possible to plan so that what is done is both effective and efficient ... so that the most is accomplished with the least use of scarce resources.

Getting key local knowledge needs to be a high priority, and this knowledge should be at the center of what is planned.

Data may come from any source that seems credible ... and data should be validated so that the data are reliable. Data are best when they are collected in ways that are independent of any single major stakeholder.

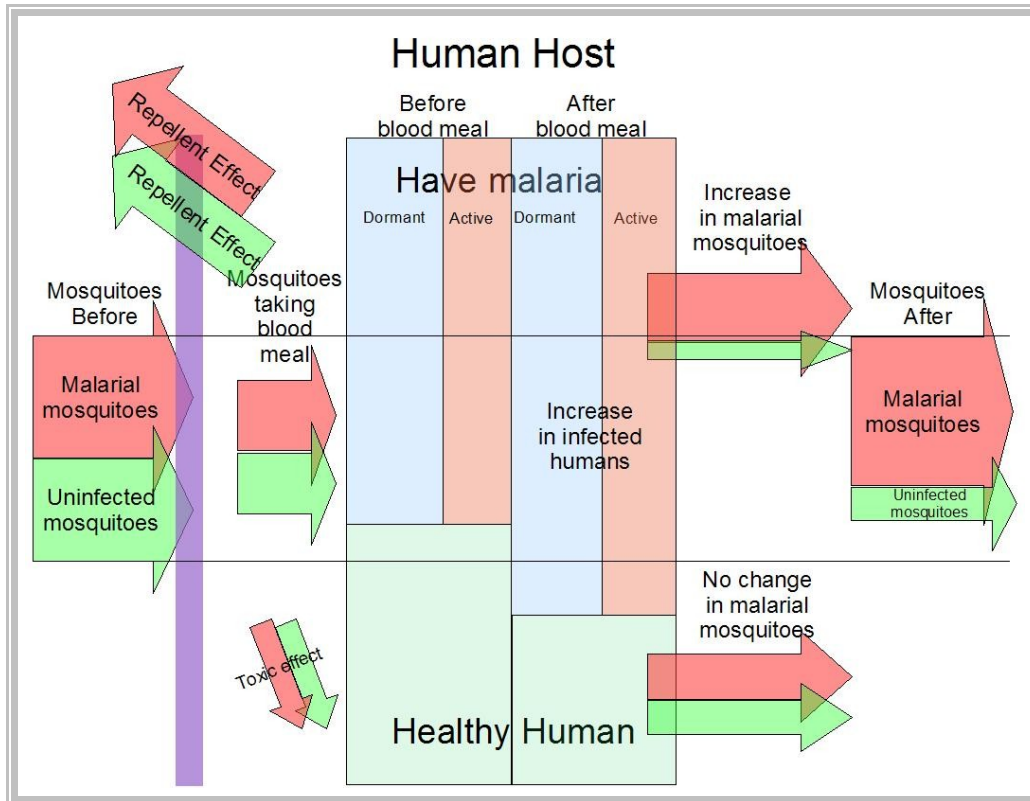
The question that the data must answer is what is best to do, and what has been achieved by doing it. Best is not simple ... it depends on the cost, and cost and impact variability ... which depends on many variables from weather and topography, to people and infrastructure and prior history of intervention.

Parasite transmission through mosquito bites

The following schematic shows the dynamic of the mosquito bite ... how it impacts the mosquito and the human host.

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.

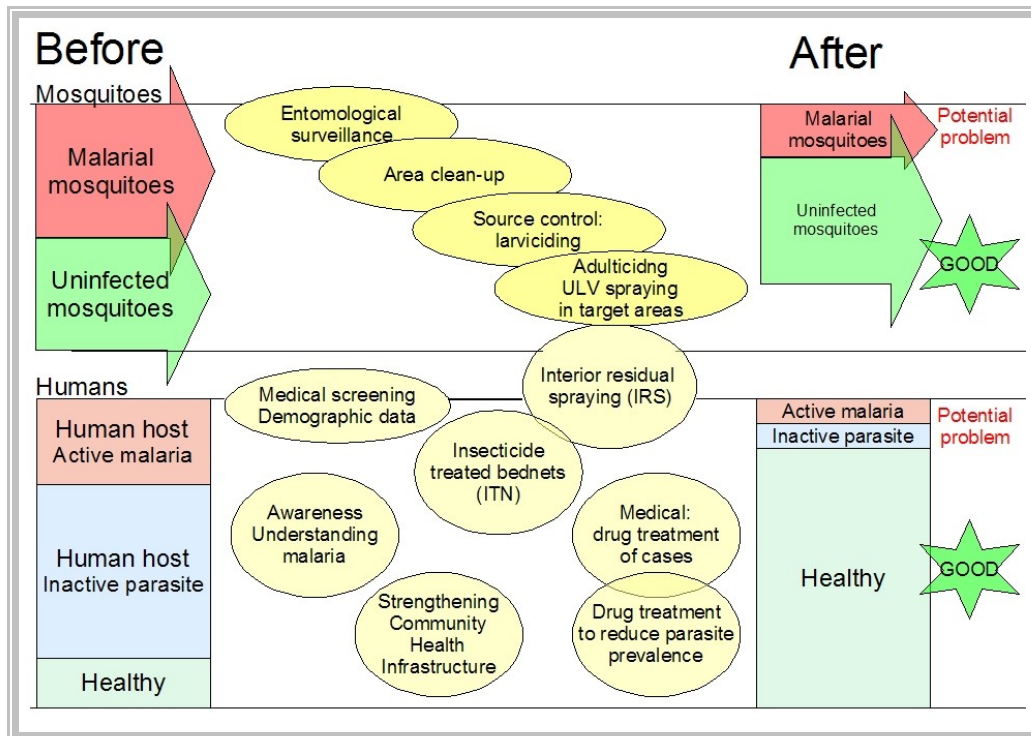


Interventions that limit contact between the mosquito and the human host reduce the number of mosquito bites and therefore the transmission of the parasite from person to mosquito and from mosquito to person.

Without intervention, in malaria endemic areas, the malaria parasite will be in a stable equilibrium at a high prevalence level in both the human host and the mosquito. The challenge is to have interventions that are efficient and cost effective.

Multiple interventions

There are many different interventions that are needed for optimum malaria control. The following graphic summarizes the various interventions involved in integrated mosquito and malaria management.



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 IMM approach.

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 various intervention respond to the complex sciences of the human, the parasite, the mosquito vector, the drug and pesticide chemistry and the habitat.

IMM includes data for management information and decision making as well as the physical interventions. These are described in the following sections grouped as follows: (1) Data; (2) Community; (3) Vector Control; (4) Medical; (5) Personal Protection; and, (6) Organization, Financing and Sustainability.

Data

The section about data highlights the importance of data in the CA and IMM framework. Data drives decisions and the expansion of scientific knowledge ... and performance. Data are ubiquitous and used to inform about everything: (1) the community; (2) spatial information about malariology; (3) entomology ... surveillance; (4) medical ... screening; (5) weather and the role of water; (6) performance ... cost and value; and, (7) research. The methods include use of satellite imagery.

Community

CA and IMM are community centric. This is because data have the most value when there is practical use and clarity ... and where the "rubber hits the road". Local control and coordination makes for accountable decision making and high performance. At the community level awareness about malaria can be built and education about malaria encouraged. Access to health

care comes from the strengthening of the health infrastructure at the community level ... clinics, organizations, human capital (staff).

Vector Control

Vector control was central to malaria control success in the past, and is a central part of the IMM strategy. There are many elements including: (1) Community Clean Up; (2) Source Control ... Larvaciding; (3) Mosquito Control – ULV Adulticiding; and, (4) Interior Residual Spraying (IRS)

Medical

There are two ways in which the medical dimension reduces the burden of malaria: (1) case management for active malaria; and, (2) therapy to reduce the parasite prevalence

Personal Protection

Personal protection using bednets (ITNs) has been the most popular of anti-malaria interventions in recent years. Other techniques for personal protection are used to reduce exposure to mosquito bites.

Organization, Financing and Sustainability

Organization, financing and sustainability are inter-connected and an important determinant of the way a program will succeed over the long run.

Research

Research is needed so that issues like resistance can be addressed in the future both in the medical area and for vector control. It may also be possible for research investment to come up with an effective vaccine.

Data

Data: About the community

CA aims to put into the record everything that is important for the progress of the community. The first set of data are about the state of the community and what can be learned about progress from an understanding of the changes in the state over time.

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 progress.

Information about everything has both these characteristics. The first step should be to get information that is easy ... usually this is information about the state, and how the state has been changing over time. Information about activities is usually more difficult, and especially to get all the data that are needed. The following are some of the many data elements that are of potential interest and value.

Identification of the community	<p>There is a need to know some basic information about the community:</p> <ol style="list-style-type: none"> 1. Name of the community? 2. Where is it? 3. What is it like?
Where is it?	<p>There are several ways to specify the location of a community</p> <ol style="list-style-type: none"> 1. GPS coordinates 2. Distance from three or more key places such as area towns
What is it like?	Physical geography
Population demographics	<ol style="list-style-type: none"> 1 What age profile; 2 What sex mix; 3 What socio-economic profile; 4 What educational profile; 5 What skills profile; 6 What health profile.
About economic activities:	<ol style="list-style-type: none"> 1 What agriculture, fisheries and forestry (jobs); <ol style="list-style-type: none"> 1. Crops 2. Livestock 3. Fisheries 4. Lumber, fuel wood 2 What industry (jobs); 3 What services (jobs) 4 What trade and commerce 5 What tourism 6 What culture, entertainment, sports, etc.

What organizations are in the area;	1	Government offices
	2	Local private businesses
	3	Businesses from other places
	4	Local NGOs
	5	International NGOs
	6	Religious organizations
	7	Political organizations

What are the economic activities;	1	Agriculture and fisheries
	2	Post harvest processing
	3	Manufacturing
	4	Construction
	5	Transport
	6	Warehousing, wholesale
	7	Small business ... retail
	8	Etc.

About people	1	Who are key people in the community leadership
	2	Who are people in activity leadership
	3	Who are external friends of the community
	4	Who are international friends of the community

About health	1	Patients
	2	Staff
	3	Supplies

About education	1	Students
	2	Teachers
	3	Supplies

About infrastructure:	1	Housing;
	2	Transport ... roads, etc.
	3	Health ... clinics, hospitals, etc.
	4	Education ... schools, etc
	5	Water
	6	Sanitation
	7	Electricity
	8	Telecom

About resources	1	Minerals
	2	Energy

	3	Timber ... forest products
	4	Agricultural land
	5	Fisheries
	6	Tourist destinations

About governance	1	Government admin
	2	Security ... crime
	3	Police
	4	Prisons

About issues	1	Jobs and economic activities
	2	Security, crime, etc.
	3	Everything else that is material

About constraints	1	Everything else that is material
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About potential	Possibilities and potential	
	1.	What is possible; and,
	2.	What is not.
	How can resources be best used ;	
	1.	Natural resources
	2.	Human resources
	3.	Organizations
	4.	Know-how
	About constraints;	
	1.	Financial;
	2.	Organizational;
	3.	Knowledge;
	4.	Politics, Governance;
	5.	Etc.

Data: Spatial information about malariology ... entomological surveillance

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 considered 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.

Mapping critical issues	There is a need to know a lot about: <ol style="list-style-type: none"> 1. About the weather; <ol style="list-style-type: none"> 1. About impact on mosquito population 2. About where people live, work and travel to <ol style="list-style-type: none"> 1. About the burden of malaria and where it is
Mapping prevalence of parasite in people	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,
Mapping sources	Where are the sources of mosquitoes,
Mapping the mosquito population (Traps)	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,
Mapping infected mosquitoes (traps plus analysis)	Where are infected mosquitoes located,
Mapping intervention activities	What mosquito and malaria control interventions have been done: when and where.
Mapping results of malaria control	An intervention is undertaken today ... such as larvaciding or adulticiding ... and there should be an impact by tomorrow that

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.

Entomological surveillance is used to get data about mosquitoes, the mosquito behavior and the mosquito habitat. A large mosquito population is always a nuisance ... but it is only a danger for malaria when there is also the presence of malaria parasites.




Entomological data can be characterized as easy data that serve to indicate population, and easy issues to identify ... for example, presence of eggs and larvae in water bodies, etc. while more difficult and complex work is needed to identify the prevalence of parasite in the mosquito population.


The data related to mosquito population and the habitat change very rapidly ... and at critical times, the data change from day to day ... even hourly!


Surveillance data identifies the 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 results 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.

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.

		<p>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.</p> <ul style="list-style-type: none"> ◆ Where are the sources of mosquitoes?
		<p>What is the stage of the life-cycle:</p> <ul style="list-style-type: none"> ◆ Are eggs, larvae, pupae present;
		<p>Using window traps to collect mosquitoes:</p> <ul style="list-style-type: none"> ◆ How many; ◆ What species; ◆ What sex; ◆ What parasite status.

	<p>Information about mosquito population is needed to</p> <ol style="list-style-type: none"> 1. plan control interventions 2. determine the success of the intervention <p>The information needs to be time and place specific.</p> <p>If an intervention works, that is good ... but if the intervention does not work, then there needs to be rapid remedial action.</p>
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	<p>Lab capacity is needed so that there can be a level of understanding that goes beyond just the quantities of the malaria population but into all aspects of the state of this population, especially the prevalence of the malaria parasite.</p>
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Data ... medical screening

The diagnosis of malaria is important. All fever is not malaria ... and data about malaria is often based on an assumption that fever is malaria. The correct diagnosis of malaria will help to treat malaria better ... not to mention reducing the problem of resistance.


Medical screening is broader in scope. The prevalence of malaria parasite in the human host population is a critical determinant of the transmission process. With data about this, work on malaria control can be focused where there prevalence of malaria parasite is the highest.

<p>Where and what and when? Mapping</p>	<p>With spatial data, it is likely that it will be 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.</p>
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	<p>Field survey ... collecting data Absolutely critical to get data about what is happening on the ground. With data there can be analysis, and with analysis understanding and good decisions to ensure the most cost effective results. But the need for surveys of this type should be minimized by having a strong local health infrastructure that knows the health issues of the local population</p>
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	<p>In most places the population would welcome better clinics. A clinic is only as good as the staff and the treatment facilities and supplies. There is a challenge of affordability ... most poor people cannot afford the cost of treatment. At the same time, there is usually insufficient budget for free service to all. This is the dangerous dynamic that results in an exponential deterioration of health in poor communities. Data are needed to show what cost effectiveness improvement is likely as a result of the build-out of good health infrastructure to communities.</p>
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		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.
		In addition, data must also be collected to show what is happening among the population that have not come to the clinic.

		<p>The question of mis-diagnosis must be addressed.</p> <p>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.</p>
		<p>Rapid diagnostic tests (RDTs) are one way to test for malaria ... but most RDTs do not identify malaria in young children. Probably best to build up the capacity to do more blood smears and microscopy.</p>

Data: Performance ... cost and operational efficiency

In most cases the aim of cost analysis is to compute the total cost of an activity, the unit cost, and to see whether the costs are in line with what was expected and adequately efficient.

Total cost?
How many?
Unit cost?
Standard cost?

The source data for cost analysis should be an accounting system ... but many accounting systems do not easily produce cost analysis that is useful. In these situations, costs have to be developed from all available information.

Sometimes ... perhaps often ... the available data does not allow actual costs to be computed. In these circumstances it is possible to estimate costs using the standard cost and the quantity of the activity. It is often possible to validate this computed number by reference to some cost indicators that are available from other sources.

Cost accounting is a missing link

There is a dire lack of good cost accounting. Even though computer based accounting systems are commonplace, they are rarely being used to develop data that may be the foundation for cost analysis and reporting.

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.

The key information needed includes things like:

1. Where?
2. What?
3. When ... data and time?
4. Amount?

What is the interesting data that describes the transaction or activity.

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.

People costs

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.

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.

Consultants

Consultants are often employed instead of salaried staff. People costs should be adjusted to reflect this where needed.

Benefits

In some situations the benefits accruing to staff are significant and should therefore be taken into consideration when computing costs

Salary scales

In many situations the salary scales that apply to different groups of staff are very different. This makes cost analysis difficult ... but it also is an important issue that needs to be considered in planning and developing a strategy for sustainability.

International pay scales are very much higher than local pay scales. This may be justified by the idea that international staff are better trained and have more experience ... but this justification may not always be valid.

Equipment

Supplies

General expenses

Operating overhead

Data: Performance ... impact, value and cost effectiveness

Impact	<p>A key goal of malaria control programs is to reduce the burden of malaria. The burden of malaria takes many forms including:</p> <ul style="list-style-type: none">◆ Mortality◆ Morbidity◆ The opportunity cost of lost work◆ The cost of treatment <p>Another goal is sustainability ... to establish a situation where the malaria burden is low and the cost of maintaining a low burden is affordable. This is achieved when:</p> <ul style="list-style-type: none">◆ Parasite prevalence in the human host is low◆ Parasite prevalence in the mosquito populations is low
Value	<p>Value is subjective ... but also important</p>
CA uses standard values	<p>Standard values are a way for complex questions of value to be simplified and a dialog to be ongoing to move value questions towards consensus.</p> <p>CA uses a standard value list for a specific place and time to reflect the best consensus of values so far achieved.</p>
Caveat	<p>Where mortality is being valued ... the money values are potentially huge. This is a fact that justifies expenditure on humanitarian grounds ... but also is used to justify sloppy expensive practices that may have value justification, but do not have optimum cost efficiency.</p>
Cost effectiveness	<p>Cost effectiveness is the relationship between cost and value. While a high value makes cost effectiveness look good ... low cost for high value makes cost effectiveness look even better.</p>
Standards	<p>Standards are a way for cost effectiveness to be better judged.</p>
Scale of activity	<p>The scale of an activity is not a measure of impact ... merely a measure of how much has been done, and not about whether or not this has had any impact, or created any value</p>

Coverage of bednets

Coverage of bednets is a measure of how much bednet distribution has taken place ... but is not a measure of how much malaria burden has been reduced.

Gaging impact

The goal is to reduce the burden of malaria at least cost and with a potential for sustainability.

1. The science tells us that parasite prevalence is a key factor in transmission rates and therefore reinfection rates. Accordingly, progress in reducing prevalence rates in both the human host and the mosquito should be a metric.
2. Reduction in mortality is another key metric ... with care taken to identify malaria correctly as a cause of death.

Time series

Collecting data that makes it possible to plot time series is a very useful exercise ... progress may be tracked over time, by day, by month and by year ... and relative to last year.

Standard values

CA uses standard values as an indicator of the value of elements of progress. The elements of progress include mortality ... which ought to have high value in computing performance and cost effectiveness, but might not, because death is so very close all the time!

Caveat

It is a common practice to use various proxies for performance and impact. This is bad practice, and serves to create perverse incentives. Examples are:

1. World Bank using disbursement as a measure of project progress ... maybe, but cost overruns never identified until it is too late;
2. Bednet programs using coverage as a measure of success ... maybe, but the assumptions are too many and multiple variables are ignored.

Management

Organizing, Financing and Sustainability

Health infrastructure

Medical treatment is more effective when the treatment is given soon after the onset of the symptoms. This requires an adequate health infrastructure that is easily accessible to the local population, and access that is affordable. It is difficult to show the impact of not having health infrastructure when much of the dataflow about health originates at health facilities ... but the CA dataflow addresses this as much as possible.

Organizing

Organizing	A framework of organization is critical to success. Economic history shows that competition is usually more efficient than a system where all the functions are concentrated in one organization. Many different organizational models are possible. The CA/IMM collaboration allows for any organizational form to be used ... and for performance metrics to be used in any operational framework.
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Sustainability

Sustainability	Low cost helps with sustainability, as does high benefit. A strategy that embraces local organization, local staff and local implementation has the basis for sustainability.
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Malaria Control District

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Decoupling data and operations

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Financing and sustainability

Financing

Financing was very limited for several decades, and malaria in Africa was neglected. For the time being there is more funding and it becomes possible to have more comprehensive programs ... but resources are still scarce.

Financing is unlikely to be available from international sources for ever, and local financing of malaria control must be planned.

Management: Strategic oversight

Management: Local control and coordination

Management: Local control and coordination

Do control and coordination at the local level.	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.
Local information is the best information	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
Local coordination	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.

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.

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.

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.

The same organization works in any area where there is a need to control insect vectors

Community: Awareness about malaria

The community can do a lot for itself ... but only when there is knowledge and awareness about malaria and mosquitoes.

Prerequisite for Success

Malaria eradication is unlikely to be achieved until there is an understanding of how malaria is transmitted, and some simple knowledge about the life cycle of the mosquito.

Learning is a long term process. While some learning can take place very quickly, there is other learning that takes a generation to take hold. Education is critical ... but not done in a vacuum. People need to learn about malaria and mosquitoes ... and have an awareness of how malaria and mosquitoes and the environment all play together to create the crisis of malaria ... and how there can be progress to reduce the prevalence of malarial disease.

It costs a lot of money to do training programs with expatriate trainers ... but it should be possible for awareness of malaria and the value of environmental clean up to be communicated by local people at relatively low cost. This information should be everywhere.

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.

It is important to have 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.

Teaching about malaria	Increased awareness of mosquitoes and their role in the transmission of malaria, and the importance of treatment is very important. The community needs to be aware:
What it is that causes malaria.	<ol style="list-style-type: none">1. about how malaria is transmitted2. 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, and7. about how malaria can be treated.
How to protect against malaria	With better understanding 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.
How the malaria interventions work	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.

Community: Education


<p>Teaching about malaria</p> <p>What it is that causes malaria.</p> <p>How to protect against malaria</p> <p>How the malaria interventions work</p>		<p>The differentiation between awareness and education is that awareness applies to everyone, while education for this purpose is more associated with more formal initiatives to encourage the children to learn about malaria, and for more experts to learn about the issues of malaria.</p> <p>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:</p> <ol style="list-style-type: none"> 8. About how malaria is transmitted 9. about ways to control the mosquito population, 10. about how to use bednets to reduce incidence of malaria, 11. about the ways to keep mosquitoes away from the house, 12. about the advantages of interior residual spraying, 13. about how to recognize the symptoms of malaria, and 14. about how malaria can be treated. <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>

Health infrastructure: Community access

Medical treatment is more effective when the treatment is given soon after the onset of the symptoms. This requires an adequate health infrastructure that is easily accessible to the local population, and access that is affordable. It is difficult to show the impact of not having health infrastructure when much of the dataflow about health originates at health facilities ... but the CA dataflow addresses this as much as possible.

EXPAND

Buildings and equipment

Examples	Description
	<p>Health 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> <p>Government budget</p> <p>Donor funding</p> <p>Physical facilities</p> <p>Drugs and Medical Supplies</p>

Health infrastructure: Organizations

Organizations

Coordination	<p>When there are many organizations, it is usual for the authorities to ask for more coordination. This is never easy, and much of the process of coordination has form but no substance.</p> <p>The IMM approach to coordination is pragmatic ... if the community benefits, then coordination is adequate ... and this is most easily observed at the community level.</p>
Single disease interventions	<p>Many organizations have a single disease focus. In some ways this is a good way to organize, but it limits health benefit from the perspective of people and families who live in underserved locations around the world who, more than anything else, need access to health care for themselves and their families that treats all common ailments of the area.</p> <p>While malaria is the focus of the IMM initiative ... the clinics and community health centers should be encouraged to have staff, equipment and supplies that are able to treat a wide range of ailments.</p>
Community focus	<p>IMMC approaches the challenge of physical infrastructure and material supplies from the community focus.</p>
What there is ...	<p>The baseline information is about what facilities and resources are actually available in the community or nearby to service the community.</p>
What is needed ...	<p>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.</p>
What is needed for all health issues	<p>The IMM 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.</p>
Long term value for the community	<p>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.</p>

Ministry of health

The Ministry of Health (MoH) is the apex organization within the health sector. The limiting factor for its activities is usually the lack of an adequate budget for all the programs needed.

Universities

Universities are training staff, though less than are needed to satisfy the need for trained health personnel. The shortage of staff is aggravated by trained staff migrating out of the country where they have been trained mainly because staff salaries are low.

Hospitals

There are not enough hospitals ... and where there are physical facilities there are staff shortages, equipment shortages and medical supply (including drug) shortages.

MoH clinics

There are not enough clinics run under the auspices of the MoH and offering low cost or free treatment to patients. Access to medical services is limited by both the

NGO clinics

Clinics run by NGOs are of varying quality ... some are very good.

Health infrastructure: Human capital

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.

Staff remuneration is a serious matter. There must be the right balance between incentive to work well and having an affordable cost that can be sustainable.

Training

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.

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.

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.

Training ... to make
the human resource
productive and
valuable

Training ... the basics

Training ... to do work
that needs to be done

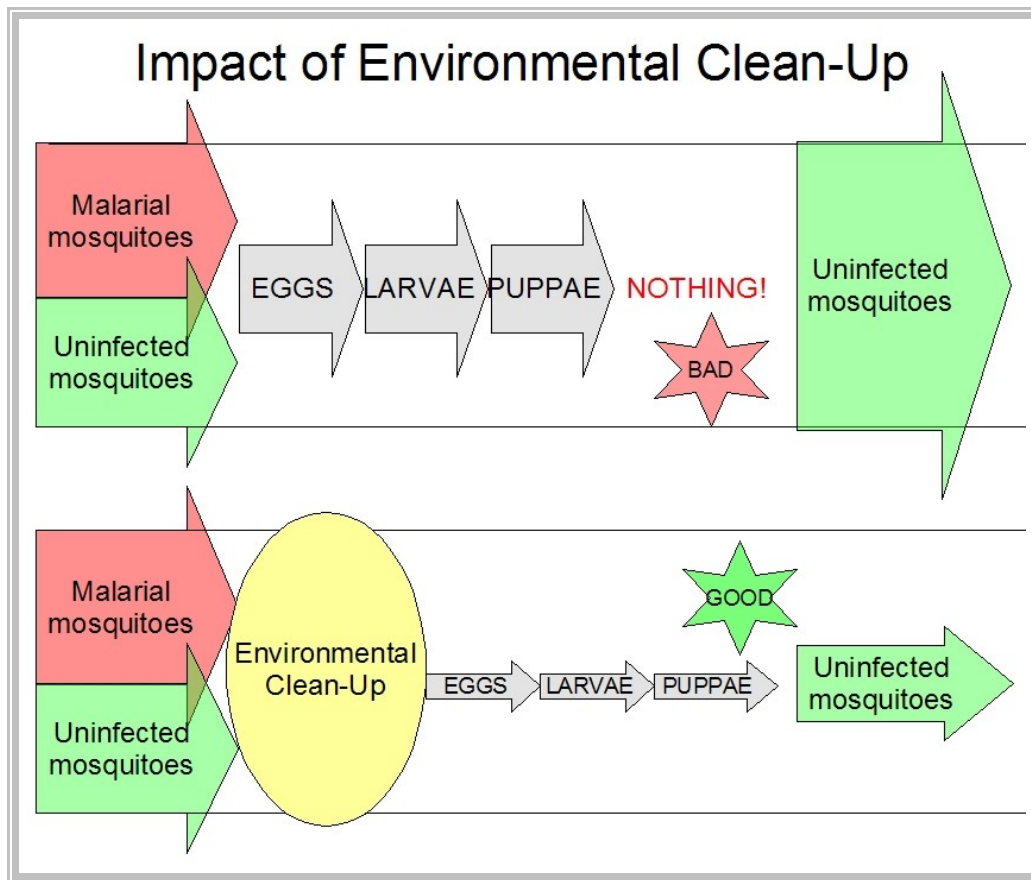
Training ... the
continuing process

Training the trainers

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.

Vector Control: Community clean up

The malaria population can be very favorably impacted by environmental clean up. The following schematic shows how the population of mosquitoes can be substantially reduced by active clean up of the area.



Mosquito populations increase very rapidly when environmental conditions are favorable. Reducing the breeding places makes a big difference. Female mosquitoes need places to lay their eggs, and the further away these sites are from the human source of blood meals, the better.

Many of the sources of mosquitoes are man made. Construction works that do not include adequate drainage are perfect places to hold stagnant water and be breeding places for mosquitoes.

The role of environmental clean up in the history of malaria control is significant. Cleaning up swamps near population centers reduced insect borne disease in Europe, and the agricultural revolution cleaned up land as well as producing food.

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

Weather conditions

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

Size of control area

applications.

A mosquito abatement area must be large enough to encompass the sources of mosquito vectors and pests it is to manage. 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.

Old buckets



Discarded tires



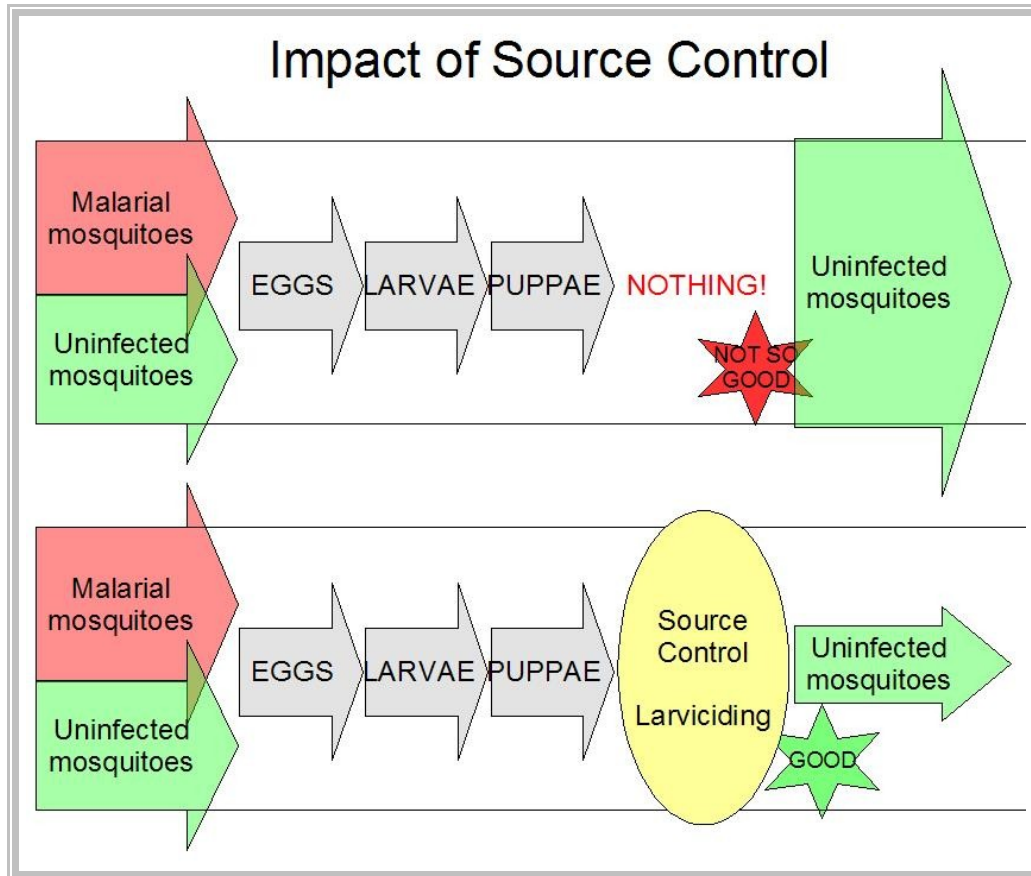
Man made structures
IMAGE

Water barrels



Vector Control: Source control ... larviciding

Source control can reduce the malaria population efficiently. With no source control the mosquito population stabilizes at a level that is governed by general environmental considerations. In humid tropical areas, mosquito populations increase very rapidly whenever environmental conditions are favorable. The following schematic shows how the population of mosquitoes can be substantially reduced by active source control.



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.

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 to predict vector population and behavior.

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. The elimination of slow moving or stagnant water during dry periods has a very important impact on the wet season population. Because of this it is critical to locate and manage all water filled harborages that provide sustainable habitats during these times and eliminate these "seed populations" that are the sources for the high 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.

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 control is accurate knowledge of where the sources are located and the stage of development of the larvae population.

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.

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.

Larvaciding



Larvaciding



About Bti

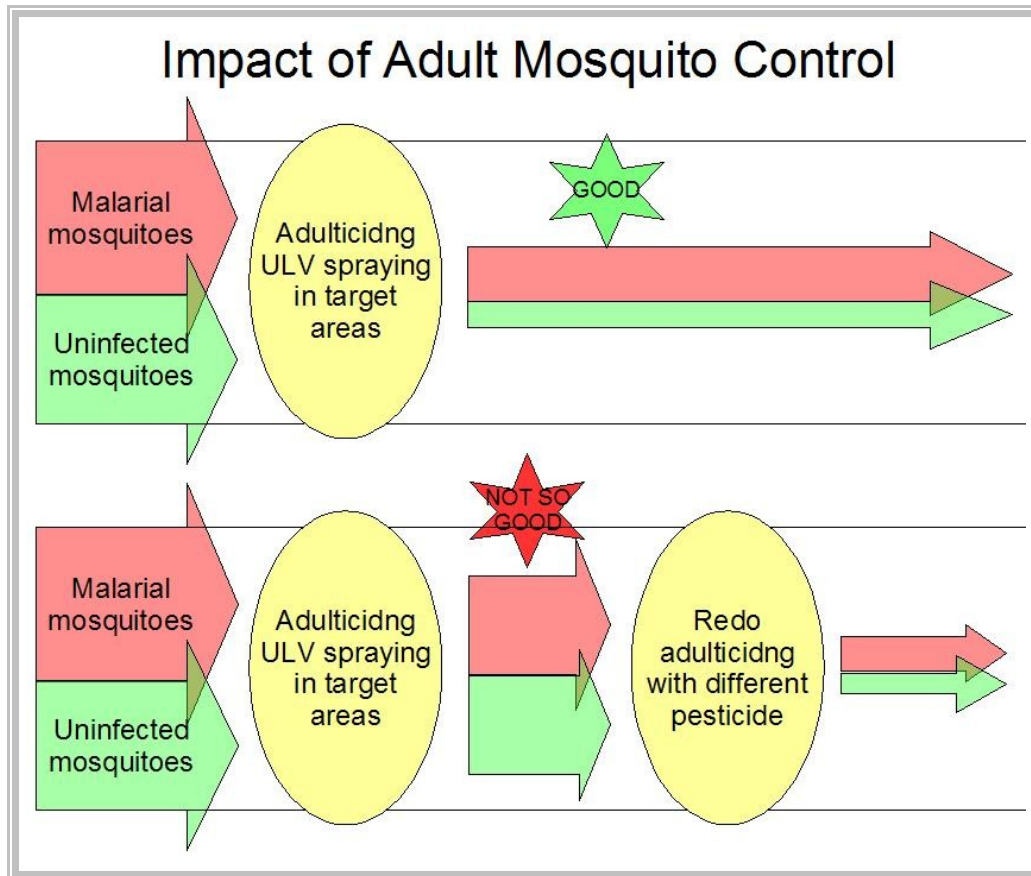
Bti is a biological agent that is very effective as a larvicide.

There is the potential to make Bti locally with guidance from people with expertise in the work. The active agent must be prepared according to a strict protocol, but the medium for the dispersion of the larvicide may be built up using any form of suitable local material that is available.

Vector Control: ULV aduictiding

When there is an abundance of adult mosquitoes, the use of aduictiding will reduce the mosquito population. This has been a central intervention in the USA, though it is not being used to any extent in the current Africa malaria crisis.

The following shows two situations. In the first case the aduictiding 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.



The cost and intermediate result of aduictiding suggests that this should be a significant part of integrated malaria control interventions.


On its own aduictiding 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. However, the use of aduictiding might accelerate the impact of other interventions, specifically medical treatment of active cases and source control of the mosquito population.


While mosquito population control is best controlled at the larval stage before they fly and disperse, modern ultra-low volume (ULV) spray technology makes it cost effective to control flying mosquitoes. 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. Chemicals such as Dibrom are used extensively in the United States for mosquito and vector control

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.

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.

Examples	Description
<p>Manual fogging</p> 	<p>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>

Examples	Description
<p>Aerial application</p> 	<p>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>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.</p>
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Vector Control: Interior Residual Spraying (IRS)

Both bednets and interior residual spraying (IRS) are personal protection interventions that aim to reduce the number of mosquito bites and thus, the transmission of malaria.

IRS and bednets operate by having a repellent effect and a toxic effect. In addition the bednet provides a physical barrier to keep mosquitoes away from the person.

According to studies, bednets and IRS have a community impact that goes beyond the individual benefit when there is a high coverage of bednets or IRS in the community. These studies show that this is very much more pronounced in the case of IRS than for bednets.

Whether there are any behavior change in the mosquito as a result of these personal protection interventions is not known though it is likely that there will be substantial changes if the availability of easy blood meals is constrained.



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.

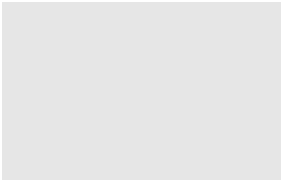
If the mosquito does bite and gorges itself on a blood meal and alights on the treated surfaces, the toxic action will kill the mosquito and stop onward transmission of the parasite.



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.

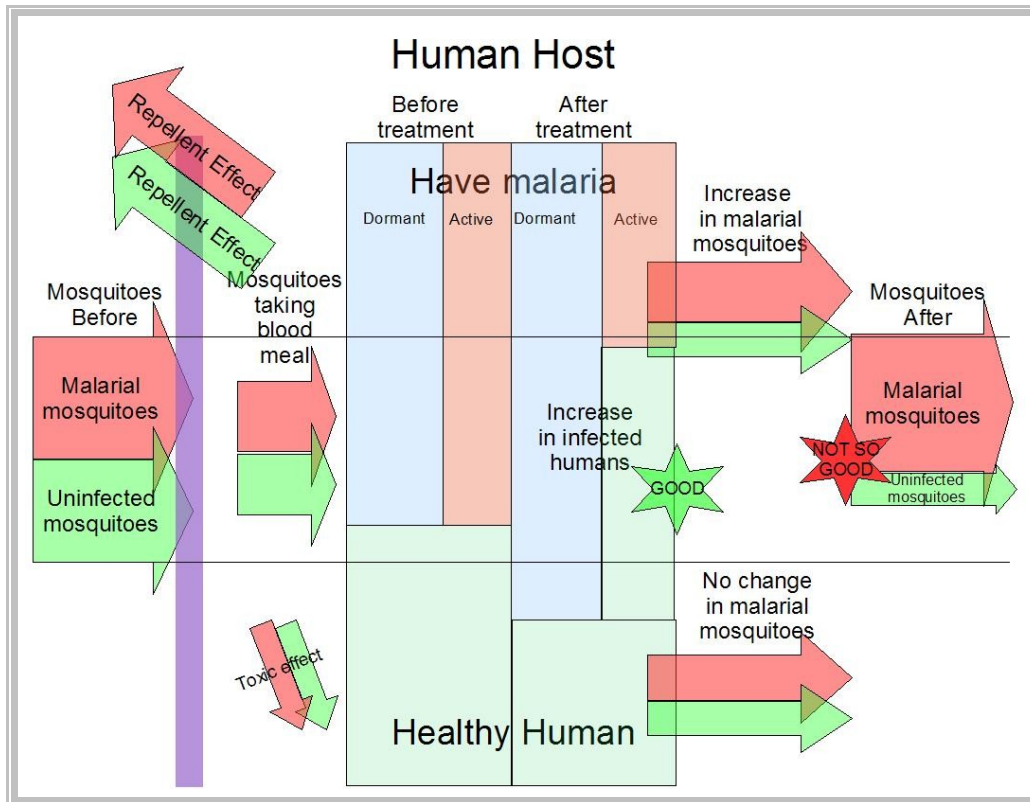


IRS should, of course, be conducted with trained personnel who know and practice safety. The environment should be monitored to confirm that there is no undesirable environmental impact.

Medical: Case management for active malaria

The impact of case treatment on the human host in a malarial setting is to reduce the burden of malaria by reducing morbidity and mortality. It also serves to reduce the prevalence of the malaria parasite in the human host.


While the treatment of every case of malaria has a beneficial impact on the immediate morbidity and mortality, it does not address the reinfection problem directly. 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 benefit.

Example	Description
Drugs	<p>Quinine, Chloroquine - 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> <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>

Example	Description
Drug resistance	Drug therapy is increasingly compromised by resistance to the low cost drugs like Chloroquine and more recently Fansidar. As long as there is endemic malaria and massive reinfection, medical treatment as a standalone curative treatment cannot be expected to produce sustainable progress. 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.

Example	Description
	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. 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.
High risk groups: (1) Young children (2) Pregnant women	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.
	

Medical: Treatment to reduce parasite prevalence

The prevalence of parasite in the human host is a factor in the reinfection cycle. By reducing the prevalence of the parasite in the human host, there is a lower risk of the blood meal adding to the population of infected mosquitoes. This helps.

Part of an integrated program includes medical screening so that people carrying the parasite can be treated and the parasite eliminated.

Screening



Screening is needed to identify where the malaria parasite is the most prevalent.

Screening ... diagnosis of malaria and the identification of the parasite in the subject may be done using rapid diagnosis tests or by using blood smears and microscopy. The latter is preferable but requires some basic equipment and trained staff.

Parasite prevalence in the human host

Drug therapy is used 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.

Long term strategy for sustainability

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.

Darwin, Australia

In situations where malaria is endemic, but locally eradicated, as in Darwin, Australia, all possible interventions to control the spread of malaria from an infected visitor are used. 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. This approach has been ongoing since 1962 with success.

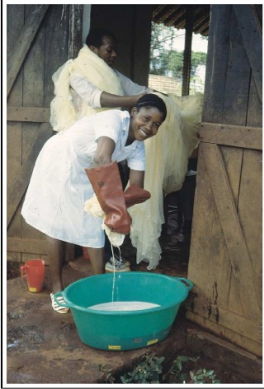

Personal Protection: Insecticide Treated Bednets (ITN)


Both bednets and interior residual spraying (IRS) are personal protection interventions that aim to reduce the number of mosquito bites and thus, the transmission of malaria.

IRS and bednets operate by having a repellent effect and a toxic effect. In addition the bednet provides a physical barrier to keep mosquitoes away from the person.

According to studies, bednets and IRS have a community impact that goes beyond the individual benefit when there is a high coverage of bednets or IRS in the community. These studies show that this is very much more pronounced in the case of IRS than for bednets.

Whether there are any behavior change in the mosquito as a result of these personal protection interventions is not known though it is likely that there will be substantial changes if the availability of easy blood meals is constrained.

Example	Description
 <p data-bbox="246 1062 508 1102"><small>Figure 1. The nets from all houses in a Tanzanian village are given their annual required dose of chemicals by a nurse from the health centre. Photograph taken by T.J. Wilkes.</small></p>	<p data-bbox="586 674 1373 737">A standard bednets needs to be retreated from time to time with insecticide</p>
	<p data-bbox="586 1123 1373 1220">Bednets only work when they are used. There are many anecdotes about the use of bednets for almost everything except as a mosquito barrier.</p> <p data-bbox="586 1234 1203 1266">Here are staff demonstrating how the bednet is used.</p>

Example	Description
	<p data-bbox="586 1451 1373 1547">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 data-bbox="586 1581 1373 1803">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 data-bbox="586 1837 1373 1934">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</p>

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.

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.

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.

Protection derived from using insecticide treated panels

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.

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.

Research

Research ... Intervention Optimization

What works?		<p>Research is needed to help determine what works and what does not. There is a lot known ... and we should use data to choose what seems to be best intervention in the prevailing local circumstances based on what we already know.</p> <p>But we should also be doing advanced multivariate analysis to help us to predict what might be the best set of interventions in any specific circumstance in the future.</p>
		<p>The data collected to manage local malaria control activities may be used more than once. After immediate use to determine plans for today and tomorrow, the data may also be used for advanced study within a comprehensive academic data store.</p>

Research ... Vaccine Research



Research ... Drug Research



Research ... Pesticide Research



Research ... Mosquito Biology



Analysis and Reports

Setting Up Monthly Summaries for Time Series

Data at the household level

Simply put, the data at the lowest level will start to inform decision makes in a useful way.

At the family or household level, the critical information is: (1) What was done, and when; and (2) what have been the results.

This is a sample of the data table that could be used.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Number of people in the household													
Number of adults (F)													
Number of adults (M)													
Number of children													
Bednets acquired this month (quantity)													
Number that used a bednet every night this month													
House was treated with interior residual spraying this month													
Adult cases of malaria this month													
Adults that got treatment for malaria this month													
Children cases of malaria this month													
Children that got treatment for malaria this month													
Number of clinic visits this month													
Deaths in the household this month													

The specific questions might vary for clarification. The aim is to have a simple time series that serves to show what is happening in the household in respect of malaria interventions (bednets and IRS)

Data at a clinic

Data at a clinic is different. These data are about those that come to the clinic, which is a subset of all the population. These data also start to inform decision makes in a useful way.

The aim of these data is to show the malaria case activity in the clinic, the treatments and the outcomes. By summarizing by month it is possible to have a view of the trend over time.

This is a sample of the data table that could be used. This is at a summary level by month. The data is recorded daily, summarized for the week ... and then summarized for the month.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Total number of people presenting at the clinic													
Of which malaria cases													
Of which adult (M)													
Of which adult (F)													
Of which pregnant													
Of which age 5-16													
Of which age < 5													
Malaria - no treatment													
Malaria treatment A													
Malaria treatment B													
Malaria treatment C													
Malaria hospitalization													
Malaria death at clinic													
Malaria death elsewhere													

The data detail may be different ... the aim is to get an indicator of the scale of the problem, and how the disease profile is changing over time.

Data from an organization

Organizations like plantations, mines or manufacturing plants and commercial enterprises that employ many people have data about employees that are indicators of health status.

The aim of these data is to show the malaria case activity in the clinic, the treatments and the outcomes. By summarizing by month it is possible to have a view of the trend over time.

This is a sample of the data table that could be used. This is at a summary level by month. The data is recorded in the most convenient way possible.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Total number of people in the workforce.													
Number of cases of malaria reported by employees.													
Malaria - no treatment													
Malaria treatment A													
Malaria treatment B													
Malaria treatment C													
Malaria hospitalization													
Malaria death of the employee													
Malaria death in the family													

The data detail may be different ... the aim is to get an indicator of the scale of the problem, and how the disease profile is changing over time.

Community activities and impact

Data are recorded in the most convenient way possible and summarized to give a month by month time series. The purpose is to help inform decision makers about the malaria situation.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Rainfall													
Temp (High average)													
Temp (Low average)													
Mosquito population (an index)													
Prevalence of malaria in the mosquitoes													
Hours of adulticide spraying													
Area covered with adulticide spraying													
Workdays of surveillance													
Prevalence of larvae in the area (index)													
Workdays of source control													
Workdays of work doing environmental clean up													
Workdays of IRS team spraying													
Workdays of training													
Amount of spraying done													
Bednets distributed													
Bednets treated													
Coverage of bednets													
Population of the community													
Estimated number of cases of malaria													
Estimated number of deaths due malaria													

AAA

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.

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.

The big role for ULV is to reduce the population of mosquitoes 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)

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.

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.

“Community Analytics is a community focused system that provides data that are useful at the community level, aggregate to provide early and strong indicators of socio-economic progress, and useful for researchers.”

The CA metrics measure progress, and they also measure performance. They are related, but they are not the same. This graphic shows some of what needs to be measured:

An integrated comprehensive set of interventions

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 IMM approach.

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 various intervention respond to the complex sciences of the human, the parasite, the mosquito vector, the drug and pesticide chemistry and the habitat.

IMM includes data for management information and decision making as well as the physical interventions. These are described in the following sections grouped as follows: (1) Data; (2) Community; (3) Vector Control; (4) Medical; (5) Personal Protection; and, (6) Organization, Financing and Sustainability.

Data

The section about data highlights the importance of data in the CA and IMM framework. Data drives decisions and the expansion of scientific knowledge ... and performance. Data are ubiquitous and used to inform about everything: (1) the community; (2) spatial information about malariology; (3) entomology ... surveillance; (4) medical ... screening; (5) weather and the role of water; (6) performance ... cost and value; and, (7) research. The methods include use of satellite imagery.

Community

CA and IMM are community centric. This is because data have the most value when there is practical use and clarity ... and where the “rubber hits the road”. Local control and coordination makes for accountable decision making and high performance. At the community level awareness about malaria can be built and education about malaria encouraged. Access to health care comes from the strengthening of the health infrastructure at the community level ... clinics, organizations, human capital (staff).

Vector Control

Vector control was central to malaria control success in the past, and is a central part of the IMM strategy. There are many elements including: (1) Community Clean Up; (2) Source Control ... Larvaciding; (3) Mosquito Control – ULV Adulticiding; and, (4) Interior Residual Spraying (IRS)

Medical

There are two ways in which the medical dimension reduces the burden of malaria: (1) case management for active malaria; and, (2) therapy to reduce the parasite prevalence

Personal Protection

Personal protection using bednets (ITNs) has been the most popular of anti-malaria interventions in recent years. Other techniques for personal protection are used to reduce exposure to mosquito bites.

Organization, Financing and Sustainability

Organization, financing and sustainability are inter-connected and an important determinant of the way a program will succeed over the long run.

Research

Research is needed so that issues like resistance can be addressed in the future both in the medical area and for vector control. It may also be possible for research investment to come up with an effective vaccine.

Getting local knowledge needs to be a high priority, and this knowledge should be at the center of what is planned.

What perspective is being used?

Data tells different stories depending on what perspective is being used. Einstein talked about this problem when he was writing about relativity. Most data flow because an organization is looking to get data about its project ... or because some researchers are looking to prove some hypothesis. But the data we need are data that flow ubiquitously and as they are analyzed it becomes clear what problems are important and what are not ... whether progress is being made or not ... whether development resources are reaching beneficiaries or not.

Permanent data

Much of the data about a community are permanent data ... data that change rather slowly. A lot of the basic information about the community fall into this class. Mapping the community to know where things are located is part of this ... including the location and capacity of the local health infrastructure.

The state of things may also be thought of as permanent data ... the state of health for example at a point in time ... compared to transient data that are the interventions and related results.

About performance ... cost and value

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.

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.

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 an operation is relative to what is theoretically possible, and is often an early warning of lack of fiscal control and possible financial misfeasance.