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

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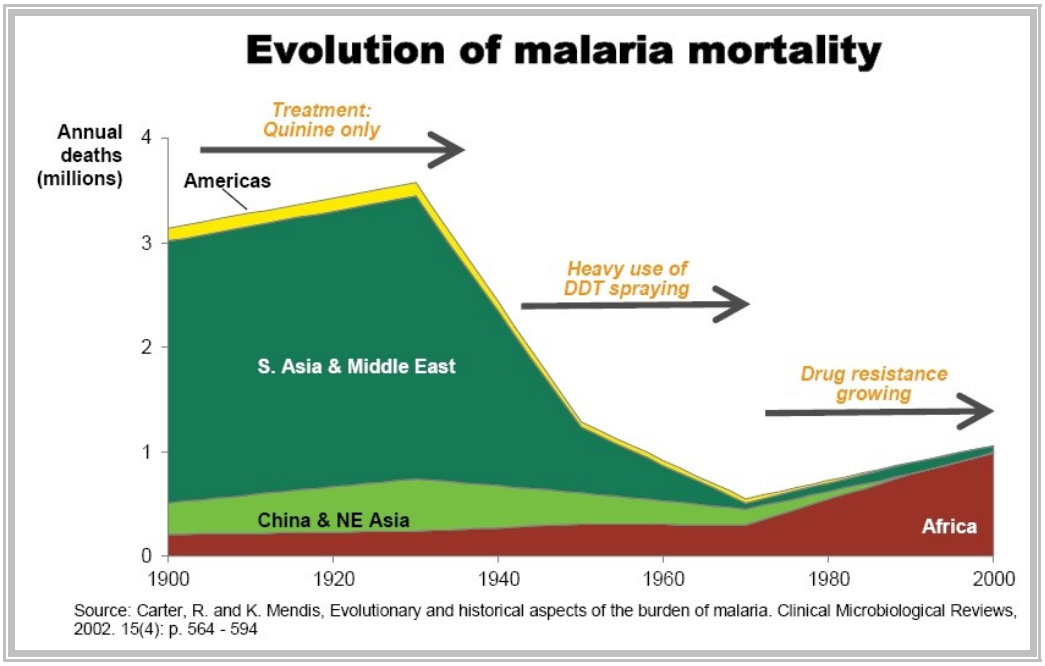
Integrated Malaria Management

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 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 and the subsequent avoidance of DDT around the world. According to the WHO, around 1 million people die every year from malaria ... a preventable and curable disease!

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. The Africa data may also reflect changes in the way data from Africa has been compiled and reported.

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.

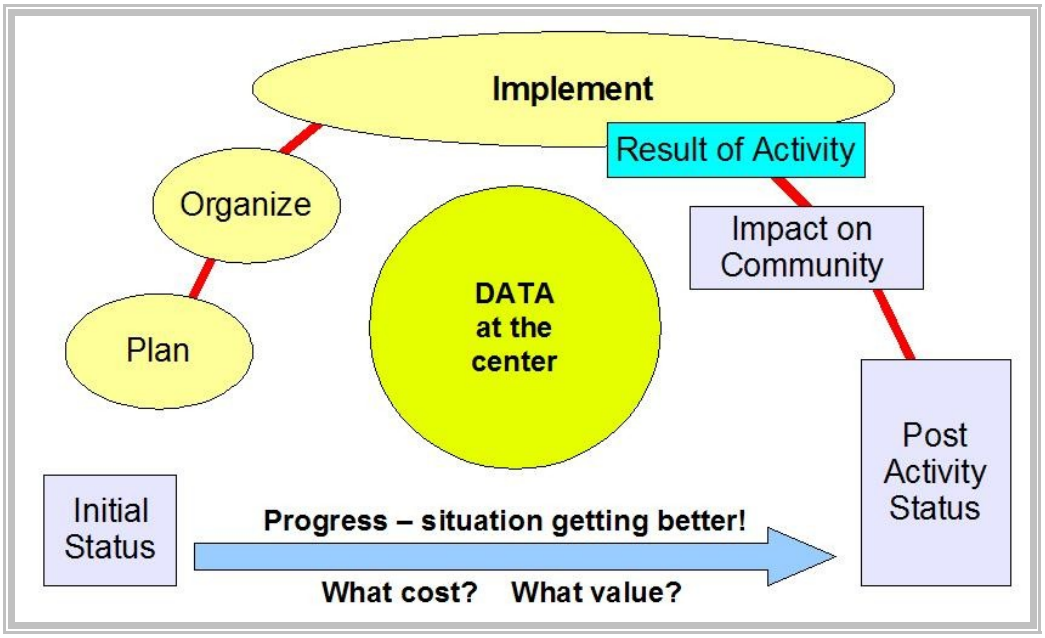
Annual funding was around $100 million in 2000, and is reported to have been more than $1.5 billion in 2008. This is a major turnaround, and a great achievement ... but the impact of this funding seems to have been rather modest relative to the funding disbursed. There is a chronic lack of easily accessible 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, what is done and the resulting performance.

The CA Management Dimension

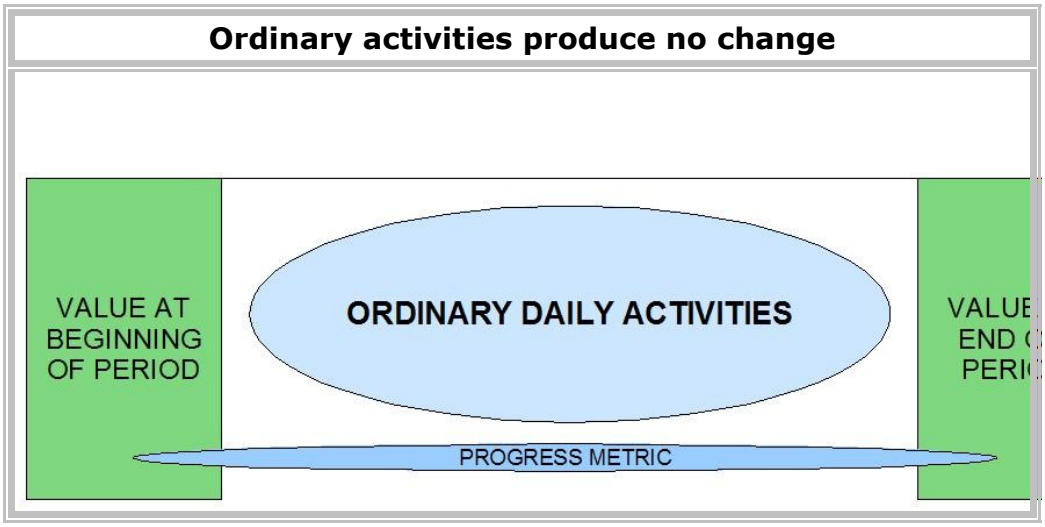
"Management information is the least amount of information that enables a good decision to be made reliably and in a timely way."

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.

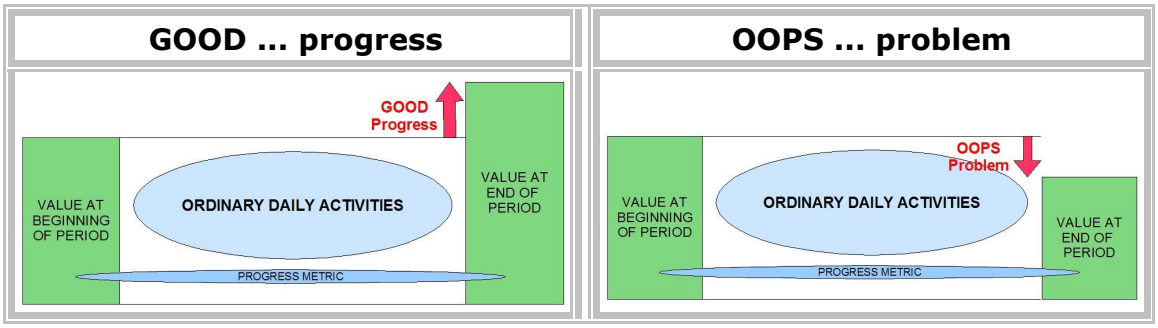


CA is a community centric system. Academic surveys may show what has been achieved ... or not ... but rarely have data been structured to inform operating decisions. The data in the CA system is used both to optimize the way operational activities are carried out, but also are used to provide for oversight,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

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

"What gets measured gets done"

CA builds on the accountancy principles that have been very effective when applied in the corporate environment to measure and report financial results and profit ... but CA goes beyond the idea of money profit to embrace the consumption and creation of value ... social value. In order to use value in the CA framework, CA adopts a set of "standard values" that are used in the analysis and reporting and serve to frame the value elements of the system.

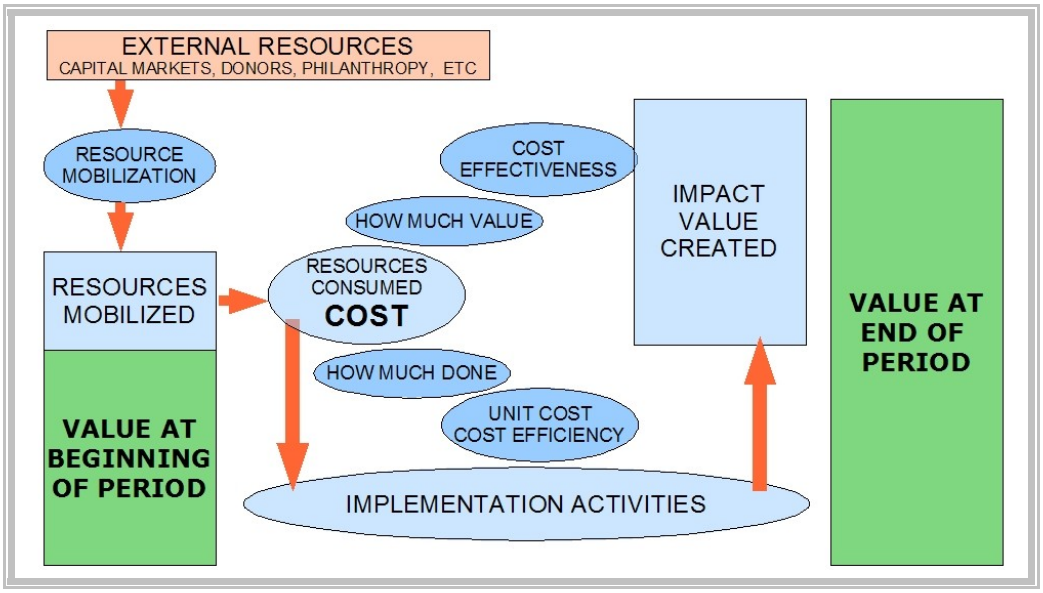
Performance is not only about progress ... but the cost of achieving progress.

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 corporate for profit analysis where cost and price are the most important, because they determine profit ... and profit determines stockholder value.

CA helps to understand the cost of activities ... and whether there is cost efficiency. CA also helps to understand the value impact from the activities ... and whether there is value adding for the community or value destruction. CA is very clear about the metrics of an activity and the metrics of the impact of the activity. On average, an activity may have a correlation with impact ... but

management information should rarely, if ever, assume that this correlation has universal application.

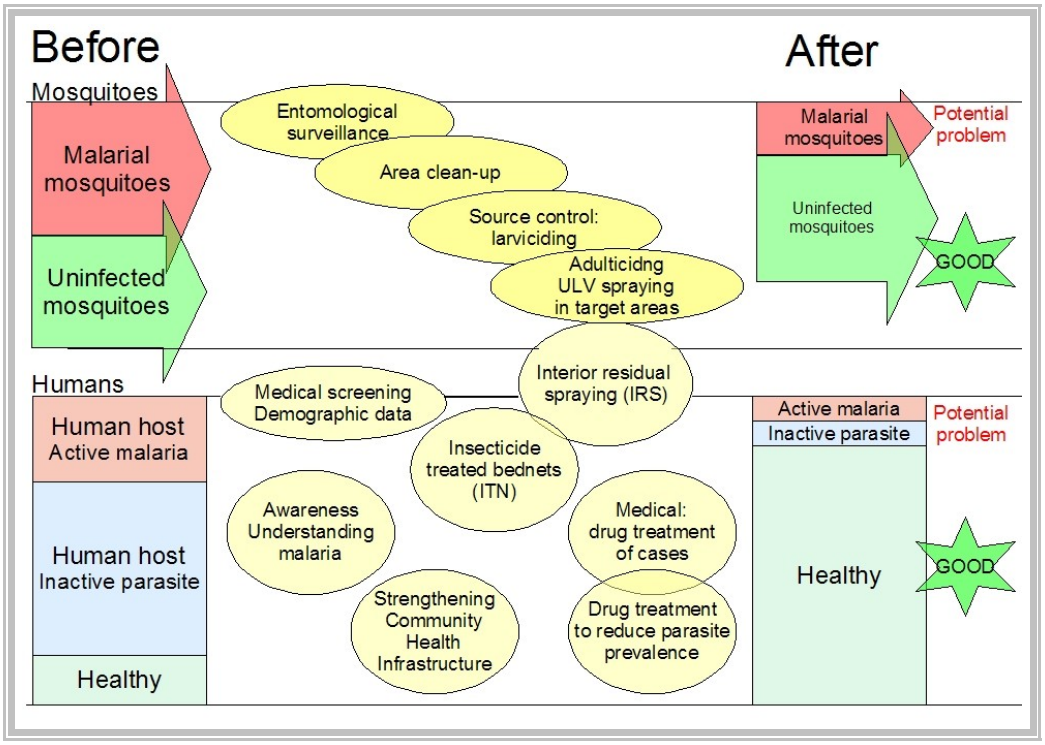
The following graphic shows two key measure (1) cost efficiency and (2) cost effectiveness.



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

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 ... hourly, daily, monthly, and from year to year.

The Benefit of IMM with CA

The benefit of IMM with CA is that there is a system of metrics integrated into the program so that performance is continually monitored and optimized. The benefit of this approach has been demonstrated over and over again in every sphere of economic endeavor and will work for malaria health 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 to have 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 the objective.

IMM and CA work together ... but the data associated with the combined initiative have value both where the interventions are done within the IMM-CA framework or by others. What this means is that the performance of the initiatives funded over the past several years may still be evaluated using the CA methodology ex-post-facto.

The CA approach to performance metrics has been used in both the private and the public sector. Experience shows that use of data to develop management information to guide decision making improves the effectiveness of operational activities by an order of magnitude. Any activity or organization that has poor management information almost always has poor operational performance.

IMM with CA does not have monitoring and evaluation (M&E) as a separate activity ... but incorporates enhanced M&E within the operational interventions so that there are continuous improvements. Benefits from this are achieved rapidly when there are feedback mechanisms that allow good decisions to be made. This is not always the case ... good information helps to identify the tough decisions that have to be made ... but individuals and organizations have to make the decisions in order for what is being done to be optimized.

Using IMM best practice (IMM-BP), it is reasonable to accelerate progress and achieve a sustainable state much sooner than is envisioned by the WHO-GMAP.

Sustainable Health

Good health should be the norm in the modern era ... funded easily because society is productive and resources to address health issues are easily available. Health is not an industrial product like an automobile, and not an economic service like banking ... health is an integral part of life, and a critical component in the quality of life. To have global health sustainable in perpetuity there needs to be productive communities and the application of good science in the right place, at the right time and by the right people. A health sector that relies on rich people paying for the medical services of poor people can never be sustainable ... whether it is done in the public sector by government or in the private sector. This IMM strategy is a first step in the direction of sustainable health.

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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. CA is characterized by its focus on what is material ... while also trying to appreciate what might be important albeit not easy to measure. 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 are difficult to incorporate into 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 ... and malaria is part of this.

CA is an independent system that aims to operate without requiring the support of any one actor. All may participate ... and the system works even when some of the major actors choose to remain uncooperative and exclude themselves from participation in the system.

CA is a system that has value by putting critical information onto a score-board ... but it is not always a popular system. It is "hard ball", and some of the players will not like what CA shows, and there will likely be repercussions. The safety of CA participants is a concern ... a sad and terrible reflection on the core ethical malaise of modern society and some of the powerful elite.

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.

There are three components of IMM:

1. Scientific data and management information;
2. Health infrastructure, capacity building and training;
3. Medical care; and
4. Mosquito control interventions.

Scientific data and management information facilitates decision making so that the scarce available resources are used in the best possible way. Health infrastructure, capacity building and training are critical elements that make it possible for the program to be sustainable in the long run, and most cost effective in the short run.

IMM has data and its analysis for scientific purposes and management decision making at the center or the work. The history of management in general and IMM in particular shows that timely information and decision making improves cost effectiveness in operations substantially ... maybe even 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 simple 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 may be some very good potential ... but in isolation rather little is accomplished and the impact is small. Put together, however, the various possible interventions can be coordinated so that there is great impact ... and sustainable progress.

Management using relevant data achieves substantial performance improvement ... perhaps twice as good as it was with limited management information ... in some situations it is possible for performance to be an order of magnitude better. Malaria control is such a situation.

IMM and CA work together ... but the data associated with the combined initiative have value both where the interventions are done within the IMM-CA framework or by others. What this means is that the performance of the initiatives funded over the past several years may still be evaluated using the CA methodology ex-post-facto.

The CA approach to performance metrics has been used in both the private and the public sector. Experience shows that use of data to develop management information to guide decision making improves the effectiveness of operational activities by an order of magnitude. Any activity or organization that has poor management information almost always has poor operational performance.

IMM with CA does not have monitoring and evaluation (M&E) as a separate activity ... but incorporates enhanced M&E within the operational interventions so that there are continuous improvements. Benefits from this are achieved rapidly when there are feedback mechanisms that allow good decisions to be made. This is not always the case ... good information helps to identify the tough decisions that have to be made ... but individuals and organizations have to make the decisions in order for what is being done to be optimized.

The Management Cycle

What is the problem?

The starting point should be to know what is the problem ... or maybe what are the problems. Managing to solve the wrong problem is not going to produced good results and success. In the CA process, the first step is to use easily accessible data to get some idea of the problem ... and then to get more data so that more specifics of the problem may be identified.

What is the goal?

In order to manage anything it is essential that there is an adequate understanding of the goal or objective. Human society has an element of dysfunction simply because there are many different groups each with competing goals ... and the result is a stalemate rather than progress.

Therefore a key first step is to ascertain the goal ... and ascertain what might be a good way to get to the goal. Community Analytics (CA) has a community focus ... and the goal is therefore a goal for the community as a whole, and less a goal that is specific to a single person or family.

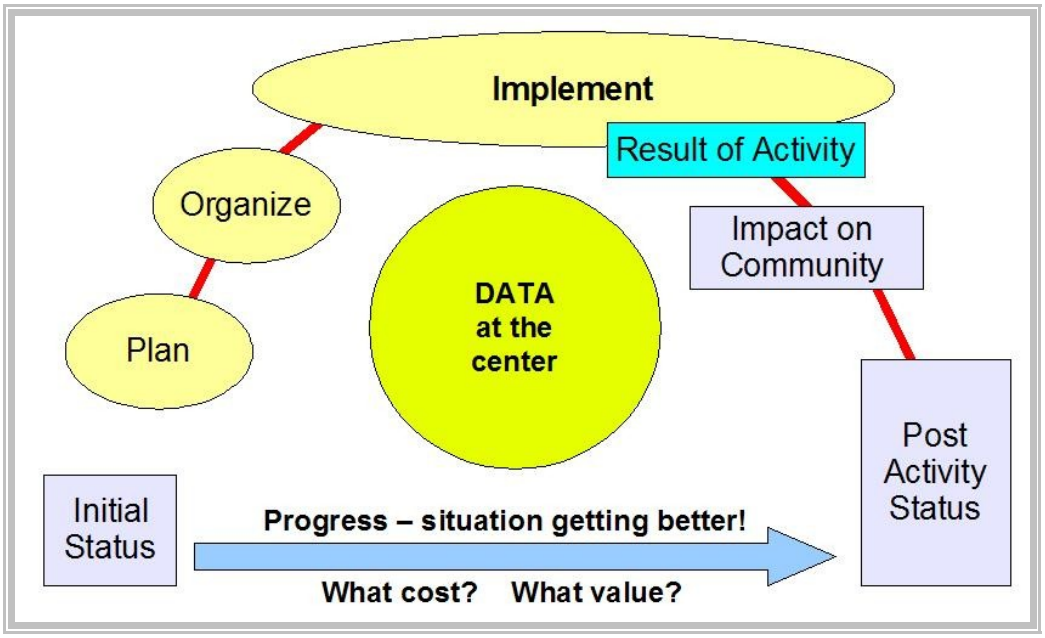
Experience shows that personal goals are rarely the same as community goals ... individuals want what is best for themselves, the same for families. A community may want the best outcome for the community as a whole ... but individuals and families will work towards their own goals.

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."**

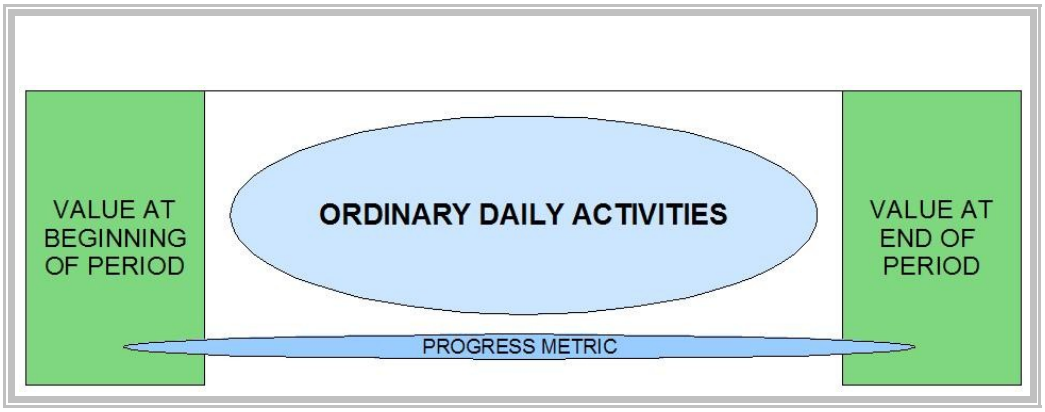
This is a simple representation of the CA perspective of the management cycle. It has data at the center ... and uses the data at every stage of the process.



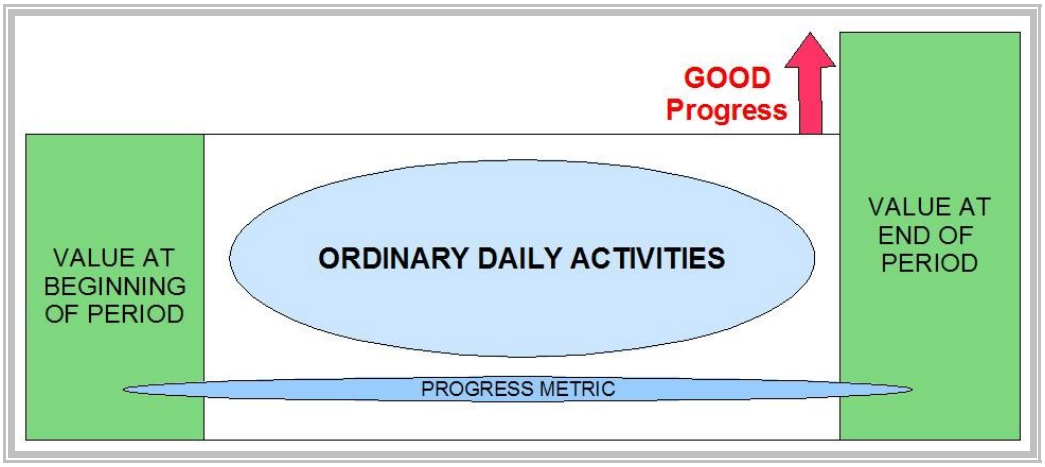
This basic idea replicates throughout the CA framework. In order to be the most effective, the data must be simple, timely and clear.

Making key metrics simple

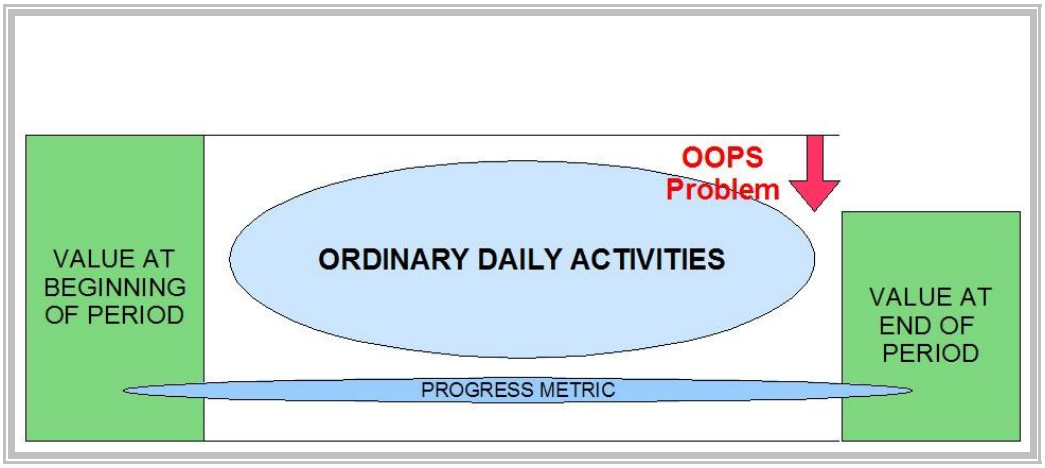
CA's primary metric of progress is very simple. Is the community better now than it was in the past? This is not a complex idea, and there is no reason why there cannot be quick, easy and useful data about this. In the image below, the value of the community is the same at the end of a period as it was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

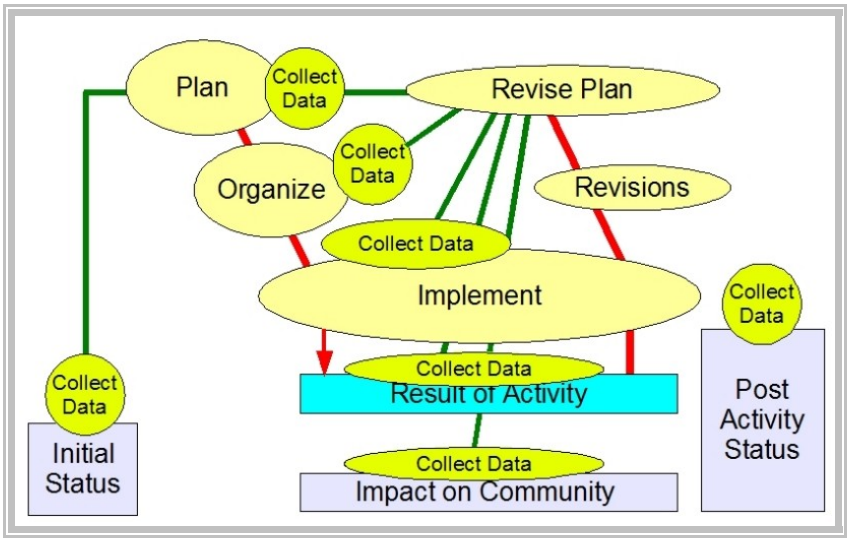


In this last case the value of the community is the less at the end of a period than at the beginning of the period ... ordinary daily activities produce less than is consumed. It is a problem situation.

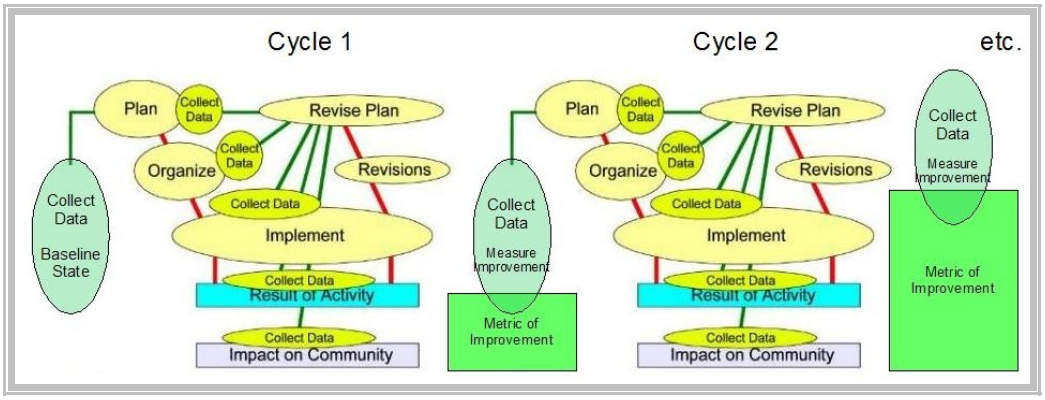


Data for managing for progress

The management cycle has three elements: (1) Collect data, do analysis; (2) plan and organize; and (3) implement ... and measure and analyze. High performance programs integrate data collection, analysis, planning, action, more data collection, more planning, more action in a perpetual process. These are reflected in the following schematic. Everything has a data component.



The basic construct is not done once but is repeated over and over again ... data are collected and used for decision making all the time.

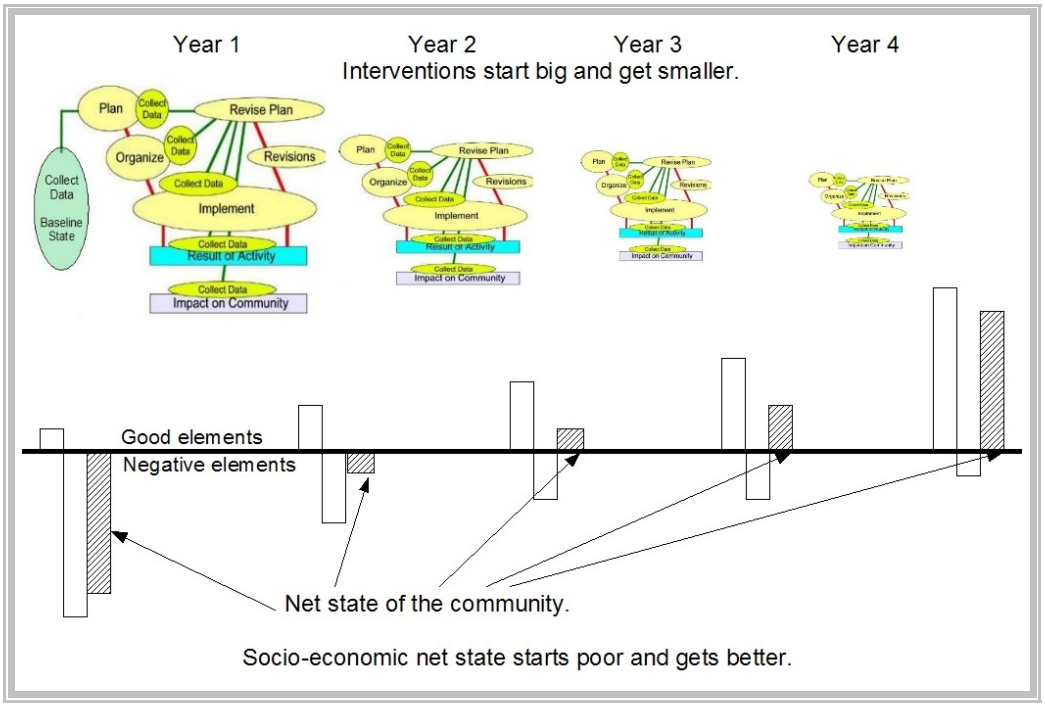


The ultimate measure of success is whether the change between the initial status and the post activity status has a value that (substantially) exceeds the costs. The above schematic shows this as a box “Metric of Improvement”. The activities produce their own results or outcomes, and in turn these have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

In corporate accountancy there is both balance sheet and operating statement as an integrated whole ... CA has the state of the community and the activities of the community as a complete whole. Corporate accountancy has, of course, a focus on the money transactions and the financial profit ... CA, on the other hand, takes into account the broader idea of social value which is either consumed (destroyed) or created (added). Money is a part of social value ... but only a part.

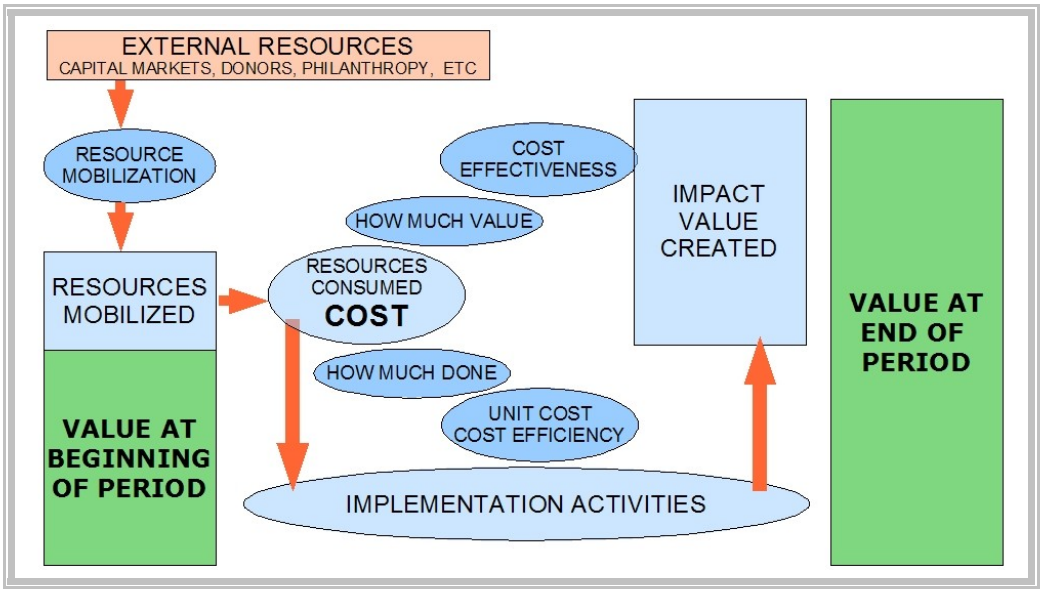
> A gold mine may make a big and quick financial profit ... while the community gets some jobs for a short time and loses a natural resource and ends up with an ugly hole in the ground and polluted water that lasts for a very long time

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.

CA measures progress ... measures performance ... they are related but not the same. This graphic below shows how resources, impact and value are all part of the same framework of metrics that measures both cost efficiency and cost effectiveness.



Metrics and feedback

The value of metrics is most when the data are used with feedback to improve decision making.

Basic control theory shows that when there is rapid measurement that feeds back to the operations, the system can be both stable and perform to its optimum. The same concepts of control theory that affect engineering systems also work in economic systems which are essentially largely human systems ... and maybe with even more impact. This may be because people learn and have behaviors that are heavily influenced by feedback, though maybe not quite with the same rigor and rigidity that there is in an engineering system.

The following experience from 1973 shows, however, how powerful feedback can be when it is used in the right way and at the right time.

Production Reports at Southern States, Inc.

This story illustrates the vital importance of timely information. Most of my career I have been associated with corporate accounting, consulting, planning and the analysis of performance. I have not done many line management assignments ... but in this case some years back I was appointed VP Manufacturing for Southern States Inc, a manufacturing company making air-break switches for the electric utility industry during a reorganization to improve the company's results.

The company had orders, but the factory was a bottleneck ... and we had neither the time nor the money to invest in expanded manufacturing facilities. We had to do better with what we had. For years the factory production report had been written up and distributed every day around 10 am ... informing everyone of the production numbers for the day before ... a fairly standard practice! I changed this to give management a report at 8.30 am (the factory got started at 7.30 am) about the anticipated production for the day ... today, not yesterday! By 9 am the support staff were deployed fixing problems that would improve performance today! The factory always beat its anticipated production ... and the factory production almost doubled without any major capital investment to expand the capacity!

CA uses metrics in this manner. This is very different from ex-post-facto monitoring and evaluation (M&E) which is normally too little and too late to make much of a difference. M&E mainly evaluates what results were achieved ... good or bad ... but too late to do anything to improve the outcome.

The only public sector organization that had very good performance feedback in my experience was the United Nations High Commission for Refugees (UNHCR). They were able to move from problem identification to effective action in hours, and keep their program relevant in very fast changing and often challenging, dangerous conditions. No other organization in the Official Relief and Development Assistance (ORDA) community had anything like the feedback capacity of UNHCR.

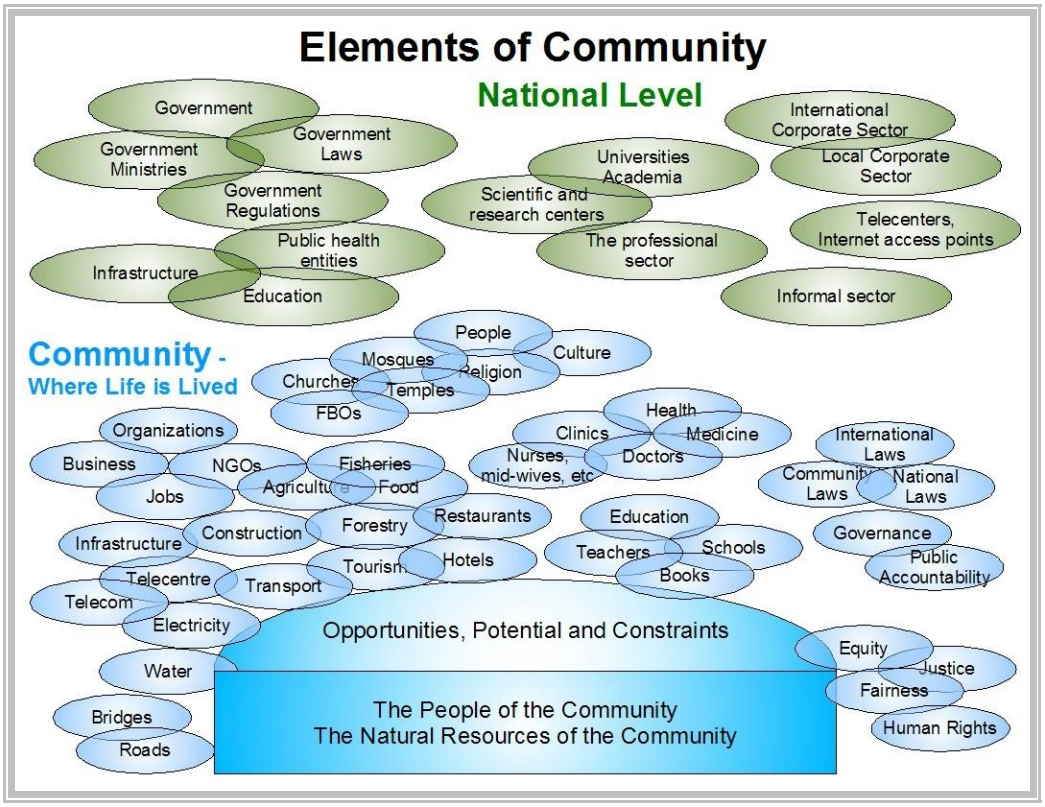
In the sporting world there is independent scorekeeping, there are statistics and there is the process of careful review of performance and learning lessons from the way the last game was played. In American football this is the famous “Monday morning quarterbacking”! But feedback is even more integrated into modern professional sport ... there is play by play analysis of performance and feedback to the players to adjust how they are playing the game.

The performance of society, in contrast, is unmanaged ... it is a system with little or no feedback until it is too late. Instead of an optimized quality of life ... society is left to lurch from crisis to crisis, and some 50% of the global population get little benefit from the possibilities of what can be done with modern science and technology.

Handling Complexity

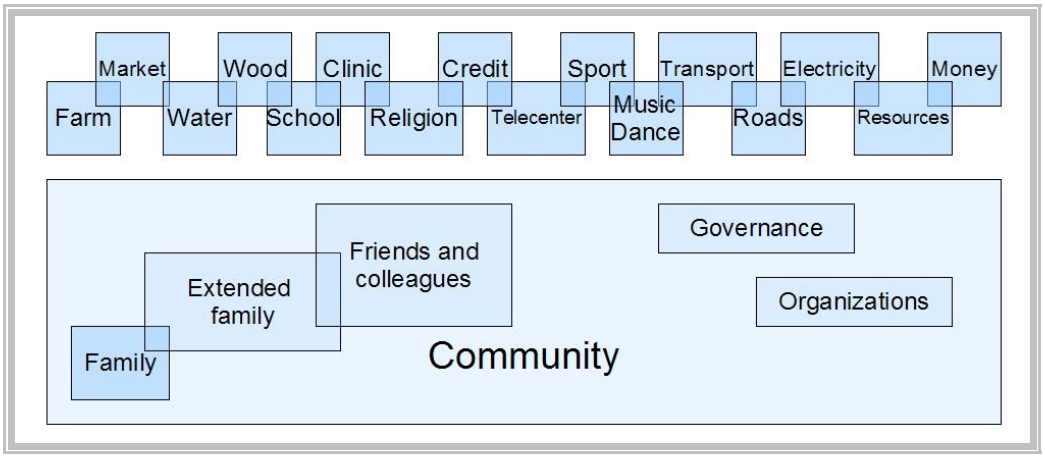
Society is very complex

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.



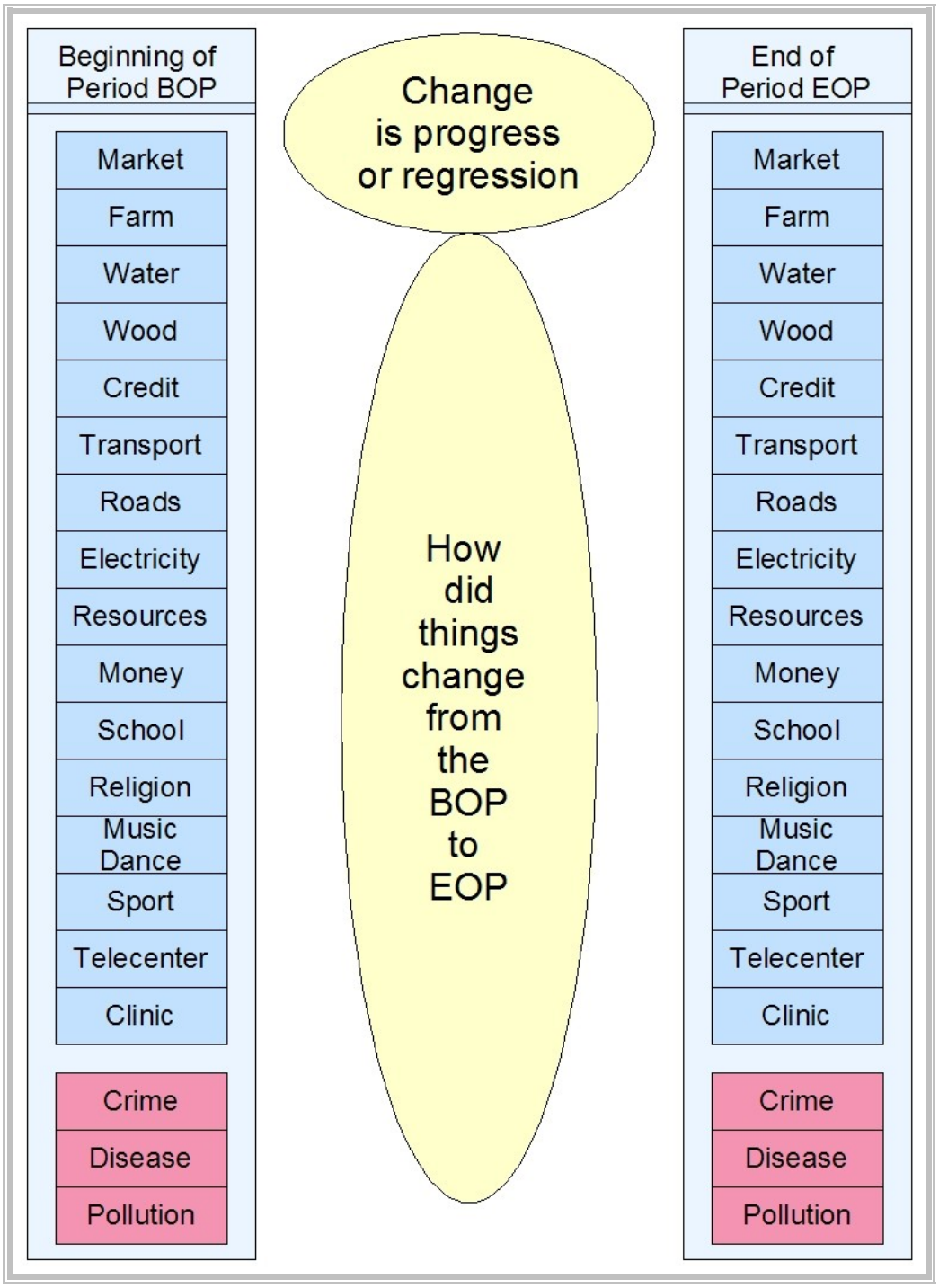
... but less so at the community level

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.

Productivity ... technology

Technology is changing fast ... very fast. Rapid changes in technology are changing the economics of society, and it is likely that this will continue. In broad terms, however, the possibilities of technology are not being well used for the benefit of society as a whole, and especially, not for the benefit of those that are at the bottom of the pyramid (BoP).

Facilitating paradigm shift

Throughout history technology has always been the primary limiting factor in making sustainable progress ... but there has been a shift in the last few decades. Technology may now have the power and capacity to do far more than our society is having it to do.

CA is about data much more than about technology. The ideas of CA were applicable when paper was the storage medium, and the same ideas still have application in a fast moving digital age. CA was designed to be independent of technology ... the data are a logical framework that does not need technology ... but these data become a million times more powerful when matched with the capabilities of technology.

Chip technology ... computational power

Chip technology has made all sorts of things possible. Computational power has increased exponentially for many years and the potential is a long way from being fully utilized.

> Moore's Law talks about computational power doubling every 18 months and costs halving every 18 months. This ideas now goes back almost 30 years ... the impact on information processing is staggering.

Stationary centralized computational systems have given way to distributed systems ... to the Internet and to mobile systems. The power has gone up and the costs have come down.

> If the cost to power relationship has improved by a factor of 1 million over the past 40 years ... how come a data centric profession like accountancy are not a million times more useful? Why has so little of the potential been used for public good?

It really is a disgrace that with so much computational power, society has progressed to such a limited extent.

Internet and World Wide Web

While CA is built on concepts that were applicable for pre-computer accountancy, the architecture of the data also works for an electronic environment and Internet accessible data and analysis. As Internet technology has evolved, the need for and use of “broadband” has increased, and most applications now require broadband access for the Internet to be an efficient tool. This has the effect of making the Internet a limiting factor for the universal deployment of CA. The combination of Internet and other technology driven tools now makes data centric programs cost effective.

Specialized PDAs

Specialized PDAs (personal digital assistants) have been used for a number of years (since around 1995) to reduce the burden of paper based data in mobile situations. Organizations like Federal Express and UPS were early adopters of this specialized technology, and it has been adopted for many applications where accuracy and speed are important (for example inventory control). The use of a PDA is cost effective when labor costs are high and the use of data has a high value. PDAs are rarely low enough in cost to be of advantage in low wage settings ... but they have been deployed by AID agencies using grant funding even though the sustainability of their use is near zero.

Mobile phones

Mobile phone technology has produced a paradigm shift in communication. The deployment of cellphone technology has been very rapid, and a very good example of a low cost technology

producing a very high value ... and marketed in ways that have made the service affordable to customers in a broad range of economic circumstances. 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

		This image shows individual houses in a section of Monrovia, Liberia. Images of this sort enable plans to be made for surveillance and for interventions. The image is a start ... how it is used to plan and deploy interventions depends on the local situation and the staff on the ground.

Social network web architecture

Social network web architecture is changing how people interact, and how knowledge is used. In general most of the data moving around social networks are of little management value, but this can change. The same data architecture that links people with people may also be used to link problem to solution and the resources needed for everything to come together.

Village bus data transfer

While most systems that have been developed have been for markets that are rich and where profits can be made, there are emerging systems that are designed to bring value to communities in the very least cost manner. Community focus data can move in and out of a community using methods other than Internet broadband ... as for example the village bus data transfer system, where data are moved from a community based system to a traveling intermediary system and on to a central datastore.

Biometrics and identity

Energy technology

Solar technology

Materials technology

Battery technology

RFID

Bar code technology

Search capabilities

Audio

Images

Video

Accountability ... forensic analysis

Caveat

Powerful technology and analytical capability should not be used as a substitute for good data. There is no more place for sloppy concepts in a powerful analytical environment than in the much more power constrained situation of earlier times.

> Dr. John Gulland, FRS was a pioneer in mathematical modeling for fish population dynamics at FAO. The value of his work was diminished because the quality of the data being studied declined over time. The lesson is that there should be effort to have good data.

Data

Purpose of data

When the post industrial age was named the information age some decades ago ... perhaps around 1970 ... there was much less appreciation than now of what role information ... data ... played in the functioning of everything.

Compared to what is possible, modern institutional management uses data systems that can best be described as stone age, or at best, medieval. The purpose of data is to make it possible to manage well ... for operations to be efficient and effective, and for knowledge to be accumulated. For this data are needed about what is going on ... timely ... accurate ... relevant.

Data are the raw material for management information and the development of knowledge. Data have no purpose unless they are used in some productive way, unless they are part of an integrated system

Representation of reality

Data are a representation of reality. Many systems have been developed and deployed that use numbers to serve to represent reality ... but this is not the only way. There are many systems that use other techniques and there have been developments and progress over the years: analog to digital ... characters and written words ... numbers and mathematical statistics ... photgraphs to digital images ... still images to video ... and more.

Ubiquitous

Data are everywhere. The more we learn about life ... about almost anything ... we learn that there is a data component that makes life work. The brain is all about data ...

Mali ... 1980s

I had a conversation with an old man in Mali ... a village elder ... when I was in his village during the Sahel famine of the 1980s. He knew a lot about the history of rain in his village ... much more than was recorded in sophisticated data systems. It taught me that "If I do not know something ... it does not mean that it is not known".

In the broader context, I argue that very little is known by economists and planners about community ... but a lot is known about community by the people that live in the community. They have the data ... but not in a form that we find easy to use!

Character

Data are used to store knowledge ... data are knowledge ... and data are used to communicate knowledge.

Reality becomes data ... then with analysis, information ... and with human interaction knowledge ... and with experience and reflection, wisdom.

Intellectual property

The recognition that data have value has been important in making it possible to collect data, process data, and manage with data ... but the downside of this has been that data and related analysis has been managed as intellectual property (IP) ... and this property then being exploited for its value to its owner rather than being used for public good.

The issue of the "public right to know" is not central to much debate ... and this has made it possible for public sector performance to be very low efficiency and nobody any the wiser. What a corporate organization tells the public is only a tiny amount of what the company knows ... and is carefully presented to send a message that is designed for the stakeholders, and not much related to the underlying data and knowledge.

The rule seems to be that only data that are required by law to be accessible to the pubic are going to be accessible ... everything else is going to be secret. More than anything else, this means that

society will progress way more slowly than it would where data and analysis were being used to the optimum.

The argument that the value of IP produces an incentive to use data and innovate has some merit ... but so also does the argument that professionals and scientists are not only motivated by money, but also see value in discovery as a value beyond just its money value.

Open access

The CA methodology is to have data and analysis as much as possible openly accessible. Data and analysis that might be useful for decision making are made openly accessible as rapidly as possible. The CA approach that makes data and analysis easily accessible contrasts with the widespread practice of treating data about public matters as a proprietary private property.

Data and analysis that might put people “at risk” are not openly accessible.

Metadata ... data about data

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 issues to be addressed;
3. Information about interventions; and
4. Information about the results ... the impact on the issues being addressed.

The general theme about information needed for decision making is that it should make it possible to calculate cost efficiency and cost effectiveness. This translates into a need to collect data that will make it possible to produce reports showing these matters. CA is a modular system. Part of the system uses data that are all about the place. Some of the data are about the specific sector or program. There is both permanent information and information that changes very quickly. 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.

Data that relate to reality

Good data have a strong link to reality ... the role of data is to serve as a proxy for reality in an analysis framework. The CA framework has been developed mindful of the fact that around half the world's population is in abject poverty, hungry, diseased and uneducated. It has also been developed recognizing that the data needed for a high performance productive society is almost totally absent ... that while data are mobilized to optimize profit, data are rarely mobilized in the community space to manage the resources of society.

Materiality

The purpose of CA data is to facilitate progress and make it possible better to manage resources. Having more and more data is not the goal ... rather it is to have more and more productivity and social value. In order for this to be achieved, the data must relate to matters that are material ... that can make a difference.

Relational model

CA data are organized using the relational model. This approach makes it possible for a small amount of incremental data to be related to everything else and have useful value within the established analysis framework.

1978

When the relational model for database design was developed in 1978, there was a paradigm shift in the way accounting could be done. The relational model made it very much simpler to handle the aggregation of data and drill down ... and to be able to study the data from different perspectives.

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. Part of the power of conventional accountancy was the logic of the account codes ... and this has become even more important as the CA approach to socio-economic performance metrics has been developed

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. Transient data sometimes changes very rapidly ... for example data about economic transactions, while the results or impact changes more slowly.

In accountancy, the operating statement reflects the aggregation of transaction data, and the balance sheet an aggregation of items that change as a result of the transactions. This is reflected in the accounting constructs of balance sheet and operating statement, with the balance sheet representing the more permanent data and the operating statement the more transient data.

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

It is relatively easy 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 it becomes far easier to understand and to put the transaction data into a proper context.

Activity data is more difficult, there is more of it ... but not all of it is needed. Activity data are needed about issues that are important in the community and the subject of current analysis and action.

In accounting all economic transactions are recorded ... in CA all transactions that are of relevance to the measurement and management of performance need to be recorded. Because of the relational architecture of the data, it is simple to record data in a way that is simple and very precise. 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.

Spatial information

In addition to data that show the time dimension, there also needs to be an ability to understand the changes that occur over space. Spatial information ... maps ... are a critical part of the information needed for planning and the management of operations. In real estate the saying goes that the three most important features of a property are location, location and location!

Entomology and malaria health also has a very strong location specific characteristic, and focus on area is very important. Everything has a spatial characteristic, and from a cost effectiveness and performance perspective, the data must include spatial information so that the planning and the operational implementation are optimized for specific locations. Spatial profiles of malaria burden and the causes of the burden are essential to the optimization of performance.

Spatial characteristics of IMM

Mosquito and malaria control have strong spatial characteristics that have a very large impact on performance. Accordingly spatial information and mapping are a very important part of cost effective high performance integrated malaria management and include:

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.

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

Times series show how things change over time. They are critical to the measurement of progress. The goal is to reduce the burden of malaria as fast as possible, and in ways that are cost effective and with a minimum of undesirable side effects. This is best done in a data environment where there is good time series information.

There are many ways to handle time series data ... but always the data must be understood. Issues like seasonality must be taken into consideration so that the time series reflects something that is meaningful.

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.

Provenance ... validation

Data needs to be right. The analysis of data that have little relationship to reality has little value ... worse, the analysis may result in bad decision making.

GIGO

Garbage In ... Garbage Out

There is a need to ensure that dataflows have integrity and there is no replacement of valid information with fictional data. There is also the need to ascertain that data that are in the system are correct through a system of validation.

While it is good practice to have fully normalized data in a relational system to have the most efficient data processing ... it is sometimes desirable to have redundancy in the data and dataflows so that data may be verified in an independent manner. Data should not only be right, but be seen to be right!

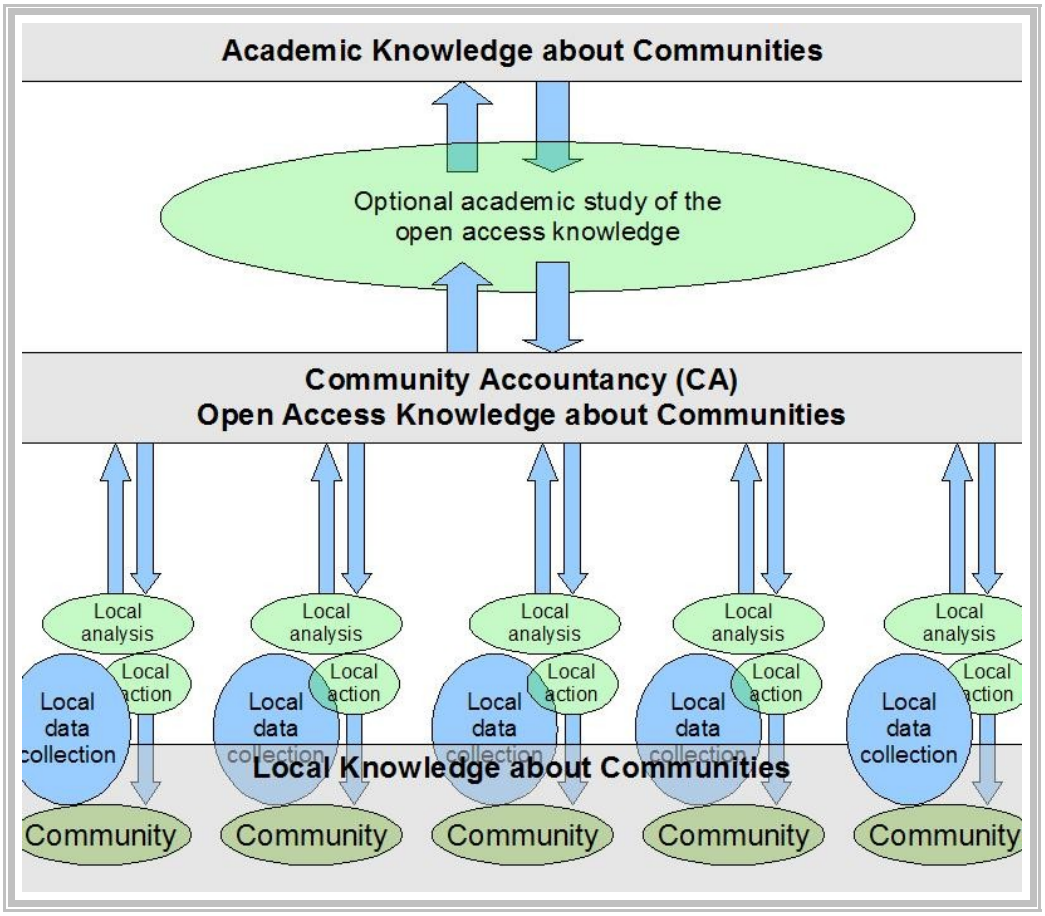
Dataflow ... data collection, transmission and storage

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.

Collect data once ... use many times

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.

The cost of data collection

Data collection always has a cost ... but in well designed systems the cost of essential data are designed to be low. Data that are compiled as part of operations may be very low cost, especially when they are paired with appropriate cost effective technology.

It is worth repeating that there is a big difference between the data that are used for management information and the data that are obtained to satisfy academic statistical criteria

> **Management information is the least amount of data that are needed for good decisions to be made reliably.**

The purpose of data collection is to: (1) provide operational information so that good decisions can be made about intervention activity and performance optimized; (2) provide information so that there can be effective management oversight; and, (3) provide data for scientific analysis so that operational decisions and interventions may be improved.

> The data that are collected may be used to further academic education ... but data must first satisfy operational, management and scientific needs ... not simply academic objectives. Data that simply are collected for academic purposes are a distraction!

Data collection always has a cost ... but this must be minimized. This must be done without compromising on the quality.

> It is common for data collection to be done by teams where international staff have a key role. This is an undesirable situation because of cost and sustainability.

Data collection must be well designed, and the staff well trained. Data should be used as much as possible for operational decisions, to provide management oversight and for scientific purposes.

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

Local people collecting local information

Local people collecting local information is a good way to achieve cost effective data collection. There is a need for adequate training and supervision, but that is true of any approach to data collection. The two advantages of local staff are: (1) modest remuneration requirements; and, (2) familiarity with the place and people.

> Some recent work supervised by Dr. Jonathan Morduch showed that interview data was hopelessly inaccurate from a first visit survey ... and only reached reasonable correctness after several weeks and multiple visits.

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. The cost effectiveness of writing in ink in a book should not be totally discounted!

Data collection workbooks

Data collection workbooks may be designed so that data collection is very efficient using the relational model. The same ideas may be used in designing for mobile phone SMS data transmission.

“Books” have been at the core of accountancy for several hundred years and having data “on the record” is key to accountable operations and activities and having data that are reliable and verifiable. Electronic recording of data may reduce the cost of data collection, but unless the system is well designed it is easy for the data quality to deteriorate and to be very difficult and expensive, if not impossible to validate. Books have been used in accountancy for a very long time and are referred to as “day books” or “journals” because they are written up every day.

These books are also referred to as “books of original entry” because they are the first record of transactions and completed when and where they happen. Data from these books can be copied to an electronic database from time to time and made part of a database and 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.

Vouchers

Accounting systems record accounting or economic transactions. In paper based accounting systems the data about a transaction is recorded on a voucher. The voucher may have many forms: an invoice, a receipt, a check or just a note with details of the transaction. Accounting systems list these voucher data in an organized way. In a disorganized environment vouchers are usually stored in the proverbial “shoe box”! A good accountancy system starts off with the premise that all the economic transactions are recorded in some way or another on vouchers.

In CA there is a role for notes ... which can then be organized just as in accountancy to be of analytical value.

Data collection technology

Available data collection technology is now 21st century ... but the mindset about using data for important things remains in the stone age! People change slowly!

There are many possibilities for the use of technology to help with data collection ... and what is used should be what is most cost effective. The best technology from the technical standpoint is usually not the most cost effective.

Over the past 50 years there have been, inter alia, manual systems, mainframe computers, personal computers, client server systems, Internet based systems and mobile cell phone systems. Analog has changed to digital. Character based communication systems (typewriters and telex) have been supplemented by images and audio and video. The technology has increased in capability and the cost has decreased amazingly ... and the opportunity to do amazing things exists for us. We are constrained by our vision, our imagination and our organization.

Data collection methodology

If the question is answered along the lines that the data are needed so that a research report can be prepared that is a requirement for an academic certification ... then the data will be collected using a very different methodology.

Collecting data about the fishing fleet

A group of experienced scientists were asked to collect data about the structure of the fishing fleet. They designed a survey and statistical method to make their inquiries and did a perfectly random set of interviews three times a week for six months. At the end of this time they had nearly nothing of value.

I was faced with the problem of time and money used and no useful data. I am an accountant that does not particularly like statistical data. Every fishing boat has a license. To get a license the fishing boat must be registered ... and to get registered a form has to be filled in, and is filed somewhere! I found the filing cabinets and now had details of every fishing boat ever registered ... date of registration, size, type of construction, date of construction, engine make and horsepower, fishing gear type, refrigeration equipment or not, etc., etc.. After a day of data entry typing there was a respectable database. After a few days of checking at the fishing port we were able to verify much of the data in the database ... and now had complete and good data about the fishing fleet.

This cost effective data collection was obtained by building on data that was already available ... but unused because it was in another department!

Sometimes, the understanding of data may be enhanced by statistical study ... but good techniques of data collection, accounting and analysis are usually sufficient to get good

management information for decision making. The key is to fully understand what data are important and what issues have a material impact on performance.

Data transmission

Modern technology makes it possible for data to move around the world instantly ... but why? The goal should be to use data usefully more than merely to have data. Although long distance and global data transmission is very low cost ... compared to pre-electronic times ... it is not costless, and it is unproductive.

Data that are useful for improving performance at the community level should be easily accessible for decision making at this level. These data do not need to travel far in order to be of material value locally. The same data, however, can be transmitted to a consolidated database for scientific analysis if that is required.

The Internet makes it possible for data to move from one part of the globe to another instantly. The only requirement is Internet access ... broadband Internet access. Increasingly broadband Internet access is widely available, though in many poorer countries the cost of access is relatively high. Data may be transmitted using an FTP (File Transfer Protocol), using an attachment to an e-mail or direct upload to a web-based application.

Mobile cell-phone technology has now become very widespread and is now capable of some data transfer more conveniently than using the Internet. Cell-phone coverage is now reaching most communities around the world, including quite poor and remote places.

Some special data design is needed for transmission efficiency, but transmission efficiency can be good where there is application of the relational model for database design.

Data storage

Data are essential to transparency and accountability but data that are needed are rarely easily accessible.

The details of the storage architecture will change from time to time ... but the general theme is that data should be accessible easily for those who need the data to make good decisions.

Data in the hands of a data collection person	These data are needed so that the work of data collection can be as efficient as possible ... including some immediate feedback about changes that might be locally important.
Data at the community level	These data may be analyzed very quickly to provide the information needed at the local level to determine what are the issues and how they might best be addressed.
Data at the national oversight level	These data are a component of the data needed for good governance and oversight.
Data for national level research	These data are a part of a research process that has the potential to help with both learning and teaching in the country
Data for global research	These data are a part of a research process that has the potential to advance learning on a global basis. Modern computational technology such as available at the US National Center for Supercomputing Applications (NCSA) makes it possible to process very large datasets and learn from these data.

Data are needed for the effective management of performance ... but it is not at all clear that the essential data are collected ... and to the extent that they exist, they are not easily accessible.

Because data are important for the administration of society, it is normal for there to be laws and regulations that give guidance about how data must be stored and be accessible to interested parties. In general these laws and regulations do not help very much with the issue of transparency and accountability as a part of day to day ordinary life. The issue of socio-economic performance and the impact on society is not part of the data landscape.

The corporate organization is increasingly aware that data storage is a cost in the best of times, and may be a catastrophic cost if the law and regulations are called into effect for access to these data.

Data storage has moved way beyond just paper ... everything can be digital ... everything can be organized so that there may be easy analysis and the data be valuable ... especially for society as a whole.

The cost effectiveness of technology is only going to be fully realized if the data architecture is sound and logical. This is the core of what CA can do. \

Multiple use

The multiple use of data is a key to making data cost effective and valuable. The basic data architecture used by CA maximizes use of data. This has the secondary effect of making the data more reliable, because data that are used are always more reliable than data that merely sit and do nothing!

Issues

Data security

As data becomes more important and more central to social performance and productivity, then the security of data takes on more and more importance. Data security has many dimensions, all of which should be taken into consideration. These include (1) physical security; (2) disaster recovery; (3) hacking; (4) avoidance of misinformation; (5) theft of sensitive data; etc. Many people and organizations might seek to corrupt the data because good use of data will have the capacity to disrupt much profitable but inappropriate economic activity.

Sensitive information

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.

Cost information ... cost accounting is often 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, and in many cases may not be able to provide cost data that are useful.

Where cost data are collected, they are rarely accessible to the general public and are kept within an organization, and even then quite often not easily accessible. Cost information is treated as if it is very valuable ... which it is! However, cost information should be reasonably accessible.

There are two problems that have to be addressed: (1) how to collect cost information where there is access to the operations and the accounting; and, (2) how to get useful cost information where an organization controls the operations and does not provide access to the operations and the accounting.

Dysfunctional systems

Large scale data collection and statistical analysis is not the best starting point for study and the understanding of most community activities. In system terms. Most community activities reflect some level of dysfunction and it is best to get some key datapoints to describe the system using sensible observation and as much easy data as possible. The key reason for data is to help to understand the situation and what, why and how it is that this is the situation.

Unless the basic question “Why are the data being collected?” is answered correctly ... the methodology used for data collection is likely to be wrong. In the CA framework the reason for data collection is simply that CA aims to generate useful management information ... and management information is defined as the least amount of information that will ensure that the best possible decisions will be made. In this CA framework, the data that are collected my well be a subset of data around a specific issue that has already been identified as important.

Analysis and Reporting

Purpose

The purpose of analysis is to understand the data and to learn something from the data. The purpose of reporting is to make it possible for others to share this understanding.

Data only becomes valuable when they are used ... and the use of the data results in something that is value adding. This is the value chain concept in practice.

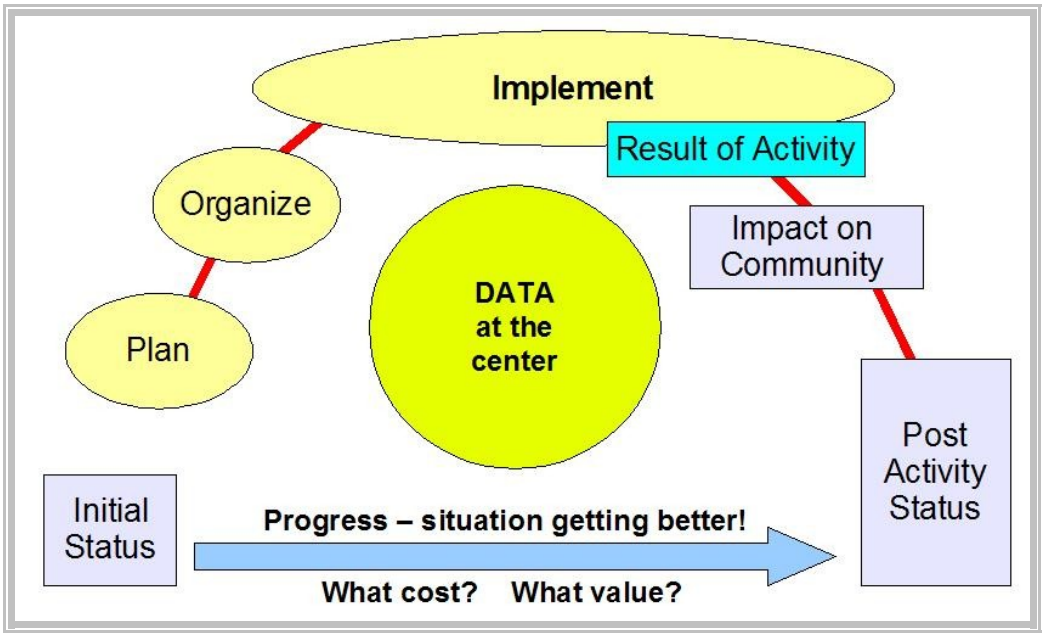
Does analysis ... do studies ... have value?

In this case ... NO or maybe! Data are obtained for a study that is then used for a treatise that results in the researcher getting a PhD degree. This has value to the researcher who gets the degree ... but no value unless the study is also used to create value.

In this case ... YES! Data that are obtained to justify a water system for a village ... and the water system is funded and built ... and the village health status is improved has huge value.

And in this case ... YES! Data are used to identify malaria control interventions that are working ... and potential resistance ... and fake drugs that are ineffective

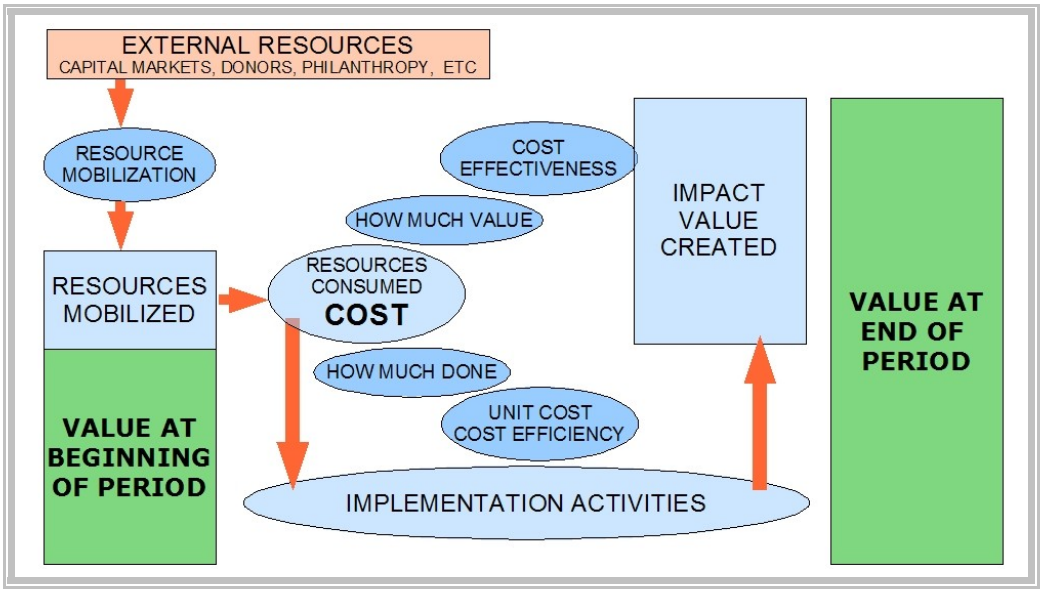
For CA data are neutral ... they are not a dataset to support a specific opinion, but all the data needed for a responsible analysis. Data flows into a store and all data are analyzed so that conclusions can be drawn. For CA the goal is reliable management information so that good decisions may be made. This CA perspective of the management cycle has data at the center ... and uses the data at every stage of the process.



This basic idea replicates throughout the CA framework. In order to be the most effective, the data must be simple, timely and clear. CA is built on the concepts of accountancy, and accountancy is, at its core, a system for recording economic transactions in an organized manner. In the corporate form, all the economic transactions are put into the record ... ALL ... and the analysis proceeds from there. In accounting there is no statistical component to the recording of transactions.

In accounting great care is taken to prepare reports based on all the relevant transactions and not just a subset that may or may not reflect all the data. This is a very different approach to surveys

and statistical studies done for research. Financial reports are not research ... they are merely all the data summarized according to the basic principles of accountancy.



It is not easy to get access to data that show the analytical elements in this graphic. Most data becomes available as a part of analysis in the context of some study with limited objectives. The key performance criteria of cost efficiency and cost effectiveness are rarely a priority ... usually not a part of a typical study.

> Book after book ... study after study ... the conclusion is reached that development assistance is not working and has not worked for the best part of six decades.
>
> Another set of studies and reports show that a specific piece of work ... a project ... has been successful, and that a specific project met its goals.
>
> Who is right? ... What is right?

\
There is a complete disconnect between the various reports and studies ... something is wrong. Maybe it is that there has been a systemic breakdown of data collection, analysis and reporting ... and a complete failure of economic actors to be effective because they are working without the support of good data and analysis.

The CA analytical approach ... materiality

CA has a community focus. The purpose of CA reporting is to facilitate decision making that improves the quality of life of a community. CA reporting aims to make the result of analysis easily accessible, convenient and timely.

One of the first steps is to be assured that the data are what they purport to be. Data should be easily verified ... and data that cannot be verified should be treated with the utmost caution.

> Sadly, this is no longer universally true because accounting principles have been superseded by various laws, rules and regulations that allow various forms of reporting of financial results that are in conflict with the underlying principles of accountancy but suit various stakeholders in the process.

The frequency of CA analysis depends on the natural frequency of the subject matter and the objective of the analysis. This requires some understanding of the underlying science or technology and some understanding of the system or process that is driving socio-economic performance.

CA analysis aims to be useful ... to improve decision making and socio-economic performance. This means that the data and analysis has a focus on what is material. There is no point in having a lot of data about unimportant things.

CA builds on accounting principles, applying them to a reporting unit that is the community and incorporating the double entry of both money and value.

There are many tools available for analysis and reporting included techniques like (1) aggregation analysis; (2) time series analysis; (3) value chain analysis; (4) various forms of cost analysis; and, (5) various way of looking at impact and cost effectiveness.

"What gets measured gets done"

CA measures progress ... measures performance ... they are related but not the same. This graphic shows how resources, impact and value are all part of the same framework of metrics.

The CA data are of two types: (1) data that describes a state; and (2) data that describes an activity. This is the same concept that is used in corporate accounting where there is a balance sheet (that describes a state) and the operating statement or profit and loss account (that describes activities). The changes in state are a result of an activity. Progress is most accurately measured by observation of the state. It is possible to have activity with no change in state and no progress.

The following shows the tabulation of any item from State 0 through Activity 1 to State 1 and then through Activity 2 to State 2 ... and so on. Typically this is for an annual period.

Item	State 0	Activity 1	State 1	Activity 2	State 2

Comparative analysis ... standards and variances

Analysis in a vacuum has little value ... there is a need to know not only what is, but what it should be, and how it differs from similar activities in other places or at other times or using other methods.

When there is just one datapoint, it is difficult to understand much about it ... but as soon as there are two datapoints much more can be said ... now there is information about one datapoint relative to the other. Comparison is very illuminating whether it is comparison from one time to another, or from one place to anther, or from one organization to another.

CA analysis takes care that comparison is done between similar comparable items ... not comparison between "apples and oranges"!

Standard cost and standard value are very powerful techniques for managing and getting control of very large and complex operations.

Actual cost systems are data intensive, with very many transactions that vary all the time, but most of the time, inconsequentially. The aggregate of these transactions is important, and the aggregate should not vary very much unless there is something going on that is of importance. A standard is built by being thoughtful about the item ... whether cost or value. The aim is to determine what the cost or the value should be. In the aggregate the cost should be the unit standard cost times the number of items. The aggregate of actual costs should be about the same as the aggregate standard cost. If there is a substantial difference, then there needs to be analysis to see what is causing the variance.

Value is different ... much more subjective ... but very useful. Arguably, the core of CA is the use of value withing a framework of accounting. Everyone knows that value is important ... but nobody wants to embrace value as a numeric measurable elements, despite the fact of its centrality to quality of life, and of everything that is important in society. CA uses an iterative process to establish standard values, and uses these values to understand the socio-economic

performance of the community. When the consumption of value (a standard value calculation) exceeds the product of value ... that is the creation of value (another standard value calculation), then there is value destruction. If value creation exceeds value consumption there is value adding.

The essence of value is more important than money ... most systems of metrics avoid putting money numbers on value. CA, on the other hand makes this a central characteristic of CA metrics.

How much did it cost?

Knowing how much something costs is pretty basic. Understanding cost and cost behavior is central to the CA system of metrics. 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.

Cost is very basic ... but even though it is a fundamental building block of analytical understanding, it is very rare that the data are presented clearly ... if at all.

Cost accounting is very well established inside corporate operations ... but little of this emerges into the public space. The level of public ignorance about costs ... and the behavior of costs is terrible low. Cost accounting is not particularly difficult ... it is not rocket science! It is facilitated when there are trained staff and there is accounting and MIS system that incorporates costing.

Cost accounting is painfully tedious and difficult when the record keeping is poorly designed and critical data not available. This is a reflection of management competence and priorities. As in many things, more and more does not mean better and better. It is very easy for cost accounting to produce massive amounts of data, and almost no usable information ... on the other hand, cost accounting data can save millions of dollars and produce success rather than failure.

> I did a cost analysis of costs on a large pulp and paper mill construction project. About three days work and I was able to show that the contractors were spending twice what the budget allowed ... they had spent 2% of the money and done just 1% of the work. The owner's representative took this up with the contractor ... the critical feedback process ... and a crew of 1,400 workers was reduced to 700 starting next day! This was a cost plus contract ... saving to the owner probably around $150 million in 1966 dollars!

There are two main ways to get at cost. One is to add up the detail, and the other is to drill down from the total. The best ... that is the most reliable ... cost data are obtained when both techniques are used and a similar result is obtained. Another important approach is simply to know the business and to keep eyes and ears open ... it is amazing how much useful information is circulating that helps to determine how much things cost.

An organization can usually report how much money ... resources ... it has used. It can usually report how much it has done ... the quantity of its primary activities. Parts of the costs are easy to obtain ... in this case the price of a bicycle. The elements of the analysis are:

	Quantity	Total cost	Unit cost
Bicycles delivered to community health workers			
Unit cost of a bicycle (price of bicycle)			$50
Estimate of other unit costs			$5
# of bicycles delivered	2,000		
Cost of buying bicycles		$100,000	
Cost of other costs (estimate)		$10,000	
Amount of funds used by the organization		$150,000	
Total unit cost of bicycle			$75

Admin and other costs		$50,000	
Discrepancy		$40,000	$20

More analysis may be relatively easy and useful. What else is known? What are the wage rates of the people working for the organization. How long did it take to deliver these bicycles? A single expatriate is expensive and not cost effective unless he/she is doing important valuable work. What is the reason that a $5 expense cost anticipated turned out to be $20 more per unit ... and $40,000 wrong in aggregate.

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. How much should it have cost to do what was done?

Knowing how much got done is also pretty basic. Without knowing how much got done, there can be no oversight, control or accountability ... no inventory control ... no operational analysis ... in other words, without knowing how much got done, the whole process of management falls apart.

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 processes and 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 efficiency is the simple idea that something should have cost X but in fact cost Y. The cost X is the cost that would be expected with a reasonably high level of performance efficiency ... usually calculated by reference to technical specifications, knowledge of the work to be done, and so on. The actual cost Y is what the accounting shows the item actually cost.

With cost analysis it is possible to move on to evaluate whether or not the operations are efficient. One way of doing this is to compare what is being achieved with what should be achieved.

A standard cost is simply what something should cost based on technical considerations and the prevailing normal prices. A well done calculation of standard cost includes norms for efficiency and what would be usual in the usual setting. In the international context different standards may be used for different countries, and used for comparative analysis.

> The international relief and development community has been doing “relief and development” for upwards of 60 years. A corporate cost accounting mindset would have set the stage for this community to know quite clearly what things should cost ... but rather than being an “open book” with a full set of accessible standard costs, the cost of everything is treated rather like a “state secret” that will put the nation in danger. Underneath this secrecy ... costs are probably too high and performance too low ... and no transparency a must

When there is a variance and costs are significantly higher than they “ought to be” there is almost always a reason. Frequently the reason is that the buyer and the seller ... people usually, but sometimes the institutions ... have some agreement that is not in the best interest of the groups that should be benefiting from the transaction. This is a common problem.

A public CA database of standard costs will help to identify situations where costs are out of control or have been distorted by inappropriate transactions. A very simple database of costs will enable comparisons to be made ... and judgments made about where costs are out of line.

Too low a cost may be an indicator of a problem just as much as too high a cost. Sometimes low cost is achieved by low quality ... and this might well have serious secondary effects.

> Low cost (price) drugs may be because a supplier is forgoing high profits ... which is good ... or it might be because the drugs being supplied are sub-standard and maybe

dangerous ... which is bad.

Impact ... value

Impact is not "How much has been done" but what value has been added as a result of doing something. Maybe as much as 90% of the data being reported back to donors in the NGO and not for profit world relates to how much has been done ... almost nothing talks about the impact as in value adding that is being accomplished.

> It has become a common practice to do a small study to show that something works and produces value adding ... and then scale up and assume that the value adding will scale up as the "how much has been done" scales up. Cost accounting (and industrial engineering) in the corporate experience shows that this rarely happens.
>
> What is vital is to understand the behavior of both costs and values. The goal is to get costs reduced without losing the value of the work. There is a point where more cost reduction results in lowering of the value of the work.

In theory, the reason for doing the work is to get a result. The result has a value ... a social value which should be given a value. In the case of health interventions the impact should be more good health ... and good health has value. It is not easy to quantify this, but CA avoids this problem by assigning standard values to most of the outcomes of community activities.

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.

CA uses standard values as the key tool to make analysis of impact or value more rigorous. While different people may have a different opinion about what value something has ... the simple step of having a standard starts to move the opinions to some consensus. The CA approach is to have a framework of standards that not only reflects what one group or place thinks about the value of something ... but various standards to reflect other views. This helps in many ways ... not least is that this starts to explain why different societies have different priorities.

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.

Cost effectiveness is the simple concept that more value for less cost is better. Rigorous analysis requires that both the amount of value and the amount of cost are known.

The challenge in CA is to consider value with some rigor while value in the world at large is totally subjective. By using CA standard values, this problem changes from being one that is ignored to one where there can be analysis of the problem and progress to improvement both of the performance (most important) and the methodology.

Value chain analysis

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.

Corporate profit reporting is based on a small part of the value chain ... a small part that excludes all of the consumption of social value and takes no credit for the social good that a good economic activity creates. Looked at from the CA perspective, typical corporate reporting is very incomplete and does a major disservice to society as a whole.

Value chain analysis is not difficult except that the data needed to do it are rarely easily accessible. Most of the effort goes into having data to work with. These are some value chain example

- Supply chain value analysis. It gets very interesting to see which part of the value chain is profiting and who are not.
- Longitudinal (over time) value chain analysis. This may be intergenerational or it may be over a person's life-time, or the life of a product.
- Inter-organization or inter-group value chain analysis. What organization profits ... and which ones do not!
- Inter-place value chain analysis. Is it the rural village or the big city that makes the profit ... is it one country or another?

Value chain analysis may be the single most powerful element in CA ... but also the aspect of CA that concerns those that are making profit from an elite position in the prevailing value chains.

A healthy value chain has two key characteristics (1) end to end value adding; and, (2) value adding at each step of the value chain. A healthy value chain serves to “pull” economic activity because it is in everyone's best interest for it to continue and grow. When either of these characteristics are missing, economic activity declines because there are interests that are not satisfied.

The CA value chain incorporates both the money costs and value and the social value consumption and social value creation. That is the value chain has both profit and value adding in its construct.

Principles of consolidation

The principles of consolidation are critical to corporate reporting where a simple but meaningful presentation is needed for complex organizations. Over the past 30 years both organization and reporting rules have become more complex ... with the inevitable outcome that this complexity cannot be managed and there can be no oversight. This is, of course, the data failure that was an important part of the systemic economic failure of 2008.

The CA principles of consolidation for a community build on the old corporate accounting principles of consolidation ... but consolidating not only the debit and credit of money transactions, but also the value adding that occurs as money transactions multiply around the community and the value destruction that takes place when money transactions take place with entities outside the community.

Analysis of aggregated activities is difficult, if not impossible. Aggregated activities are always difficult to understand and report with clarity. The reports of large corporations are rarely clear enough to be useful ... except to people who either have studied the company for a very long time or have insider information.

Macroeconomic indicators are the ultimate in aggregation. This maybe helps to explain why so little of these indicators have specific relevance in the communities where people live. They are largely intellectual constructs. They do perhaps help to explain “what” but do little to help

understand “how”. Because of this fatal flaw macro-economic dialog is one where opinion and interpretation hold sway rather than clarity about the dynamics and mechanism of actual economic activity.

Accounting has good concepts for how corporate entities and subsidiary activities should be aggregated so that there is a minimum of double counting and distortion ... this is consolidation accounting, and it is very useful when rigorously applied in the analysis of community performance.

The CA reporting format embraces the accounting ideas of “roll up” and “drill down”. The CA reporting framework has the community as the primary unit for accounting. The data about community may be aggregated to provide reporting at the district and provincial level as well as at the national level.

The same framework of data is used at each level. The “roll up” and the “drill down” of the data provides a coherent set of data for decision making at the national policy level and at the tactical operational level in the community.

The following shows the “roll up” and “drill down” framework by geographic area:

Country	Province	District	Community	Location

The CA analytical model aims to have a minimum of assumption and a maximum of simple aggregation ... accounting arithmetic more than statistical mathematics.

A good system is easy to navigate ... and with the ease of navigation there ought to be questions arising. Typically the questions will be (1) let me see more details about this; or (2) how does this affect the big picture?

The drill down capability helps to get at more details. For example going from the total cost to the specific elements of cost that make up the total, or, going from total child mortality to the specific causes of this mortality ... was it malaria, or diarrhea or respiratory illness.

The roll up capability makes it possible to see how changes in a detail change the performance at the aggregate level. In most of national level reports the data being reported are statistical constructs that incorporate all sorts of assumptions.

Behavior of cost and value

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.

Optimizing performance requires understanding of the behavior of both cost and the value ... neither of which is simple. An optimization model that incorporates the many variables that are normal in human society and in sectors such as health is very complicated ... and does not work well unless there are large quantities of reliable data.

However, some of the behaviors are easy to understand ... but even the simple behaviors are not being documented well and knowledge about cost and value is primitive. It need not be ... and the CA initiative in conjunction with initiatives like IMM will help to change this aspect of performance metrics.

> Good managers use the available data to achieve the best possible results. Good managers respond quickly to what they see is happening way more quickly than an ex-post factor academic study.

The behavior of cost is determined mainly by the system or process ... that is, the underlying science and technologies, and by the competence of the people involved and the decisions they make. Most students of cost accounting know about fixed and variable costs and know the simple breakeven chart ... but in practice everything varies, and the variations can be substantial.

In CA, the basic approach is to understand the way the system or process works, and use data to determine how costs relate to the system at a specific state ... and work from their to determine how costs are going to change as the system changes.

If a software application costs $1 million to develop plus $100,000 to deploy the first unit ... the unit cost is $1,100,000 million. If the second unit deploys for $50,000 then the total cost is $1,150,000 and the unit cost drops to $575,000. If the next 8 units cost $25,000 each to deploy the total cost becomes $1,350,000 and the unit cost drops to $135,000. After this the deployment cost drops to $100 each, and by the time 100,000 have sold the total cost is $11,349,000 ($1,350,000 plus $9,999,000) at a unit cost of $113.49. This is not an extreme case ... it is the basic business or economic model that has made modern IT such an important value adder for society.

Value usually has a different behavior. A medical intervention for a critical health condition that makes death likely without treatment has a value that is huge. How huge is subject to debate, but the value in social value terms is big. A medical procedure that makes one look a little more handsome is not in the same league as the one that saves life. And value may not relate simply to the way costs are incurred ... preventative care does not have immediate impact ... but in time its value emerges. This is addressed within CA by the use of value chain analysis that links a series of costs with a series of values.

Understanding causal relationships

Data have great value when analysis helps identify causal relationships. Most systems that are influenced by humans are complex, but good data and analysis can help to understand something of how the system works.

Large scale datasets and complex multivariate analysis may make it possible to discern relationships within complex systems ... but it is also possible to figure out some of the most important causal factors by simple observation. Good observation and common sense should be used to the maximum.

Quite brief observation of a situation where performance is very bad may be sufficient to identify a practical solution ... a low cost analysis giving a high value outcome.

> A factory production line is producing on average 20,000 units per shift. The theoretical production should be nearly 40,000 per shift. Labor cost was nearly double what it should be! What is wrong?
>
> Watching the production line for a short time showed the unreliability of several of the machines ... strung together in series ... and downtime escalating exponentially.
>
> There were two possible solutions ... redesign the production line to have parallel equipment ... or using a spare line approach so that the production crew could be fully utilized. The second approach was used and labor costs dropped to almost what is should be theoretically!

Considerable care needs to be taken in drawing conclusions from small observations ... but in many cases material improvement can be achieved by getting data simply by “walking around” and making observations.

> Stock prices are reported as a continuous stream ... indexes of capital market valuation are also reported in real time. Why? Bloomberg News and others facilitate some knowledge about economic activity ... but rather little of the totality of what is

required for an informed public. The socio-economic behavior of society would be changed substantially if more understanding of cost was in the public debate.

Reporting approach

Reports must be clear, complete and unambiguous

CA reporting has more of accounting than it has of statistics. The goal is for everything that is "material" to be accurate and reported ... and for the important elements to be reported well and clearly and not be overloaded and hidden by minutiae. The concept of materiality applies.

CA also addresses the problem of reporting objectively in situations where there are not numbers or generally accepted proxies for the numbers.

Financial reports are able to report a lot about corporate performance in very few numbers ... a few pages to report performance of an organization with more than 100,000 staff is impressive. In order for this to be reliable, there have to be sensible rules and the strict application of good principles of financial reporting.

Though there have been serious problems with financial reporting in recent years ... notably Enron, Worldcom and others, financial sector institutions, and a number of corrupt enterprises, the basic principles of accountancy applied to financial reporting are very powerful.

Time series

Time series trends are great indicators of progress ... or not. Time series are simple, clear and powerful. While it is possible to do advanced statistical manipulation ... simple and clear time series tables and charts work very powerfully 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

A plot of a single parameter shows how this parameter has changed over time ... but in isolation does not show what might have been the cause of any changes. Plotting multiple variable may show something about cause and effect. While this may be done by simple visualization for a couple of variables, a more rigorous mathematical approach is needed for large scale multivariate analysis.

Time series trends are great indicators of progress ... or not. Time series are simple, clear and powerful. While it is possible to do advanced statistical manipulation ... simple and clear time series tables and charts work very powerfully as well ... maybe better.

> When I made a very simple plot of prices of shrimp in the New York market month by month over a period of nearly thirty years .. from 1946 to 1974 ... I gained a perspective of the shrimp industry better than most. I believe this enabled me to interpret the history of the industry correctly, and because of this I was able to predict how the oil shock turmoil of the 1970s would impact our company ... a major producer of marketer of shrimp worldwide ... and how we should position ourselves for success.

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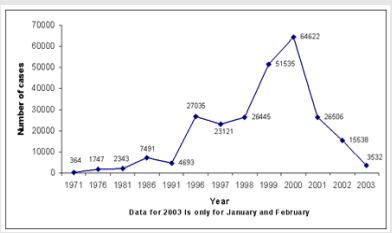
Time series example	**Experience from Kwa-Zulu Natal.**
	In this example the measure was low, then increased rapidly, and then decreased again. In this example the measure is the number of malaria cases in the area, which rapidly increased when the use of DDT was stopped, and then decreased again when 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.

Time series are powerful. The time interval should be what is natural for the activity being studied and reported. This may be frequently through a day, or at intervals over years. The important thing is to retain integrity in the data over time and not change methods arbitrarily during the course of the series.

By month seasonality

Many of the elements of the community socio-economy have seasonal characteristics, and the data needs to be compiled to show this. Using a monthly reporting format will show seasonality clearly.

Time series that compares different places for year YYYY

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
etc.													

Time series that compares different years for the location ABC

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 1													
Year 2													
etc.													

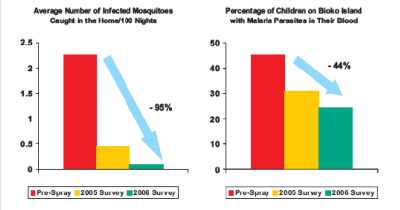
Problem of reports that misinform ... disinformation

There are many reasons why reports are prepared to misinform, rather than to inform. Favorable information ... about, say, a company's prospects and increases the stock market value of a company and can make someone money ... and drive the demand for reports that misinform. Misinformation is big business, and keeping control of this used to be the province of professionals in accountancy and regulators like the SEC.

There are many ways in which reports are prepared in ways that misinform. One of the best ways to misinform ... or half inform ... is to report using graphs. Another is to associate a well respected name to a report without disclosing the fact that the name has done little more than being paid to use the name. This practice is widespread ... and totally unprofessional and irresponsible.

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.

Example 1

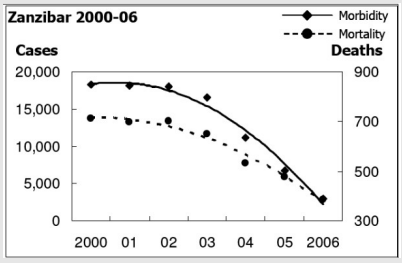


Experience from the Marathon Oil, Bioko Island

In this example, the graphic clearly shows good 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 graphic does show progress ... but at what cost?

Example 2

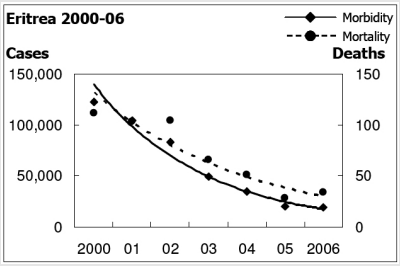


Experience in Zanzibar 2000-2006

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.

IMM

Integrated Malaria Management

Section III

Integrated Health and Malaria Management

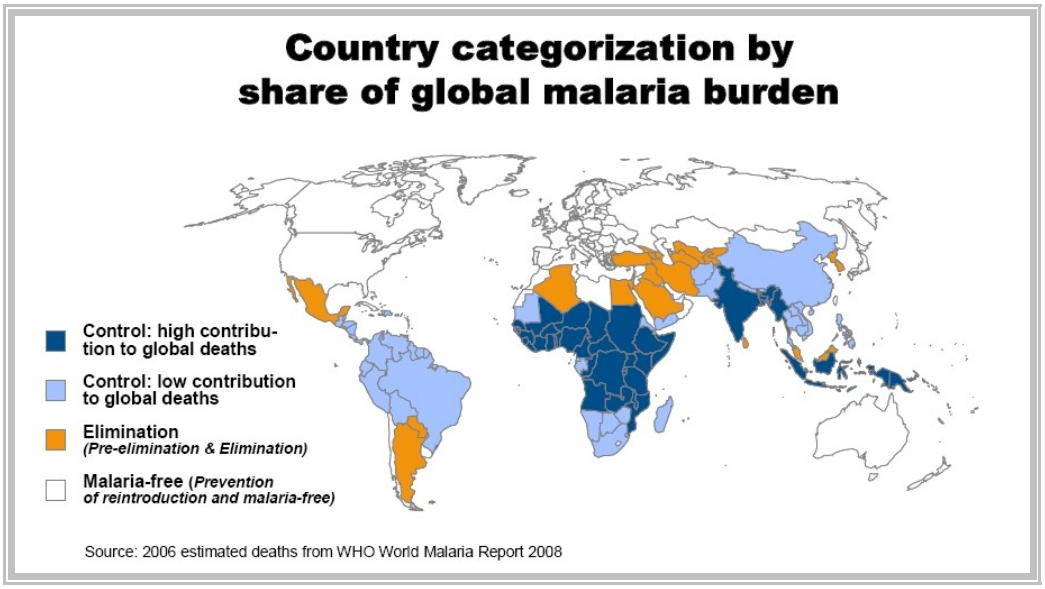
Context

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.

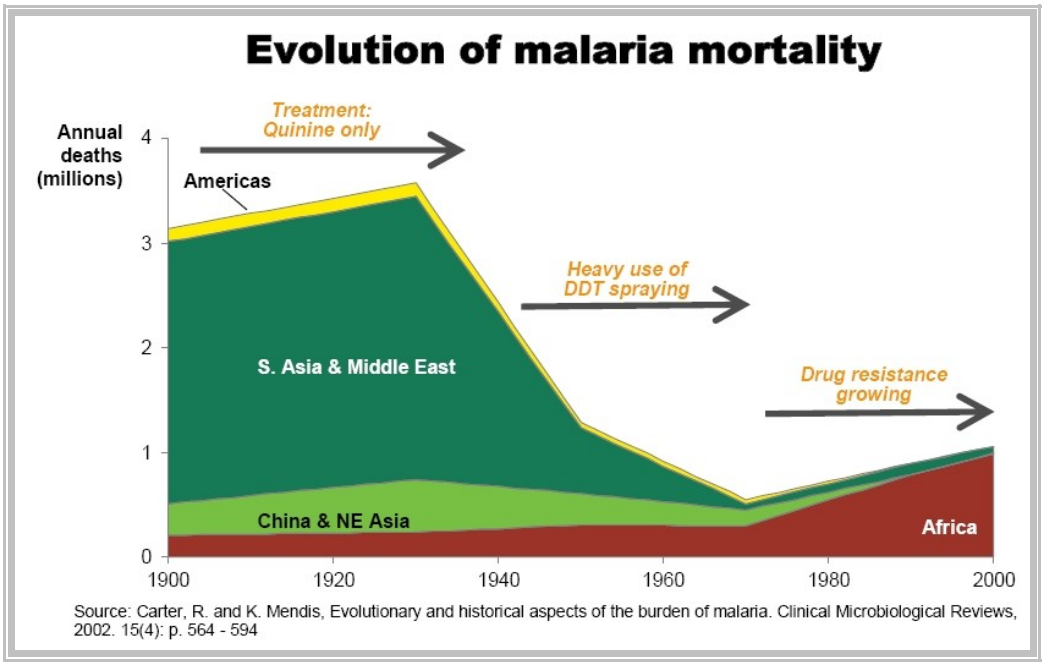


Near eradication of malaria has been done in some parts of the world, but not in Africa where it remains a major health crisis and contributes seriously to poor socio-economic performance. Much of the work done in the past in Africa has been expensive and ineffective.

Good health is not an impossible dream

Modern knowledge about health is advanced. Much of the disease in Africa that is lethal is also preventable or curable. The challenge is not the science ... but rather the dysfunction of the global economy and the major institutions charged with important responsibilities. The IMM best practice is a way for health to be improved both with respect to malaria, but also other critical diseases, especially acute respiratory illness of children, diarrhea and reproductive health.

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 from around 1935 to 1970.



Source: WHO-RBM image in the 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.

It is worth remembering that much of the United States had malaria until sometime after WWII, and that the problem was eliminated by vector control and medical treatment using the science available up to that time. Europe was a malarial area for much of history ... but largely eliminated as development progressed ... and finally eliminated using aggressive vector control in the 1950s.

Health science and technology

Enabling science

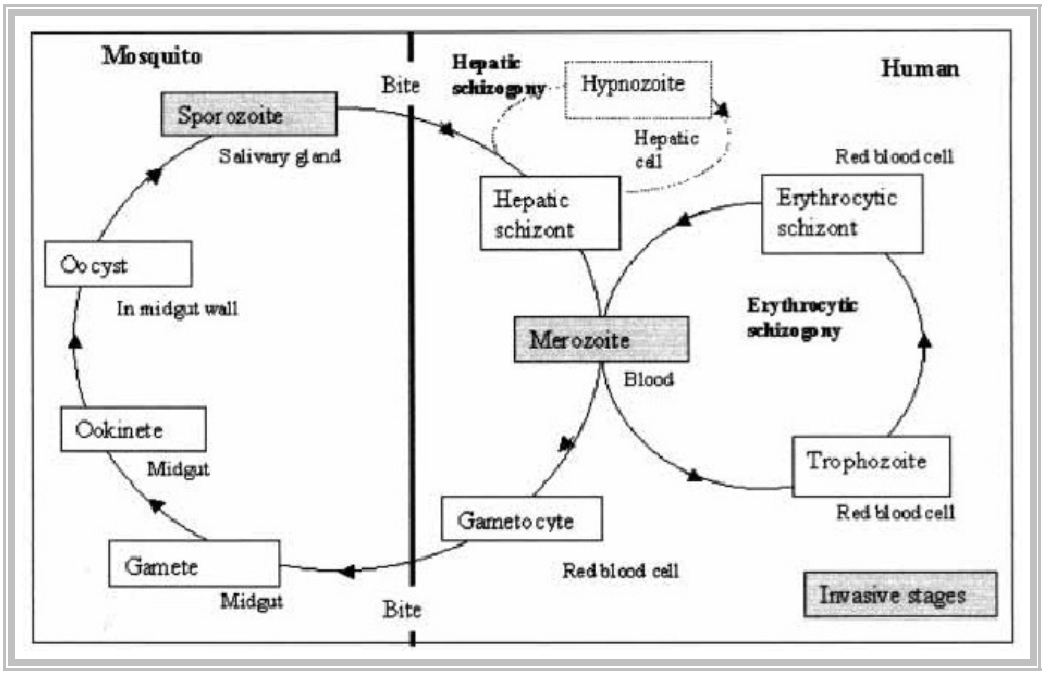
Scientific knowledge has been sufficient to eliminate malaria from many areas that were once dangerously malarial ... but the practices that were successful were not widely used for the general public in Africa after independence.

Malaria 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.

Medical science

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-invection ... 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

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. A lot of the failure of development can be attributed to the lack of understanding of human behavior, especially when different cultures are involved.

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.

Computer science

Computer science has facilitated paradigm shift in other sciences, and in some parts of industry and commerce. The potential of technology that applies modern computer science to deliver paradigm shift that serves public health is enormous.

Computer science has become an integral part of modern society and the global economy ... it is ubiquitous. However the power and the potential value of computer science applications is largely unrealized.

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.

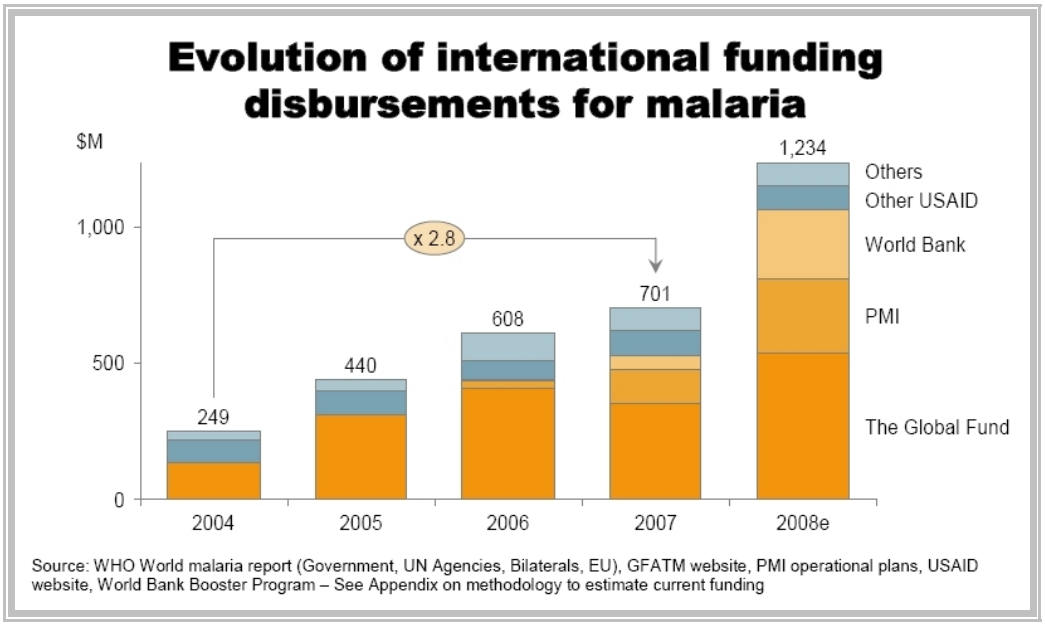
Since 2000 there has been significant media attention to the African malaria crisis, and the outcome has been very much increased international commitments of funds to fight malaria and the emergence of a new community of people and organizations engaged in various aspect of the malaria industry.

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.

Funding growth for malaria control

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.

Table 1: Summary of annual global costs

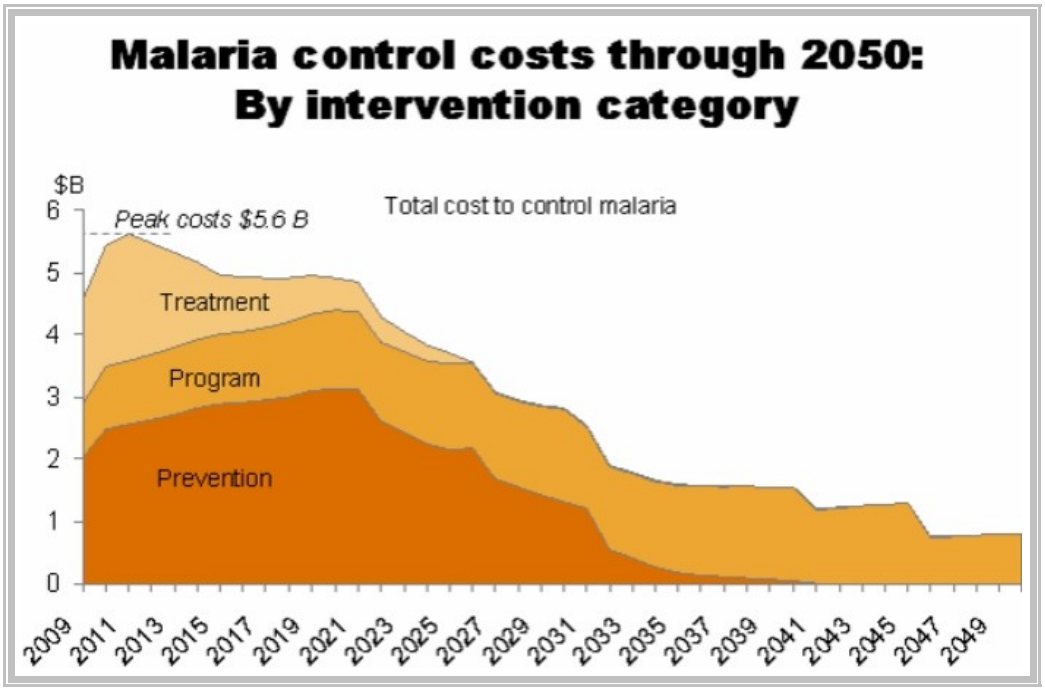
Cost (US$ millions)	2009	2010	2015	2020	2025
Prevention cost	3,728	3,982	3,724	3,864	2,576
Case management cost	968	1,359	550	226	87
Program cost	638	839	764	787	714
Global control and elimination costs	*5,335*	*6,180*	*5,037*	*4,877*	*3,378*
Research & Development cost	759	759	800	681	460
Total cost	**6,094**	**6,939**	**5,837**	**5,559**	**3,838**

Note: Detailed cost estimates are included in Part II - Chapter 5: Costs and Benefits of Investing in Malaria Control, Elimination and Research, Appendix 4 and Appendix 5

Source: GMAP costing model

The projection for 2007 is more than $6.9 billion for 2010, and still more than $5.8 billion in 2015 as shown in the following table from the WHO Global Malaria Action Plan. (WHO-GMAP)

These costs decline from about 2020 onwards, but the annual cost remain around $1 billion a year as shown in the graphic also from the WHO-GMAP



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.

Strategy for sustainable good health

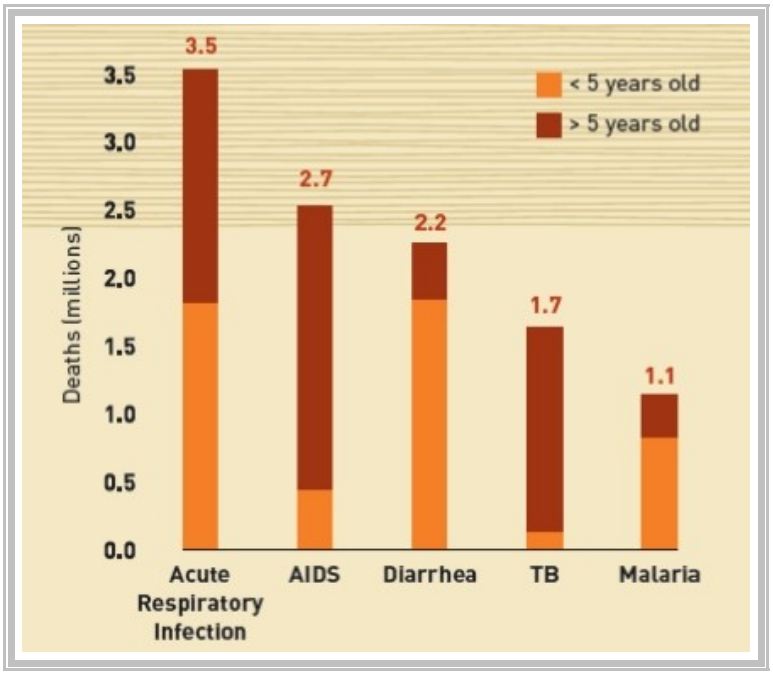
Health strategy

It is widely accepted that early diagnosis and treatment is the best way to mitigate the bad consequences of illness and disease. For this to be possible there has to be an appropriate locally accessible health service ... and the starting point for having this is to have data that shows what elements of health infrastructure exist and what capacity and capability there is. An adequate health infrastructure must not only be easily accessible to the local population, but this access must also be affordable.

The strengthening of health care infrastructure should start with what the community needs based on the profile of disease in the area. A strategy for addressing a single disease is unlikely to produce a long term sustainable health infrastructure unless there are the data that help determine best use of resources.

The case for integration of health programs

The following data from WHO in 2000 shows the relative importance of diarrhea, acute respiratory disease and malaria for under 5 child mortality. While malaria mortality is high, so also is mortality from diarrhea and acute respiratory disease. From a purely medical perspective none of these diseases should be life threatening for young children ... but if there is no infrastructure there is going to be preventable mortality.



The data show that for older children and adults HIV-AIDS and TB are the diseases associated with high mortality.

These data suggest that the most cost effective successful health performance at the community level will be one where there is a broader clinical capacity rather than one that is deep but has only a single disease focus. Infrastructure is most cost effective when the system has the capacity to address all the main diseases, and not just a single one. A system that has the capability to reduce mortality caused by diarrhea, acute respiratory infections and malaria is going to have a level of cost effectiveness way better than one that only treats malaria ... or only treats an other single disease.

Managing for impact

As the funding has increased, there has been increased attention to performance metrics and accountability. In the early stages this was more talk than walk, and there were many initiatives where money was disbursed and the results were inconsequential. The issue of performance metrics and accountability has remained on the agenda, and there has been progress ... but the quality of the metrics is more pass than excellent.

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 also said that getting performance metrics is essential and appropriate for an ongoing program that will have to be accountable to funding sources.

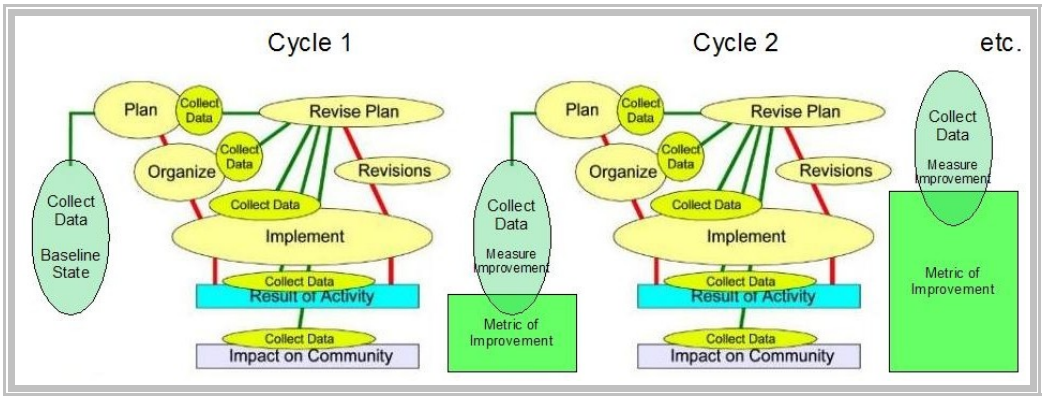
The IMM strategy puts data at the center, and organizes around what the data suggest are the best ways forward. Experience suggests that a data centric program can be substantially less costly ... much more cost effective ... than programs that make less use of detailed data for decision making.

> 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.

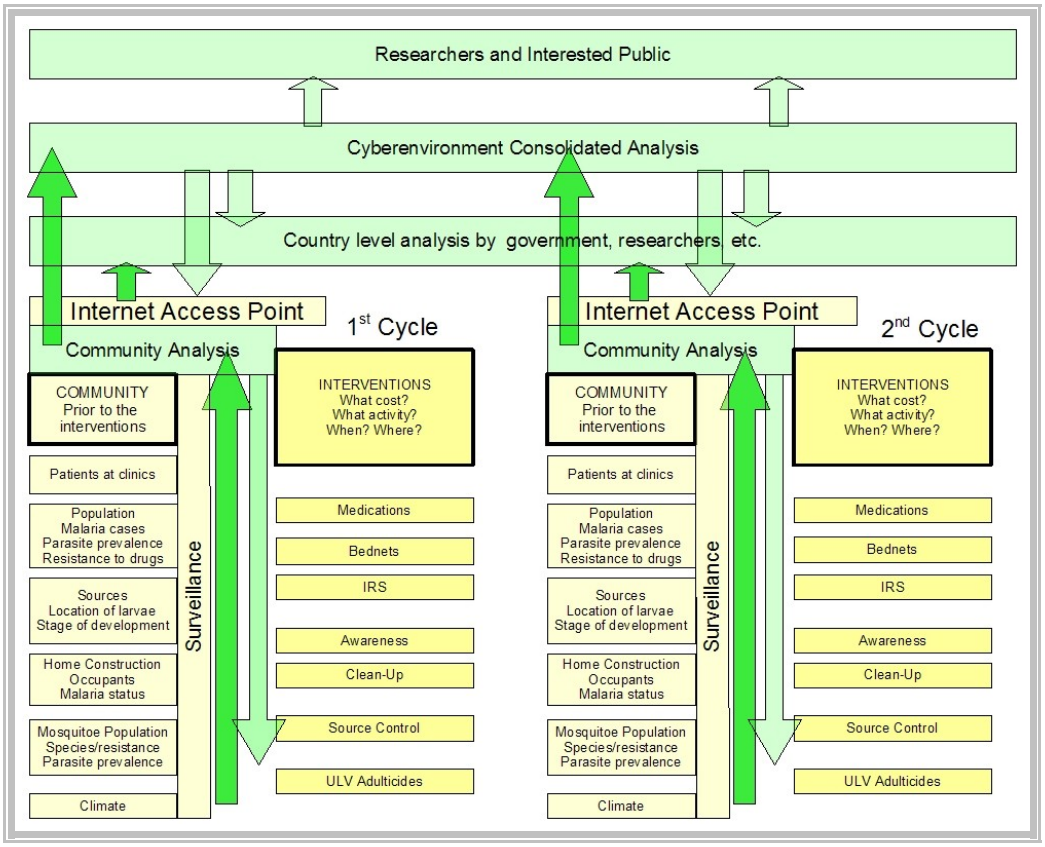
Management Strategy

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 and progress is achieved over time ... a continuum of progress:

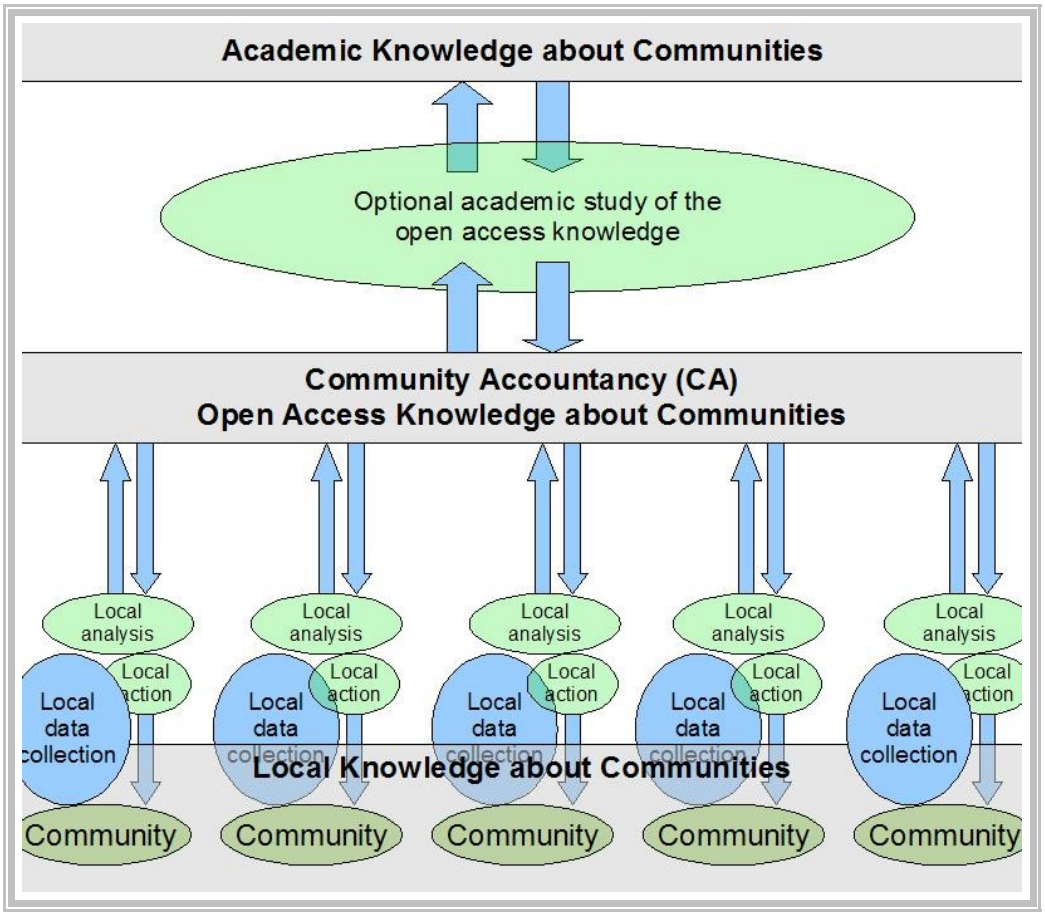


This can be represented by the specifics of IMM in the following graphic. Relevant data are collected and used for planning the detail of the interventions at the community level ... and then monitored to check progress. These same data may be used at higher levels to monitor progress and for research.



It is evident from the research that the various parameters of malaria disease very considerably from place to place. Working at the community level makes it possible to have a range of interventions that are most suited to the place ... and this results in significantly better cost effectiveness of the program.

Another way of representing the dataflow and decisions is set out below. This shows that community centric data gets used at the community level to do local analysis and get local action ... and then these data are also used to have an oversight level ... and hen again an academic or scientific level. Data are most cost effective when one set of data are capable of being used in many different ways ... in this case at the local level, the oversight 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.

Data that makes it possible to have easy oversight is also important. Oversight ensures that the operational decisions are getting good results ... and if not allows for rapid response so that the important questions are asked, specifically (1) is the result because of poor operations that management must addressed locally; or, (2) is the result because there are problems emerging, such as resistance, that need to be addressed on a local and global basis.

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.

Community centric health strategy

About community health infrastructure

The community health infrastructure may well be the most important determinant of the health of the people in the community. If timeliness is important ... then a community health care presence is very valuable. But community health is improved with local infrastructure because the process is lower cost as well as the outcomes being better.

With community health infrastructure	No community health infrastructure	No community health infrastructure
	Good outcome	**Bad outcome**
A person feels ill	A person feels ill	A person feels ill
Easy visit to the clinic	Waits in hope illness will go away	Waits in hope illness will go away
Quick accurate diagnosis	Illness gets worse	Illness gets worse
Treatment specified	Have to find transport	Have to find transport
Pays for clinic	Pay for transport	Pay for transport
Drugs purchased ... pay for drugs	Get to clinic	Get to clinic
Treatment started	Wait in line	Wait in line
Person goes home	Maybe have to wait to next day ... stay overnight or redo the journey.	Maybe have to wait to next day ... stay overnight or redo the journey.
Person gets better	See health worker ... get diagnosis	See health worker ... get diagnosis
	Treatment specified	Needs hospitalization
	Clinic paid for	Clinic paid for
	Buy drugs ... pay for drugs	Pay for hospital
	Treatment starts	Treatment starts
	Patient goes home	Buy drugs ... pay for drugs
		Treatment too late
		Patient dies

The data about the health cost and health situation in communities that have a working health infrastructure and those that do not are not easily accessible ... and may not exist in a form suitable for easy analysis. But simple observation suggests that there is a great difference in the two situations.

Community governance ... and local oversight of health activities

The political governance of the community must be respected. It is not only a courtesy, but it is also very practical since it is common for the elders to be custodians of much of the important wisdom of the community.

Health activities are best coordinated at the community level. A person who is sick wants to attend a clinic that is going to address whatever illness there is ... not merely a single specialty of the clinic. This is doubly important where the capacity for diagnosis is low.

Coordination of malaria specific interventions needs to be area specific. Malaria is an unusual disease. Because of the mosquito vector and the life cycle of the parasite, people are exposed to

reinfection. This has many consequences including the need to have multiple interventions that both treat malaria and control mosquitoes.

There must also be capacity to carry out malaria control interventions. Having the capacity to carry out malaria control activities must be a priority. For staff, this means recruitment, training and the funding for staff remuneration. For treatment, this means capacity for accurate diagnosis and the availability of the required drugs and medical supplies.

The value chain ... ensuring it adds value

There are costs to create the infrastructure and there are costs to keep it working. How should these costs be funded? Is it a government responsibility, or the responsibility of international donors or charities? Maybe ... if the costs are moderate ... the payment for these services should come from local people and local business in the general interest of the community.

The value chain of community health interventions is very healthy ... low cost intervention quickly reduces illness and makes it possible for the people to be more productive. More productive people should be able to pay for the healthcare intervention.

In some communities the health care intervention may be paid for by the intervention of a microfinance institution that can pay for the healthcare and recuperate the cost from the clients directly or as part of an insurance program.

Public awareness and community involvement. Good health is facilitated when the community has some understanding of the need for early intervention, and knows the critical issues about malaria and mosquitoes. Changing long held beliefs is not easy and quick ... but is essential and yields great results when given enough time.

Creating jobs is always a benefit. Local health care should be provided in some part by locally hired staff. These staff may need extra training, but the value to the community justifies the additional expense.

It is difficult to show the impact of not having health infrastructure when much of the dataflow about health originates at health facilities

Portfolio of interventions

For each community ... or most appropriate geographic area ... there are many different interventions that are needed for optimum malaria control. These interventions should be planned to be least cost and maximum impact based on data about the local habitat, the local mosquito population, the local human population, the history of prior interventions and the health infrastructure.

The portfolio of different interventions is as follows:

- Local coordination and oversight
- Surveillance ... data collection and analysis
- Education and awareness
- Local health infrastructure strengthening
- Community clean up
- Personal protection
- Medical care
- Source control ... larvaciding
- ULV adulticiding
- Interior residual spraying (IRS)
- Insecticide treated bednets (ITNs)

Each of the interventions operates in a different way, is planned differently and has different cost behavior. There are very little data that show the optimum mix of interventions ... the models that have been used to simulate the behavior of mosquito and malaria suggest that integrated programs work better, but the data have never been organized to study this and generate reliable results.

Review of the literature suggests that IRS using DDT is one of the most effective interventions, and when combined with good medical care using an effective anti-malarial ACT drug can reduce the malaria burden rapidly. Sustainable results, however, are achieved only if all the activities are organized to be done by local staff, and there are pipeline products available in the future to counter any emerging resistance.

In addition there are also a range of medical interventions that are specific to other diseases. What is clear from some understanding of the behavior of cost is that trained medical staff have the capacity to treat more than one single ailment ... and that any system where there are separate systems operating to serve single specific diseases is an inefficient way to use scarce resources.

Oversight ... management, policy and strategy

The oversight dimension

The purpose of oversight is to ensure that available resources are used effectively. Oversight is a critical component of a management framework ... it serves to ensure that good decisions are made. The oversight function should not, under normal circumstances, be a decision making entity.

Characteristics of the data needed for oversight

The data that are used for oversight management information is clear quick data that goes to the heart of all the issue that have importance. Management oversight data flows so that everyone concerned is making good decisions and is seen to be making good decisions.

These data are best when they are quick, clear and simple ... and low cost. When the situation is under control, the data will confirm what is expected. A situation is out of control when the data show that what actually is happening is very different from what was expected.

> It is important to note that cost and management data have a different purpose than the statistical data used in, for example, clinical trials. Generally speaking, statistics used in cost accounting give results that are frequently just plain silly ... while a drill down to critical data will provide useful and sometimes very accurate information.

Oversight ... not second guessing

The purpose of oversight data is simply to ensure that the community level interventions are going well ... and if not to see what is the cause of the problem. Most of the time, oversight should merely confirm that work is going well ... not much more.

From time to time the oversight data will show that interventions are not going according to plan, and steps will need to be taken to rectify the problem. The oversight data are not designed to identify specifics about the problem ... just to give a quick reliable indication that there is a problem.

Where a problem is identified using oversight data it should be possible to: (1) drill down to more detail about the specific community interventions; and, (2) to get more information from the community to see what is going wrong.

Comparative analysis

CA uses comparative analysis to ascertain how performance is relative to something else ... the something else can be a standard or it can be relative to another time, or another place, or another organization. Putting performance into perspective this way helps to ascertain whether performance is good or bad relative to what it should be.

Comparison helps to identify why and how performance is different from what it is in other situations ... and what it should be. With this it is possible to start a process of drill-down to get meaningful explanations.

Research

Importance of managing research

Research is a vital part of tomorrow ... and yesterday's research is why there is so much that is important today.

Research is best when it is managed ... but the methods of management are way more subtle than anything that gets taught in a quant class at a business school ... even the very best.

Great research does not neatly fit into a box in a business process flow chart ... or in the 9 to 5 work-day syndrome. Research progress happens when it is ready to happen.

Great research is motivated by something more than merely money ... but money reward should not be ignored ... nor is it sufficient on its own.

And great research that does not yield a great outcome is sometimes as important as that that does yield the great outcome ... especially when it is done in a way that allows collaboration and cooperation.

Sadly there is also research that has little potential either for meaningful progress for science, or for valuable application. Good managers of research are able better than others to identify this and guide the research into a better path. This is not easy ... but some do this much better than others.

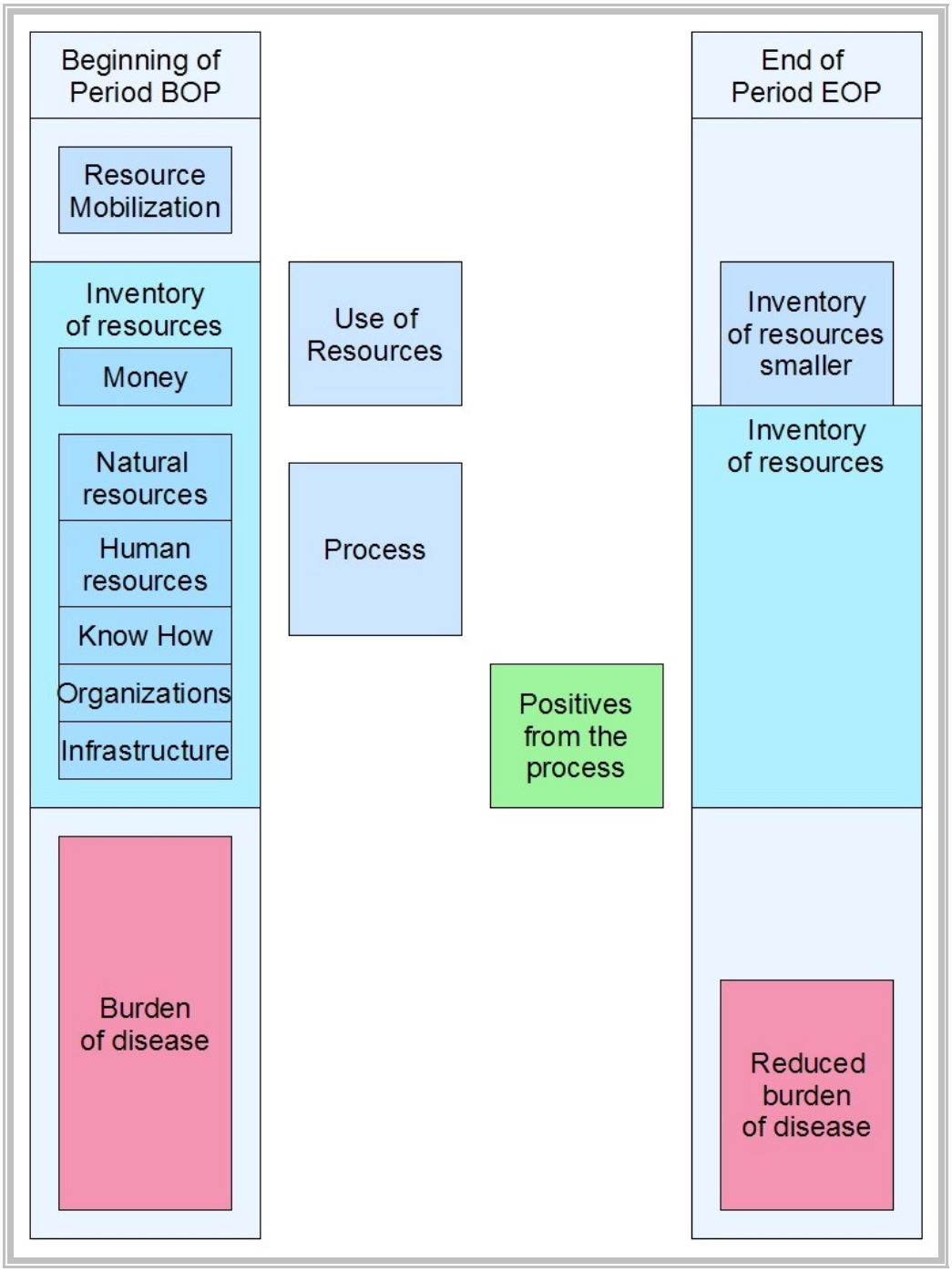
Arguable, there must be effort to ensure that most resources get allocated to research that has potential to be of value, if not now at some time in the future. There must be effort to identify those that merely want research simply it is an area where there is rather less accountability for progress and performance than in other areas.

It is also necessary to manage the matter of money. Research is needed because there are problems that needed to be solved now, and there are problems that need to be addressed because they are likely to emerge in the future. The research agenda needs to be driven by what is scientifically and socially important. It is, however, a challenge to get the funding to be on the same agenda and with the same priorities as the priorities for an optimum research agenda.

Integrated Health Management

Managing in a complex environment

Managing in a complex environment is less difficult when the complexity is recognized and steps taken to get good results in spite of the complexity. The concept is very simple ... to use the minimum of resources to get the most result. The schematic below sets out the theme ... an inventory of resources used in a process that has some value because of its multiplier effect and further value because of the reduction of the burden of disease.



Some key facts about global health are well known: (1) too much disease; and (2) too little resources. These are facts that impact quality of life and constrain performance.

Health and malaria coordination

How it works

Coordination is frequently identified as an issue that constrains performance ... but the usual solution which it to have a top level coordinating group rarely works, rather it adds to the problem. On the other hand a focus on coordination at the community level is very effective. This is where coordination really matters and where results can be achieved.

By having coordination at the local level it is possible for local surveillance, local data and local analysis to inform decision making about local action to get results.

> 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 interventions are 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.

Planning considerations

An integrated malaria management program has several components all of which impact on each other ... but there is also a broader impact on how the whole of the health sector performs. Interventions that only improve malaria health without there being any progress on other killer diseases in the community is poor outcome.

A malaria control area and mosquito vector abatement area must be large enough to encompass the sources of mosquito vectors and pests to be managed. 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.

Local information is the best information ... if the local information is the primary information that is used for operational management and control, these data will be operationally accurate. Data that are used tend to be good data.

These data then can become a good foundation for additional scientific analysis in a multi-variate setting.

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.

Comprehensive portfolio

Characteristics of the needed data

These data are important ... but the goal is to have data that are useful rather than merely to have a lot of data. CA embraces the following idea and applies it in the IMM framework:

> **"Management information is the least amount of information that enables a good decision to be made in a timely way."**

Some data has a high value if it is available at the right time. With timely data, there can be the correct response and a problem resolved. Examples include:

- Data about the life cycle stages in mosquito breeding sites;
- Data about disease in a sick person.

Data have value when the data can be used in decision making. There are two issues that play into this:

- Is there a feedback process for decision making;
- Is there the capacity to implement what is needed.

Data for planning are different from data to assess performance. In both cases data may have different levels of detail depending on the situation.

- A good starting point is to get the data that are needed to get started ... and a framework of data collection so that the work can be re-planned when more facts are available;
- For performance it is useful to have data about "quantity" done ... but this is not enough. The has to be data about the impact of what is done, even though this may be difficult to ascertain.

Data needed ... based on experience and common sense

Someone with long experience of vector control and public health was asked how he would implement a malaria control program in Africa. His reply had a focus on getting data to show where the problem of malaria was the most serious ... where malaria mortality and morbidity was the worst and starting there. This would be followed up by getting data that showed progress relative to the interventions that were implemented.

In the CA methodology, 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 data are of two types: (1) data that describes a state; and (2) data that describes an activity. This is the same concept that is used in corporate accounting where there is a balance sheet (that describes a state) and the operating statement or profit and loss account (that describes activities).

Item	State 0	Activity 1	State 1	Activity 2	State 2

Surveillance ... data collection and analysis

How it works

Coordination is frequently identified as an issue that constrains performance ... but the usual solution which it to have a top level coordinating group rarely works, rather it adds to the problem. On the other hand a focus on coordination at the community level is very effective. This is where coordination really matters and where results can be achieved.

By having coordination at the local level it is possible for local surveillance, local data and local analysis to inform decision making about local action to get results.

> 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 interventions are 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.

Planning considerations

An integrated malaria management program has several components all of which impact on each other ... but there is also a broader impact on how the whole of the health sector performs. Interventions that only improve malaria health without there being any progress on other killer diseases in the community is poor outcome.

A malaria control area and mosquito vector abatement area must be large enough to encompass the sources of mosquito vectors and pests to be managed. 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.

Local information is the best information ... if the local information is the primary information that is used for operational management and control, these data will be operationally accurate. Data that are used tend to be good data.

These data then can become a good foundation for additional scientific analysis in a multi-variate setting.

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.

Satellite imagery

Satellite imagery is a very powerful and cost effective way of getting rapid knowledge about an area and an overall understand of the topography. 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 much 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.

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 more affordable prices. Initiatives like Google Earth are helping to make the use of satellite imagery an essential step in cost effective data collection.

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.

Image 1 		Image 1 shows the area around Monrovia, Liberia. The map covers around 50,000 acres of which some 15,000 acres is marsh, and very close to human habitation. Ground surveillance will confirm whether the whole of the marsh is habitat for mosquito breeding, or just limited areas. 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.

Image 2 		Image 2 shows individual houses in a section of Monrovia. Images of this sort enable plans to be made for surveillance and for interventions. The 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 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, ESRI and others. The cost effectiveness of

satellite imagery for purposes like IMM is improving rapidly ... but it is not yet clear that the prices for access to these tools will be affordable for sustainable use in IMM type work.

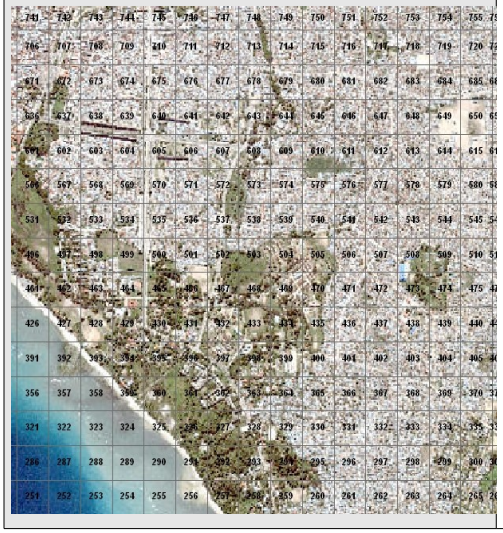
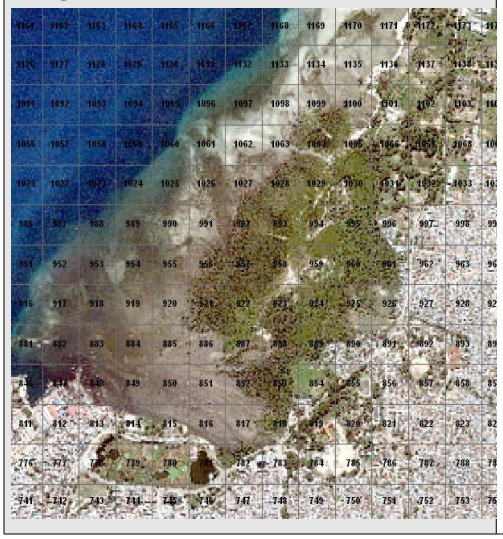
Image 3 		Image 3 is of Stone Town and its outskirts in Zanzibar. It is supplied by QuickBird and incorporates data from both the visible and the near-infra-red (NIR) spectrum. A grid based matrix has been overlaid.

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

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

A database provides the functionality that addresses the challenge of time series analysis with many variables. The powerful analytical capability of computer technology may be used to great effect.

Cost factors for surveillance ... data collection and analysis

Coordination cost – actual by month for year N

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Workshops													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training programs

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Person.days of trainers													
Cost													
Person.days of students													
Unit cost per student													

Activities – Standard versus actual

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
People involved													
Std. cost													
Standard													
Actual													
Variance													

Cost factors for health and malaria coordination

Coordination cost – actual by month for year N

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Workshops													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training programs

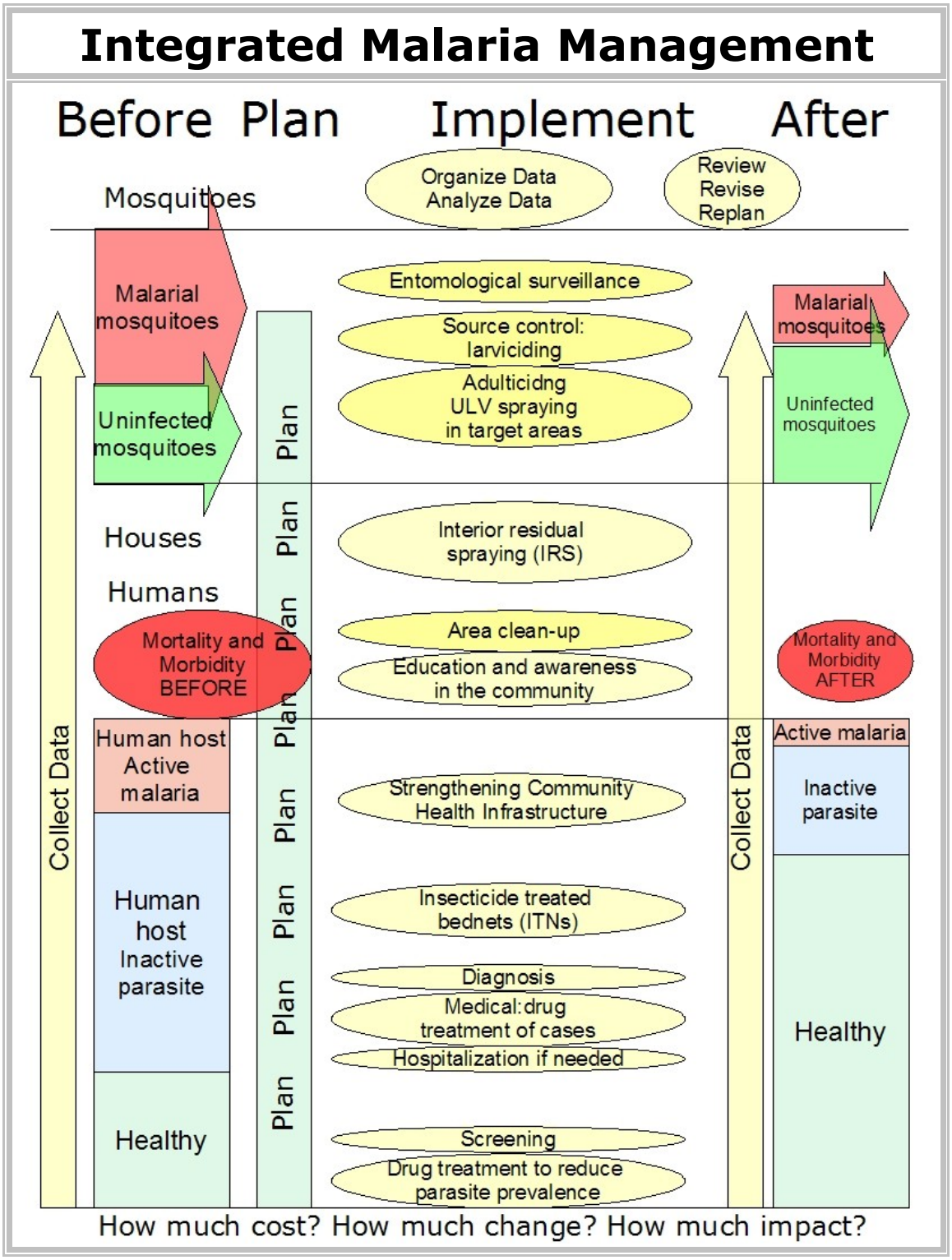
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Person.days of trainers													
Cost													
Person.days of students													
Unit cost per student													

Activities – Standard versus actual

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
People involved													
Std. cost													
Standard													
Actual													
Variance													

IMM interventions

IMM is an integrated program. The following graphic summarizes the various interventions involved in integrated mosquito and malaria management together with some of the key before and after parameters:



Framework for IMM data

IMM uses the following metrics to plan interventions and measure performance:

	Item	Prelim	State 0	Activity 1	State 1	Activity 2	State 2
	State						
A	Area surveillance	X	X	X	X	X	X
S	Where are people living and getting malaria ... is problem getting better?	X	X		X		X
A	Area surveillance	X	X	X	X	X	X
A	Data from health centers	X		X		X	
S	What is mortality arising from malaria ... is mortality reducing?	X	X		X		X
S	What is morbidity due to malaria ... is morbidity reducing?	X	X		X		X
A	Area surveillance	X	X	X	X	X	X
A	Health infrastructure improvement	X		X		X	
S	What is state of access to health clinics	X	X		X		X
S	What is status of malaria expertise and drugs	X	X		X		X
S	What is status of all disease expertise and drugs	X	X		X		X
A	Medical screening for malaria parasite	X	X	X	X	X	X
A	Medical treatment	X		X		X	
S	What is prevalence of malaria parasite in the human host?	X	X		X		X
A	Area surveillance	X	X	X	X	X	X
S	Where are mosquitoes breeding ... how big is this problem?	X	X		X		X
S	What is prevalence of malaria parasite in the mosquito population ... is it reducing?	X	X		X		X
S		X					
		X					

S	What is lost economic activity arising from malaria morbidity ... is it reducing?	X	X		X		X
S		X					
S		X					
	Activities	X					
A	Education and awareness	X		X		X	
A	Area clean up	X		X		X	
A	Personal protection	X		X		X	
A	Strengthening community health infrastructure	X		X		X	
A	Medical case therapy	X		X		X	
A	Screening and treatment	X		X		X	
A	Interior residual spraying (IRS)	X		X		X	
A	Source control (larvaciding)	X		X		X	
A	Mosquito control (ULV adulticiding)	X		X		X	
A	Bednets (ITNs)	X		X		X	

This rapidly leads to the idea that access to health care at the community level is the most critical matter, and resources should be allocated to multi-tasked community level clinics, staff and necessary medicines and appropriate community environmental clean-up initiatives.

Data: Performance ... cost and operational efficiency

In most cases the aim of cost analysis is to: (1) compute the total cost of an activity; (2) compute the unit cost; and, (3) 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.

Impact, value and cost effectiveness

Impact	A key goal of malaria control programs is to reduce the burden of malaria. The burden of malaria takes many forms including: ◆ Mortality ◆ Morbidity ◆ The opportunity cost of lost work ◆ The cost of treatment 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: ◆ Parasite prevalence in the human host is low ◆ Parasite prevalence in the mosquito populations is low
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.
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.

Result

Scale of activity	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
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.

Value	Value is subjective ... but also important
CA uses standard values	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. CA uses a standard value list for a specific place and time to reflect the best consensus of values so far achieved.
Caveat	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.

Cost effectiveness	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.
Standard costs	Standard costs are a way for cost efficiency to be measured. Standard costs are what something should cost based on technical considerations and knowledge

Costs	Cost accounting can give information about what something costs. A good cost accountant will be able to explain not only how much something costs under the prevailing conditions, but also how this cost will behave as conditions change. This variability is important because it facilitates optimized

	operations.
Standard costs	Standard costs are what something should cost based on technical considerations and knowledge. Standard costs are a way for cost efficiency to be measured ... how much did something cost compared to what it actually cost?

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

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!

Cost and cost efficiency

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Interventions - cost													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Total													
Interventions - quantity													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Interventions – unit cost													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Interventions – cost efficiency (actual cost as % of standard cost)													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													

Impact and cost effectiveness

The most impact is not achieved using a single intervention but many interventions ... and impact is not measured easily using one single metric.

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Impact													
Mortality arising from malaria													
Morbidity due to malaria													
Lost economic activity arising from malaria morbidity													
Prevalence of malaria parasite in the human host													
Prevalence of malaria parasite in the mosquito population													
Index of progress													
To be developed													
Cost (from above)													
Total cost of multiple interventions													
Cost Effectiveness													
A derived index to be developed													

These tables give a very clear indication whether the results are good or bad ... whether they are in line with expectations. If the results are poor relative to expectations, there should be inquiry and an explanation of why there are differences. These results may be compared to other communities and lessons learned from the comparison.

Because of the large number of variables it is difficult to optimize without a large dataset and computer assisted analysis. (See page nnn for more).

Health Infrastructure

Importance of health infrastructure

Medical treatment is more effective when the treatment is given soon after the onset of the symptoms. This requires an well functioning health infrastructure that is easily accessible to the local population.

The process of strengthening the infrastructure

Strengthening builds on what exists and takes steps to make things better. In some cases there is nothing at all in the local community ... in other places there are some things, but not others. The starting point is what is present ... the goal is a system that produces good health outcomes.

Facilities

Organization

The form of organization is important ... it must suit the prevailing conditions. What is sometimes referred to as a public private partnership might work, or it might be a public unit of the Ministry of Health, or it might be a private social business. It is unlikely to be successful as a pure profit maximizing business. It might be a community cooperative of some sort. What is important is that it has an ability to earn revenue and have income to sustain its operations and provide the services needed to the community.

Rwanda

Rwanda has made substantial progress in reducing the burden of malaria in the country. A large part of this success has been the use of more than 40,000 community health workers who have been trained to diagnose malaria ad provide the recommended basic medication. Some are trained to do house spraying and others to help with bednet use.

Facilities and equipment

Data seem to suggest that having health facilities accessible to local residents is important ... but the facility must have adequate staff and supplies in order to function.

A community focus strategy for health sector facilities and equipment can be very cost effective when it is done as part of a comprehensive program for health. Most health care interventions are best done quickly. The travel to a health facility should not be long and difficult. There should not be a long wait before a health professional does a diagnosis and the facility should have the capacity to take care of most cases at this stage.

The value of a functioning local community health facility is substantial not only for malaria, but for all diseases affecting the community.

Drugs and medical supplies

There are many problems with drugs supplies including (1) resistance to available low cost drugs like chloroquine; (2) fake drugs that have no pharmacological value; (3) counterfeit drugs manufactured without the patent holder's authority; (4) poor storage conditions; (5) affordability; etc.

Affordable Medicines Facility for malaria (AMFm)

Initiatives like that of the Global Fund for AIDS, Tuberculosis and Malaria (GFATM), the Clinton Global Initiative (CGI) and the Bill and Melinda Gates Foundation in establishing an Affordable Medicines Facility for malaria (AMFm) are emerging, but they are not getting to the root cause of why medications cost what they do ... rather these initiatives are large scale subsidy programs for a very high cost patent based pharmaceutical industry.

Sustainability

Where an initiative is valuable ... it would be good if there was the possibility that it could be paid for by the people that need it and the community get benefit not only when some external funding is available ... but when the community must pay the costs. This is the essence of sustainability.

Improving health outcomes makes economic activity more productive ... but is the economic activity available for most of the people in poor countries sufficiently productive so that the resources need to pay for health are available. If not ... why not?

Donors who have become a big resource for health financing need to look carefully at what they are paying for, and especially need to understand the distortions in the pay scales that get introduced when donor funded projects are implemented.

There are many situations in health where cost effectiveness can be improved by a small intervention at the right time ... yet this is almost totally absent because the health infrastructure is so weak.

The health infrastructure needs to be present ... needs to be functional ... and needs to be affordable. The health infrastructure needs to be staffed by local professionals and para-professionals, and support staff that earn enough to be motivated, but not so much that the system cannot pay the salaries.

Clearly the structure that has become the norm in a country like the United States should not be used as the model for best practice in every other country, and especially developing countries in Africa. Similarly, there are practices in some government services that make labor expensive without providing commensurate value.

Cost Effectiveness

Cost effectiveness is more about result than it is about cost. A low paid nurse at a clinic is not cost effective when the essential medications he/she needs are not available or affordable. Good cost effectiveness requires that all the pieces of the puzzle are in place.

Characteristics of health infrastructure data

Health infrastructure data are mainly "permanent data" that change rather slowly ... but important because these data show the constraints of the available infrastructure and help to focus on what is most critical.

> When the data show there is no hospital, no clinic, no doctor, no medicine, no nurse and there is a population of 100,000 people ... the projection of health outcomes is not going to be very favorable. The anticipated health outcomes deteriorate further when data about food shortage, no safe potable water, inadequate sanitation, etc. are factored in.

Purpose of these data

The purpose of these data is to facilitate progress ... to manage scarce resources so that there is a better future. These data are important because of the following:

> **"What gets measured gets done"**

The following is a starting point:

What there is ...		The baseline information is about what facilities and resources are actually available in the community or nearby to service the community.
What is needed ... for malaria		Another level of baseline information is about the facilities and resources that are needed by the community, and how these compare with what the community actually has. This shows the deficit (or perhaps a surplus) between what is available and what is the need.
What is needed ... for other common health issues		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.
What is the long term value for the community		More important is that the facilities that help to achieve success in reducing the burden of malaria can be used subsequently to address other diseases of importance in the community.

Health activities in the community

Health activities ... what there is!		What focus ... What organization is doing it?

Additional health activities needed in the community

What is missing ... what is needed?		What focus ... What organization might be able to do it?

Cost factors for health infrastructure strengthening

Health infrastructure strengthening cost – actual by month for year N

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Workshops													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training programs

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Person.days of trainers													
Cost													
Person.days of students													
Unit cost per student													

Activities – Standard versus actual

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
People involved													
Std. cost													
Standard													
Actual													
Variance													

The strategy for health in a community ... and from a community perspective ... should be to do all that is needed to have good health using available resources in the best possible way. Few organizations have this focus ... and few donors or funding organizations have this focus explicitly. 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 the ailments of the area.

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 the community and all its needs.

From the community perspective it is better to be more than malaria ... while malaria is the focus of the IMM initiative ... the clinics and community health centers should have staff, equipment and supplies for all ailments in the area.

Government units

The government has a tremendous responsibility for public health ... but resources for this important responsibility are usually inadequate. This is not a matter of the available resources being, say, 10% or 20% below what is needed, but something more like 90% below what is needed. While donor support ... or humanitarian assistance ... is sometimes available, it is not programmed to allow for a reliable development of a sustainable high performance health sector.

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.
What MoH presence?		Name of the MoH unit? Where is the unit? What are its capabilities? Who runs the unit (organization)? Who is in charge of the unit? How big a staff? How big a budget?

Clinics

Health clinics?		Name of clinic? Where is the clinic? What are its capabilities? Who runs the clinic (organization)? Who is in charge of the clinic? How big a staff? What equipment?
		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.
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
Private clinics		
NGO clinics (including religious organizations)		Clinics run by NGOs are of varying quality ... some are very good.

Hospitals

Hospitals?		Name of hospital? Where is the hospital? What are its capabilities? Who runs the hospital (organization)? Who is in charge of the hospital? How big a staff? What capabilities What equipment?
Public hospitals		There are not enough hospitals ... and where there are physical facilities there are staff shortages, equipment shortages and medical supply (including drug) shortages.
Private hospitals		
Mission hospitals		
Emergency humanitarian aid hospitals		

Education and training

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.
Doing basic education and training		
Doing research		
Doing consultancy		
Doing vocational training		
Community health workers		
Nurses		
IRS spray staff		
Surveillance staff		
Etc.		

Research

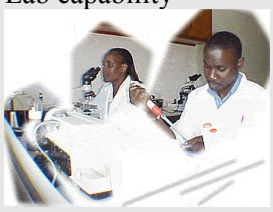
Universities		Universities are training staff, though less than are needed to satisfy the need for trained health personnel. The shortage of staff is aggravated by trained staff migrating out of the country where they have been trained mainly because staff salaries are low.
Doing basic education and training		
Doing research		
Doing consultancy		
Doing vocational training		
Community health workers		
Nurses		
IRS spray staff		
Surveillance staff		
Etc.		

Supply chain for pharmaceuticals and medical supplies

What is the point of having competent staff if there are no medicines and supplies to treat the patients? And what is the point of dispensing drugs when their quality is unsatisfactory? There are all sorts of questions that need to be addressed so that the system works and serves the public well.

What is the medical drug supply situation?		Name of the drug sale outlet? Where is the outlet? What are its capabilities? Who runs it (organization)? Who is in charge of it? How big a staff? How are drugs verified as good?
Problem of resistance		Resistance is widespread for the low cost anti-malarial drugs (e.g. chloroquine, pyrimethamine). This must be taken into consideration and data collected to identify emerging new resistance.
Drug quality		There is a problem with fake drugs, counterfeits and drug quality. There is big profit in bad practice and little incentive to follow high ethical standards. There must be a practical enforcement mechanism and easy access to testing facilities so that bad practice can be identified.
Government regulation		The Government's regulatory environment is often weak partly because of lack of legal regulation and partl;y because of the capacity to provide oversight and enforcement
Generic drugs		
Prices		
Subsidies		
Mark-ups		
Taxes and duties		
Regulation		
Professionalism		

Support infrastructure

Blood bank		
Testing labs ... drugs		
Entomology labs		
Equipment maintenance		
Transport		
Diagnostic screening 		Malaria transmission is linked to the prevalence of malaria in the human host population ... so steps need to be taken to identify high levels of parasite in the human host and treat effectively to reduce transmission
Lab capability 		Lab capability is needed
Diagnostic screening		Do people have malaria ... or is it a fever caused by something else? What is the capacity to do “blood work” for the analysis of a patient's health? What is the use of RDTs
Medications		Are the available drugs of the correct standard and quality ... or are they fake or counterfeit? Are any testing facilities available?
Blood		Where are blood supplies available? What steps are taken to ensure that the blood is safe?
Cold chain		How are drugs, vaccines, etc transported and stored? How much medicine is stored at the proper temperature?
Transport		How do patients get to the clinic ... or to a referral hospital. Are there any vehicles that are equipped as ambulances?

The people dimension of the health sector

The biggest resource is human capital ... but human capital needs development. With perhaps as much as 70% of the population under 20 years old, the demographics of Africa are a huge challenge ... and an opportunity. The challenge is to help this population get jobs that are productive, and to have enough education and training so that they can do the available jobs well. The need for work to be done is everywhere ... but the training and skills and the organization is missing. Work to help improve health in Africa should be a great work opportunity and a priority.

Training is a key factor. There needs to be a lot of training, but it needs to be well designed, The current situation is that some training is good, but a lot of the training is inadequate. Well designed training has a lot of value. Training is an essential for human capital development ... training that is both basic and valuable. The basics make it possible for an individual to start the learning process ... and start to do work that is needed. The recommended IMM approach 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 best practice is for a person to be engaged in a continuing process of learning ... with nothing a dead end. Everyone should always have the possibility of learning more and doing more that is valuable to the community.

Training		
MD training		
Nurses		
Community health workers		
Traditional birth attendants		

Certification		

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. The use of volunteers for essential work that needs to be done should not be done.

The problem of living conditions must be addressed. Housing in rural communities ... and poor communities ... is of a low standard, and a problem for staff that must move into the area. When staff are recruited locally, this is less of a problem.

Remuneration Base pay of health workers is low in almost all developing countries		
Incentive pay Incentives are rare ... and when they exist they are usually not providing the right incentives.		
Career path Career path is also important for		

people working in the sector.		
Living conditions		

Doctors? Very few doctors are available and therefore usually at hospitals, expensive private clinics and externally funded projects		

Nurses? More nurses than doctors ... but not enough. Trained nurses in international demand. Key to success of the health sector		

Administration, etc. Underestimated in importance ... critical to keeping the health infrastructure functioning.		

Community health workers		

Traditional birth attendants		

Health economics ... sustainability

Health science and health economics		Health science has made amazing progress ... health economics does not reflect the same progress. Why not?
Staff pay		High pay for some and low pay for others is distorting the cost and performance of the health sector. There is a need for radical reform of the systems for remuneration.
Funding		The system of funding accentuates some of the dysfunctional distortion in the sector.
Subsidy		How should subsidy be integrated into the sector? High cost, high profit and high subsidy is expensive and unsustainable. How much should subsidy be used to maintain a high profit or should the social business model be embraced within the broader health sector.
Private/public issue		
For profit or not for profit focus		
Why health costs are out of control (as in the USA)?		
Why socialized medicine (as in the UK) has quality and delivery issues?		
Why government health service in developing countries is often dysfunctional.		

Community Responsibility

Education and awareness

How it works

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.

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.

The differentiation between awareness and education is that awareness applies to everyone, while education is more associated with more formal initiatives in schools to teach children about malaria, and programs for more people to learn about the issues of malaria at a fairly high level. People in the community need to know: (1) What it is that causes malaria; (2) How to protect against malaria and, (3) How the malaria interventions work.

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:

1. About how malaria is transmitted
2. about ways to control the mosquito population,
3. about how to use bednets to reduce incidence of malaria,
4. about the ways to keep mosquitoes away from the house,
5. about the advantages of interior residual spraying,
6. about how to recognize the symptoms of malaria, and
7. about how malaria can be treated.

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.

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

Planning considerations

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.

Cost factors for education and awareness

Education and awareness cost – actual by month for year N

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Workshops													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training programs

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Person.days of trainers													
Cost													
Person.days of students													
Unit cost per student													

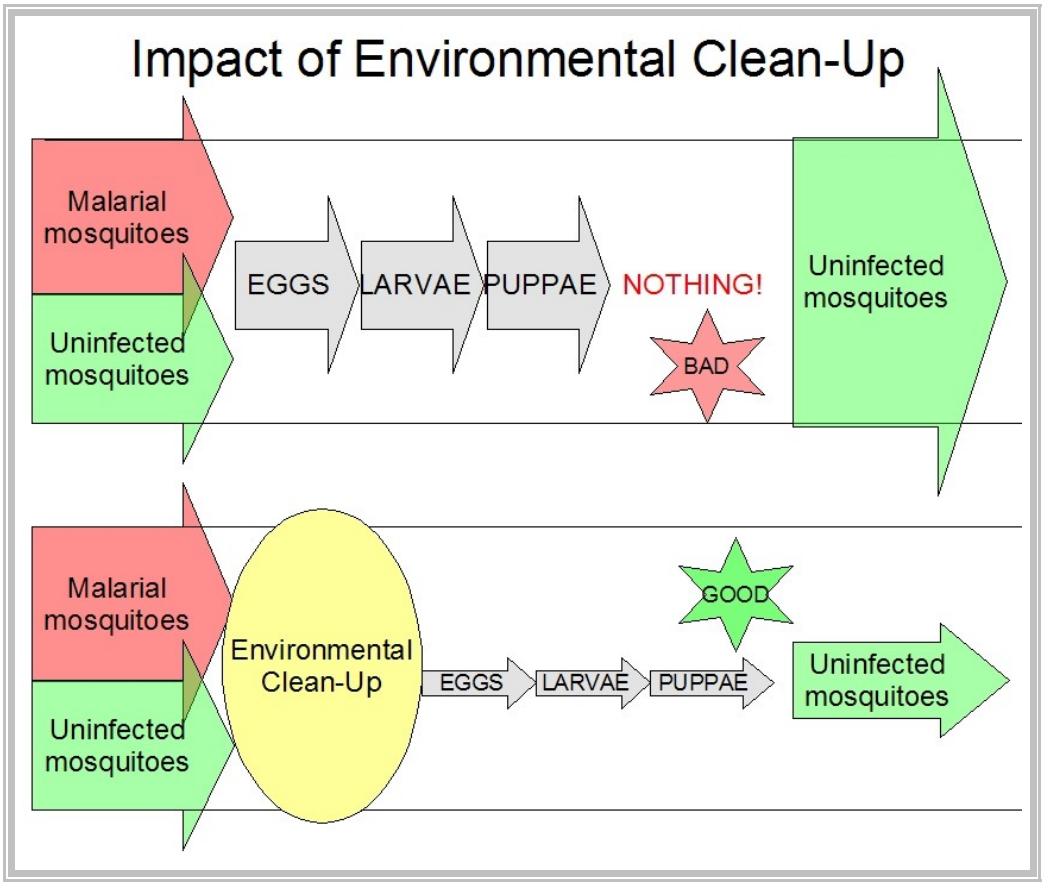
Activities – Standard versus actual

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
People involved													
Std. cost													
Standard													
Actual													
Variance													

Community clean up

How it works

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. When nothing is done ... the mosquito population renews itself and a population of uninfected mosquitoes emerges to start the continuing cycle of blood meal and disease transmission.



Planning considerations

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. 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.

Area clean up requires some community spirit ... it is not something that is easy without local leadership and local commitment to a malaria abatement strategy. Area clean up does make a difference when it is done in conjunction with other efforts. 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. 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. Clean up had a role in Col.

Gorgas's success in reducing the burden of malaria disease during the construction of the Panama canal in the early 1900s.

Old buckets, paint cans, plastic containers all serve to collect water and facilitate the breeding of mosquitoes.

Old tires serve as reservoirs that collect water ... they need to be removed or buried so that water does not collect in them.

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 become the breeding places for mosquitoes.

All sorts of containers serve as places for stagnant water to collect ... and for mosquitoes to breed. They need to be covered or treated with an appropriate larvacide.

The issue of malaria in urban areas versus malaria in rural areas needs to be better understood. A strategy that might work in an urban area may not be appropriate in a rural area. How do you do clean up in an urban slum? How do you do clean up in a remote rural area? They are vastly different problems and the solutions are unlikely to be the same.

Cost factors – community clean up

Area clean up may not cost much money, but it does require effort and organization. The organization is facilitated when there is local understanding of what causes malaria.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Chemicals													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Personal protection

How it works

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.

Example		Description
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.
Prophylactics		Taking anti-malaria drugs as a prophylactic is possible ... but has the disadvantage of creating resistance which may preclude effective curative therapy if needed.

Planning considerations

These interventions are all possible, but only in areas where personal incomes or wealth are substantial. For most communities these interventions are not affordable, and are not suited to public subsidy.

Cost factors – personal protection

Getting rid of malaria would make it possible for substantial expenditures on personal protection by the more affluent to be substantially reduced. The out of pocket costs may easily add up to $1,000 per household per year, and the potential danger of using sprayed pesticides should also be taken into consideration.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Chemicals													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Sustainability

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.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	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													

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.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	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)

Medical

Medical care

How it works

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. In combination with other interventions, the use of malaria case management to reduce the prevalence of malaria in the human host has benefit that is both immediate and sustainable.

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.

Healthcare is more than just malaria ... the DALY as a measure of performance assumes that when a treatment is successful ... the value of the treatment is determined by how many years there is post treatment survival ... which is OK if there is a reasonable expectation of living an average lifespan ... but not OK when there are multiple killer diseases in the community. With childhood disease killing perhaps 30,000 children a day, and malaria responsible for killing 3,000 a day ... it appears that the situation is one of multiple killer diseases.

Because of this the best outcome is going to be one where there is integration of malaria interventions with a broader all disease medical strategy ... and for this to be optimized, there will be easy all health access at the community level.

Planning considerations

Health infrastructure

Health infrastructure at the community level is critical for medical health success ... this is addressed earlier as a separate matter (see page nnn).

Diagnosis

Diagnosis is important. All fever is not malaria, and mis-diagnosis has consequences, notably the excessive use of anti-malarial drugs results in accelerated resistance build up.

		Lab work should be locally possible. There should be capacity to do blood smears and microscopy. The lack of required health infrastructure is a problem ... and trained staff.
Staff training		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.
Rapid diagnostic tests (RDTs)		Rapid diagnostic tests (RDTs) are one way to test for malaria. All RDTs are not the same, and the accuracy of the diagnosis varies quite significantly. Some RDTs do not identify malaria in young children.
		Some data about malaria prevalence based on use of best performance RDTs suggests that malaria has come down in some places (like for example Zambia) even though prevalence

		of fever may still be high. This needs clarification. FORWARD

Treatment

Example		Description
Drugs		**Quinine, Choroquine -** Medication has been used for many years. Initially it was quinine that served to minimise the fever due to malaria. For a very long time the drug Chloroquine was used both as a prophylactoc and as a treatment, but over the years, malaria has become resistant to chloroquine and it is no longer effective. **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. **Artemesin Combination Therapy -** Artemesin Combination Therapy (ACT) has been developed and is now the preferred treatment, but it is again more expensive than Fansidar.

Drug resistance

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.

Focus on high risk groups

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

Sustainability

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 bulk of the population is small, and the economic situation is not improved.
		The strategic impact of this approach is likely to be failure because it is not a tactic that builds towards the reduction of parasite prevalence and reduction in the transmission of the disease.

Screening and 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 microsopy.
Treatment	The

Drug therapy

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

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.

Cost factors – medical care

Getting an understanding of cost behavior requires data about the unit cost of all the elements that go to make up medical interventions. Good cost accounting data would be an advantage, but to the extent that good cost data are not available, good cost models should be developed.

What is most cost effective?	A strategy that has the least amount of treatment and medical care being required ... the most success is the least amount of health care being needed

Table of comparative costs

Type of facility / Element of cost	Health clinic	Rural hospital	Referral hospital	Community health worker	Transport
Capital cost of land and buildings					
Capital cost of medical equipment					
Capital cost of vehicles					
Capital cost of office equipment					
Total capital cost					
Annual cost of land and buildings					
Annual cost of medical equipment					
Annual cost of vehicles					
Annual cost of office equipment					
Total annual cost of capital items					
MD salary and benefits					
Nurses salary and benefits					
Other staff salary and benefits					
CHW salary and benefits					
Consultants, etc					
Total staff costs					
Drug costs					
Other medical supplies					
General expenses					
Travel					
Housing					
Training					
Other					
Awareness training					
Bednet marketing and promotion					

Medical Activity cost

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Drugs													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cost													
Person.days													
Unit cost													

Medical intervention

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Number of cases													
Unit std. cost													
Standard													
Actual													
Variance													

Medical data

Health data inclusive of malaria

Health data will be most useful when they are for both malaria and all other diseases affecting the people in the community.

About medical data sources

Data from clinics		Data should be collected from clinics and hospitals. These data will show something about the malaria situation among people that come to the clinics and hospitals, but only this.
Data from general population		In addition, data must also be collected to show what is happening among the population that have not come to the clinic.
Screening for malaria		Data about the prevalence of the malaria parasite is needed. Sustainable progress requires that the malaria parasite prevalence is reduced to near zero
		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

Diagnosis

Diagnostic activity - # of tests performed by site

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Total													

Diagnostic activity – results of diagnostic testing – per site

Site # NNN	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
# of tests													
# positive for malaria													
Percent having malaria													

Diagnostic activity – results of diagnostic testing – summary for area

Area # NNN	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
# of tests													
# positive for malaria													
Percent having malaria													

Actual cost of diagnostic activity - by site

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Total													

Standard cost of diagnostic activity - by site

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Total													

Medical interventions

Case treatment	Malaria case treatment is a confusing metric. Zero malaria cases treated either reflects an excellent outcome or something that is totally unacceptable. If there is no malaria in the area to be treated ... that is good. A decline in the number of cases because there is less malaria is good ... but is this the reality, or is it something else? If there are cases of malaria and they are not being treated for any of many reasons, this is a bad situation. For example 1. Ill patients cannot get to the clinic to receive diagnosis and treatment 2. Patients are diagnosed with malaria, but there are no drugs available to treat the patients 3. Patients are ill with malaria abut cannot afford the fees for treatment
Cases treated and illness cured	With increasing resistance to drug therapy, the treatment of cases may or may not result in cure.
Parasite prevalence	Is the parasite prevalence going down? If there is a reduction in parasite prevalence, is it because of the seasonality of malaria in the community or because there have been effective interventions.
Performance	How much has malaria parasite prevalence in the human host gone down, and what have been the cost of the malaria control interventions to get this result.

Time series of malaria cases

By population segment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Population (total)													
Population (male)													
Population (female)													
Population (5 and under)													
Population (6 to 15)													
Population (16 to 45)													
Population (46 up)													
Population (female pregnant)													

The number of cases is a result and can be considered either as a state or as an activity ... the number of cases can be used as a metric for “state” or as a metric of “activity”.

Time series about the malaria parasite in the population

By population segment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Population (total)													
Population (male)													
Population (female)													
Population (5 and under)													
Population (6 to 15)													
Population (16 to 45)													
Population (46 up)													
Population (female pregnant)													

The malaria in the population can be measured in various ways. This may be done using statistical sampling with a sufficient sample size and an approach that includes all the population.

It is not normally satisfactory to use those visiting a health center as a sample that reflects the whole population.

It is possible, however, to use almost any time series of data that are compiled on a consistent bases to serve as an indicator of change.

Time series about mortality in the population

By population segment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Population (total)													
Population (male)													
Population (female)													
Population (5 and under)													
Population (6 to 15)													
Population (16 to 45)													
Population (46 up)													
Population (female pregnant)													

The data about mortality with the same analytical breakdown as the data about population. There are two groups that normally have high mortality: (1) children under 5 and (2) pregnant women.

Time series about morbidity in the population

By population segment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Population (total)													
Population (male)													
Population (female)													
Population (5 and under)													
Population (6 to 15)													
Population (16 to 45)													
Population (46 up)													
Population (female pregnant)													

The data about morbidity with the same analytical breakdown as the data about population. Morbidity affects all of the population. Morbidity in the group aged 16 to 45 has the most impact on economic performance.

Vector control

Vector control management

Intervention planning

What is to be done where, when and how much?	Mapping intervention activities ... what mosquito and malaria control interventions need to be done: when , where and how much. There is evidence that shows that multiple interventions are more effective than single focus interventions ... but they are more difficult to manage and ascertain costs. Because of CA's standard costs and values it is easy to get an approximation of cost effectiveness by knowing how much of each intervention is done and what result or impact is observed (see results, impact below)
Where are the concentrations of malaria infected mosquitoes	Map these concentrations ... plan for immediate adulticidng if this capability exists in the community where there are high concentrations near housing.
Where are the sources of mosquito breeding with imminent recruitment	Map these locations ... plan for immediate larvaciding if the capability exists for all sources where mosquito emergence is imminent.
What houses near concentrations of malarial mosquitoes have not been treated with IRS	Map these houses ... plan for IRS to be implemented as a priority in these locations
What area clean up has been done, and what remains to be done	Arrange for this information to be shared with community leaders

Intervention performance – cost and cost efficiency

What was done ... how much, by whom and at what cost	What organization and details of intervention ... a responsible organization should be identified for every intervention. Details of the intervention should include key factors about the type of interventions, identifying especially the critical active agents: drugs; pesticides; type of bednet; larvacides; etc.
Cost of the intervention	Key data should be compiled to show the scale of the intervention and how much the intervention cost.
Cost variance	The actual reported cost of the intervention should be compared to the standard cost and explanations obtained for the differences observed.
Cost efficiency	The actual cost compared to the standard cost gives a measure of cost efficiency.
Comparative cost analysis	The actual costs may be compared to costs in other places and by other organizations can be compared and performance ranked.

Intervention performance – impact and cost effectiveness

Mapping results of malaria control interventions	All interventions should have an observable impact. Were

Performance data

Purpose of these data

Operational performance data are needed to ensure that there is progress ... that the strategy for progress is working ... that the operational activities are effective and efficient. These data address the questions of cost effectiveness and cost efficiency.

In most cases the aim of cost analysis is to: (1) compute the total cost of an activity; (2) compute the unit cost; and, (3) see whether the costs are in line with what was expected and adequately efficient. Are the data capable of providing this analysis?

Total cost?	
How many?	
Unit cost?	
Standard cost?	
Cost efficiency?	

The data should also show the impact of the activities. Impact is different from the scale of the activity ... it is what value the benefit had to the end beneficiary.

How much benefit?	If the benefit is less mortality ... this is good
How much value?	And the value of less mortality is very high ... and in the CA methodology is computed using a table of standard values.
For what standard cost?	How much did it cost to get this benefit? One calculation is done using standard cost?
For what actual cost?	An alternative calculation of cost is to use actual cost data ... which should normally be similar to the standard cost, but when it is not should be subject of inquiry.
Cost effectiveness?	Cost effectiveness ... somewhat similar to cost benefit analysis ... shows the relationship between the value added and the costs incurred.

Characteristics of these data

These data are, above all, timely and relevant. They are data that are used to manage operations and as such have to be sufficiently detailed to facilitate decision making.

Data: Performance ... cost and operational efficiency

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.

Impact, value and cost effectiveness

Impact	A key goal of malaria control programs is to reduce the burden of malaria. The burden of malaria takes many forms including: ◆ Mortality ◆ Morbidity ◆ The opportunity cost of lost work ◆ The cost of treatment 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: ◆ Parasite prevalence in the human host is low ◆ Parasite prevalence in the mosquito populations is low
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.
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.

Result

Scale of activity	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
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.

Value	Value is subjective ... but also important
CA uses standard values	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. CA uses a standard value list for a specific place and time to reflect the best consensus of values so far achieved.
Caveat	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.

Cost effectiveness	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.
Standard costs	Standard costs are a way for cost efficiency to be measured. Standard costs are what something should cost based on technical considerations and knowledge

Costs	Cost accounting can give information about what something costs. A good cost accountant will be able to explain not only how much something costs under the prevailing conditions, but also how this cost will behave as conditions change. This variability is important because it facilitates optimized operations.
Standard costs	Standard costs are what something should cost based on technical considerations and knowledge. Standard costs are a way for cost efficiency to be measured ... how much did something cost compared to what it actually cost?

Entomological data

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! 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.

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

		Information about mosquito population is needed to 1. plan control interventions 2. determine the success of the intervention The information needs to be time and place specific. If an intervention works, that is good ... but if the intervention does not work, then there needs to be rapid remedial action.

		Using window traps to collect mosquitoes: ◆ How many; ◆ What species; ◆ What sex: ◆ What parasite status.

Entomological and medical data are at the heart of IMM decision making. Entomological surveillance gets data about mosquitoes and the habitat, and medical diagnosis and screening provides information about the disease status and population health.

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

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.

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. Some data about malaria can be obtained from clinical records in health centers and hospitals, but this does not capture information related to people who never come to these facilities. Medical screening is broader in scope, and provides data on the prevalence of malaria in the population as a whole, and also the prevalence of the parasite in the human host.

With data these data, work on malaria control can be focused where there prevalence of malaria parasite is the highest, where the transmission is the highest and where the burden of malaria is the highest.

About the weather

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

Rainfall (mm per month)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Average													

Temperature

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Average													

Humidity

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Average													

Prevailing winds

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Average													

About people

Mapping people	Where do people live, work and travel?
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 cases of malaria	Where are people getting malaria?

About houses

What sort of houses	What sort of houses are people living in? Are they susceptible to ingress of mosquitoes? What is the most suitable way of keeping mosquitoes away from people in these houses?

About sources

Mapping sources	Where are the sources of mosquitoes.
What is the breeding status of the place?	What is the state of the breeding place? Should the place be treated to kill the emerging larvae? Is this the right time?
How should the source be treated?	What is the best way to treat the sources? What is the best way for the sources to be treated that is possible with the larvaciding materials, equipment and staff that are available?

About 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?

The population of mosquitoes fluctuates over the course of a year. Controlling the mosquito population has a favorable impact on quality of life, as well as the transmission of disease.

Summary about mosquitoes

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Population of mosquitoes													
Population of malarial mosquitoes													
Percentage of malarial mosquitoes													

Population of mosquitoes

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Total													

Population of malarial mosquitoes

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Site 1													
Site 2													
Site 3													
Site 4													
Etc.													
Total													

Population of mosquitoes

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 0													
Year 1													
Year 2													

Population of malarial mosquitoes

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 0													
Year 1													
Year 2													

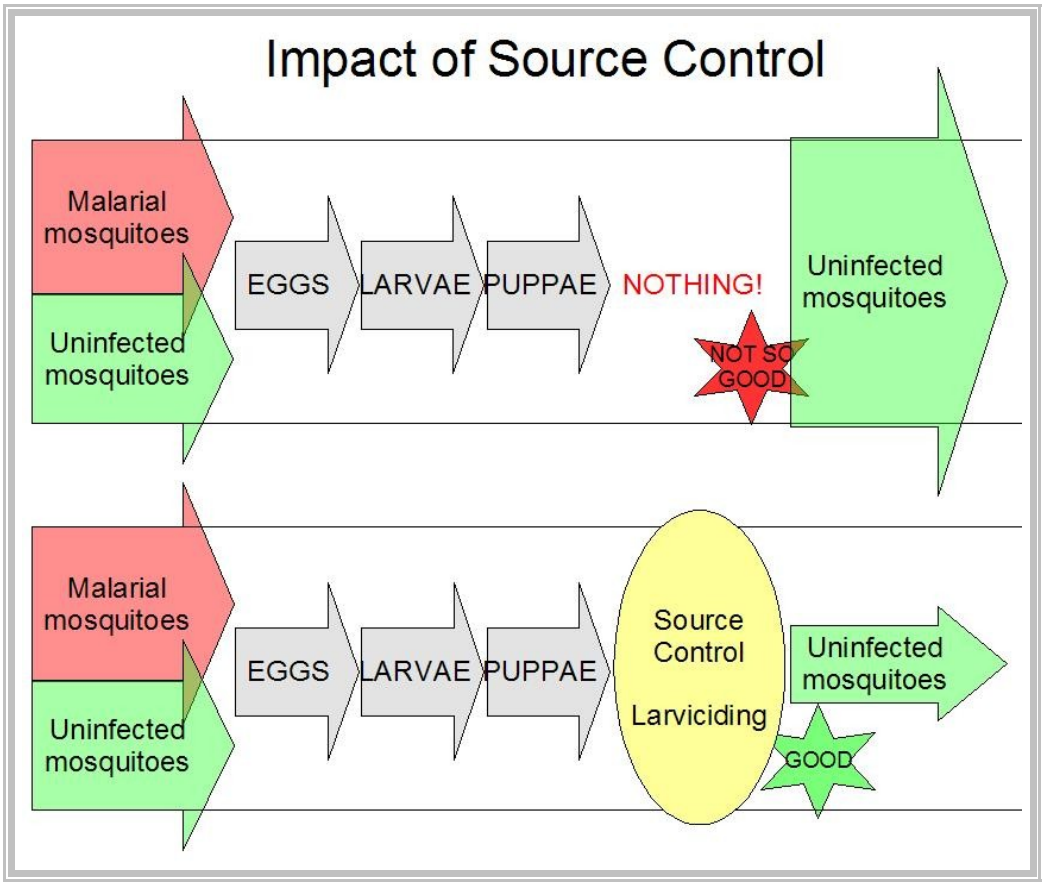
Percent of malarial mosquitoes

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 0													
Year 1													
Year 2													

Source control ... larvaciding

How it works

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 reduces a mosquito population by killing the mosquito in the larval stage. At this stage the pest is immobile and concentrated, and carefully targeted intervention can be very effective. The key to cost effective source is accurate knowledge of where the sources are located and the stage of development of the larvae population.

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.

Planning considerations

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.

		What is the stage of the life-cycle: ◆ Are eggs, larvae, pupae present;

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.

	Larviding may be done manually. It is not good for very large areas, but works very well where the area is relatively small.
	Larviciding from a truck mounted sprayer speeds up the treatment ... but is only possible where there is good road access

About Bti

Bti is a biological agent that is very effective as a larvacide. The cost of Bti has to be given consideration ... because while most chemicals can be shipped in a concentrated form and then diluted locally for use, Bti granules are bulky and do not dilute.

There is the potential, however, 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.

It was source control that had a big impact on malaria reduction during the last century ... and it should be part of an integrated program today. Source control can be implemented successfully by local staff who have been trained in what to do.

Cost factors – source control – larvaciding

There are two ways to optimize costs: (1) is to use larvacides in places where larvacides are needed; and (2) to have local people doing the work. For this to be possible there needs to be good surveillance information about the location of breeding sites and the stage of the life cycle, and for local people to do the work well there needs to be thorough training both in the spray work to be done and the safety protocols to be followed.

Training is a key cost that must be taken into consideration.

The cost of active chemicals is substantial. The cost is reduced by using well trained spray operators that know how much is needed ... not too much, not too little.

Activity cost - Source control

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Chemicals													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cost													
Person.days													
Unit cost													

Larvaciding operations

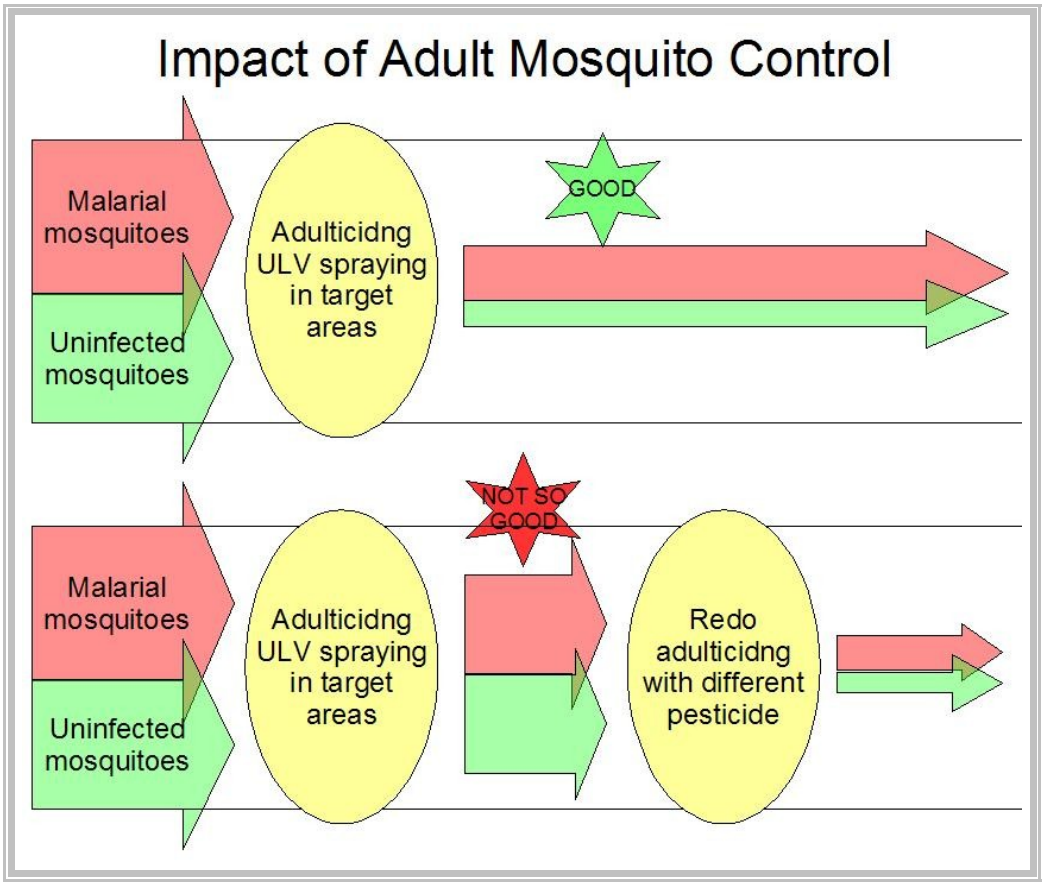
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Scale of activities													
Unit std. cost													
Standard													
Actual													
Variance													

ULV adulticiding

How it works

When there are an abundance of adult mosquitoes, the use of adulticiding 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 adulticiding is successful and mosquitoes are killed and the population is reduced. In the second case there is resistance to the first chemical used, so the procedure is repeated using a different chemical treatment.



On its own adulticiding is going to have little impact on the ultimate goal because there will be rapid reestablishment of the mosquito population and because there will also be rapid reinfection of the mosquitoes with the parasite. However, the use of adulticiding might accelerate the impact of other interventions, specifically medical treatment of active cases and source control of the mosquito population.

Planning considerations

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.

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.

Ground fogging

Examples	Description
	Ground fogging equipment may be used for small areas. It is very effective but is limited to ground accessible areas and takes a lot of time.

Aerial application

The fastest and least cost method for ULV spraying over a large area is by plane. It is accurate and efficient. A large area can be done in a short time.

Examples	Description
Aerial application 	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.

	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.

The environmental dangers associated with ULV spraying are very small. A typical chemical Dibrom is toxic to mosquitoes, but not to most other insects and animal life. The concentrations used are very small ... around 1 oz of active pesticide per acre.

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

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.

The unit cost depends very much on the way the ULV capacity is organized. A small spray plane can treat 5,000 acres per hour and bring about a 90% reduction in the mosquito population. However, because there are high fixed costs, a price of $2.50 per acre is only possible when the plane and the organization are achieving a high utilization of the equipment ... say aircraft use of more than 100 hours per month.

Setting up a ULV spraying operation requires a substantial capital outlay ... around $ 2 million for two aircraft and spray gear, plus another $2 million for working capital (spare parts, inventory, fuel, accounts receivable, etc.)

Expenses like insurance are substantial even when risk is managed well with experienced pilots, good aircraft and maintenance ... in large part because of the inefficiency of the modern insurance market.

Cost factors – ULV adulticiding

ULV adulticiding activity cost

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Chemicals													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cost													
Person.days													
Unit cost													

Spraying operations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Scale of operations													
Unit std. cost													
Standard													
Actual													
Variance													

Interior Residual Spraying (IRS)

How it works

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.

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. 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.

Planning considerations

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.

		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.

Use of DDT		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.

Protection derived from using insecticide treated panels

		One of the behaviors associated with some insecticides ... especially DDT ... is a repellent effect, which keeps mosquitoes away and stops them taking blood meals. DDT treated fabric panels can be hung around openings in the house structure to keep mosquitoes out of the house. The technique has been used on an experimental basis with success.

Cost factors for interior residual spraying (IRS)

Interior residual spraying (IRS) activity cost

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Training													
Salaries													
Chemicals													
Transport													
Equipment													
Supplies													
Etc.													
Total													

Training

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cost													
Person.days													
Unit cost													

Spraying operations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Number of houses													
Unit std. cost													
Standard													
Actual													
Variance													

Insecticide Treated Bednets (ITNs)

How it works

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.

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.

Planning considerations

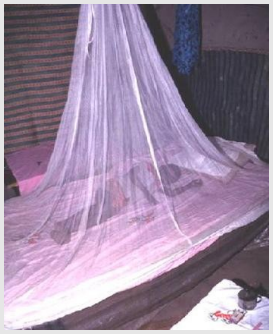
Fund raising for bednets has been a great success. Part of the success can be attributed to the various programs to fund bednets and the simple notion that buying a bednet for $10 will save a child's life in Africa. The idea is easy to grasp, and fund raising based on this premise has been successful both at the individual level and with the major donors, institutions and governments involved with international aid.

The simple concept that investing in insecticide treated bednets will save lives has helped build funding for malaria at an unprecedented rate. The lesson is clear ... simple messages sell.

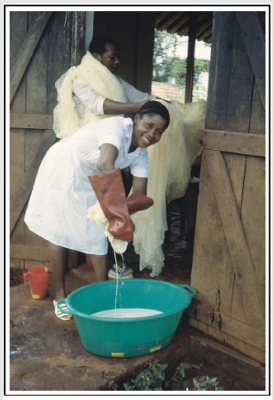
Studies show that using bednets reduces malaria mortality ... especially insecticide treated bednets. However, the studies are rather small relative to the number of bednets that have now been distributed.

A well known researcher, Christian Lengeler has observed, in plain English, that with an 80% coverage of insecticide treated bednets, there would be a 25% reduction in child mortality due to malaria. (see ref: xxxxxxxxxxxxxxxxx). While Lengeler is widely quoted as a source of justification for the ubiquitous bednet focus ... other studies seem to show that bednets work best in an environment where other mosquito control strategies are also in place. In fact, over the past three years it seems to becoming clear that every success is a result of multiple interventions rather than a simple singular bednet focus.

Long lasting insecticide impregnated bednets (ITNs) (LLITNs)

Example		Description
		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.

Untreated bednets

Example	Description
Standard bednets	Bednets have been used for a very long time by people who could afford them. They help ... and certainly they reduce the nuisance of insect bites. Many communities in developing countries have had small-scale bednet production that has served local markets.
Local producers out of business	The global programs to introduce various forms of bednet marketing at highly subsidized prices ... in many cases 100% subsidy has been devastating to these local producers.
 Figure 1. The nets from all houses in a Tanzanian village are given their annual retreatment free of charge by a nurse from the health centre. Photograph taken by T.J. Wilkes.	A standard bednets needs to be retreated from time to time with insecticide. While this is important to the effectiveness of the bednet, and needs some organization and funding ... the costs are quite low and the employment is local. It is, however, almost totally excluded from donor funded initiatives.

The use of bednets

Example	Description
	Bednets only work when they are used. There are many anecdotes about the use of bednets for almost everything except as a mosquito barrier. Here are staff demonstrating how the bednet is used. When the distribution of bednets includes getting people to understand and appreciate the benefits of bednet use, there is more use of bednets
Importance of awareness	It is critically important that there is awareness in the community about malaria and how it may be prevented. The process for distributing bednets should recognize that the quality of awareness training is very important and include appropriate interventions. The popular mass distribution of bednets widely used in donor funded bednets programs usually do little or work on awareness.
Myth or reality? People only value things they pay for!	There is the notion that people use what they pay for ... and people do not use anything they get for free. But this is not the whole story. People buy things that they know are valuable ... but there are many ways to help people to understand that bednets are valuable other than the price approach. Most people will not buy them because (1) they do not know they are valuable and (2) they are not able to afford them anyway!
Superstition	There are cultural issues related to color and covering up that make use of bednets problematic without adequate awareness training. Many do not know it is mosquito bites that help transmit malaria ... rather they may know, for example, that it is eating mangoes is the causal factor. Why not? Mangoes grow profusely with the rains, just as mosquitoes multiply and transmit malaria during the rains!

Resistance

Example		Description
Mosquitoes		Mosquitoes are likely to become resistant to the pesticides being used in the bednets ... especially where the type of pesticide is similar to pesticides being used in agriculture.
What chemicals are most prone to resistance?		The chemicals that are used in both public health and in other areas like agriculture are most prone to rapid development of resistance
Pyrethroids		Pyrethroids are at risk as a chemical family that is widely used both for public health and for agriculture [CHECK THIS?]
Behavior change		Mosquitoes are known to change behavior rapidly in response to the habitat ... probably something to do with the need to find blood meals easily and without aggravation. This may be used to encourage mosquito behavior that reduces transmission of malaria in humans or could aggravate the transmission problem
What to do?		An effective program that rapidly reduces the need for chemical interventions is a big help ... careful surveillance to identify resistance build up early ... rapid change to other chemicals when resistance build up is detected ... development of a pipeline of alternative chemical and other interventions.

High risk vulnerable groups

Example	Description
	The main goal in many of the programs has been to get young children who are at the highest risk of dying as a result of a malaria bout to sleep under a bednet and be protected. The result of these efforts seems to have been positive in that it seems that less children are dying of malaria in the critical first year, or even two or three, but it is less clear that children as a whole are growing up to adulthood. The possibility is that children survive initially, but subsequently die because malaria is so prevalent in the society at large. 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.

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Cost factors for insecticide treated bednets (ITNs)

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.

It should be easy to understand the cost, price and value associated with bednets, but little of this information is available. The CA approach calls for details of the value chain from manufacturer to the final user so that costs are fully understood, and also calls for the value chain that relates the cost incurred to get the bednet to the user with the value actually realized by the user. If the user paid nothing for the bednet, and the organizations delivering the bednet have disbursed $10 ... what change in health outcomes were achieved? How much less malaria did the user get?

Bednet intervention cost ... by element of cost

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Salaries													
Benefits													
Chemicals													
Transport													
Equipment													
Supplies													
Other													
Total													

Bednet intervention cost ... by type of activity

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Purchase of nets													
Warehousing													
Transport													
Community distribution costs													
Advertising and promotion													
Education and awareness													
Local health worker training													
MoH admin and overhead													
Program admin and overhead													
Management information													

Summary of bednet distribution and cost by month for year N

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Number of bednets													
Standard cost per unit													
Standard cost													
Actual cost													
Variance													
Variance %													

Bednet distribution by month year to year (000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 0													
Year 1													
Year 2													
Year 3													
Year 4													

Bednets in use ... month by month detail (000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
In use BOM													
Distributed													
Discarded													
Adjustments													
In use EOM													
In use average													
% of total													
% of under 5													

Bednet coverage by month year to year (%) for all of population

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 0													
Year 1													
Year 2													
Year 3													
Year 4													

Bednet coverage by month year to year (%) for children under 5

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 0													
Year 1													
Year 2													
Year 3													
Year 4													

Bednets in use by month for year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Population of the area													
Of which children under 5													
Bednets for 100% coverage													
Bednets for children under 5													
Bednets in use													
Coverage re total population													

Coverage for under 5 children													

Bednets in use ... year trends ... 5 year intervals and year by year

	1980	1985	1990	1995	2000	2005		2004	2005	2006	2007	2008	2009
Population of the area													
Of which children under 5													
Bednets for 100% coverage													
Bednets for children under 5													
Bednets in use EOM													
Coverage re total population													
Coverage for under 5 children													

Bednet value chain

The value chain associated with bednets has the potential to be optimized. The data needed for optimization should be easily accessible, but has not been up to now. None of the key data are easily accessible to the public or decision makers and it is not clear from the available data who are benefiting from the bednet value chain. CA value chain analysis is a simple concept, but not simple to get the data that show how the value chain works. The following data will help understand the value chain.

Bednet value chain ... the generic model

	Unit cost	Cumulative unit cost	Unit profit	Cumulative profit	Unit Price
Ex factory					
Local freight					
Ocean freight					
Ocean insurance					
Export taxes					
Import taxes and duties					
Port charges					
Local freight					
Warehousing					
Inventory accounting					
Logistics management					
Project management					
MoH administration					
M&E expenses					
Retail costs					
Subsidy					
Training (of staff)					
Training (of clients)					
Advertising and promotion					
Fund raising expenses					
Awareness training					
Bednet marketing and promotion					

Bednet cost/price/profit value chain analysis time series

A very simple table showing the price month by month for a bednet shows a lot. The price should be recorded at the same level in the value chain. A series of these tables reflecting prices at different levels of the value chain shows even more. These are very simple data ... very very clear ... and missing because, in all probability, there are stories that would emerge from these data that key actors would not want to be so clear! Comparisons of these datasets shows very clearly where there is efficiency and where there are costs ... legitimate or otherwise.

Year over year by month ... prices for ABC at XYC point in the value chain

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Year 1													
Year 2													
Year 3													
Year 4													

aaaa

Mosquito and malaria control interventions

Activity summary

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Total													

Surveillance, data collection and analysis

Activity cost summary

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cost 1													
Cost 2													
Cost 3													
etc.													
Total													

aaaa

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.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	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.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	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.

Other Programs ... Issues

Other programs and issues

Over the past 60 years as much as $1 trillion has been disbursed for development aid ... and the results have not been very good.

One of the key reasons for the poor performance has been the single issue focus of much of the programming ... with the very predictable outcome that a successful initiative makes little or no sustainable impact because other factors make it impossible. IMM therefore looks to have a very much broader perspective than simply malaria ... or simply one aspect of malaria.

Scientific research

The progress of science in the last 50 years has been amazing, and pace of scientific discovery continues to accelerate.

Vaccine Development

Drug Research

Pesticide Research

Mosquito biology

Diagnostics

Operations research

Resistance identification

Early warning	Early warning about resistance emergence is very valuable ... and unlikely to be done where the data are processed for analysis in small sets. The IMM framework allows for data to be used locally and used within a large scale data mining system as well.

Intervention optimization ... what works best?

What works?		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. 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.
		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.

Multivariate analysis

What works?		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. 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.
		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.

Ontology of a Cyberenvironment for Malaria Surveillance

Ian Brooks, Ph.D.[1], Arkalgud Ramaprasad, Ph.D.[2]

Objective

This paper presents an ontology of a cyberenvironment for malaria surveillance. The ontology encapsulates a comprehensive natural language enumeration of the requirements of the cyberenvironment using a structured terminology. It can be used to systematically analyze and prioritize the functions of the cyberenvironment. It will help the medical, individual, environmental, and strategic management of malaria.

Background

Malaria control programs suffer from weak and fragmented surveillance of the wide range of information required to manage the disease effectively and efficiently. A computational framework to manage, integrate, analyze, and visualize the data resources, a cyberenvironment, can improve the surveillance and the outcomes.

Methods

The proposed ontology has been developed by parsing the concept of a cyberenvironment for malaria surveillance into four dimensions, each represented by a column in Figure 1 below. They are: (a) timing of the surveillance, (b) surveillance process, (c) information surveyed, and (d) malaria management. Each dimension is defined by a taxonomy derived from the literature. The categories in the four dimensions can be combined (with the conjunctive word/phrase between the columns) to form natural language statements of the cyberenvironment capability or requirement. Four illustrative capability statements are shown at the bottom of Figure 1. A total of 6*5*9*11=2970 such combinations are possible with the present ontology. They represent a closed description of the cyberenvironment for malaria management. Some meaningless or impractical combinations will have to be eliminated from consideration. One meaningless combination could be: Predictive collection of clinical management information for outcomes assessment. The dimensions and categories can be modified to provide a different perspective on the problem.

Results

Consider the four illustrative capabilities below the ontology in Figure 1. Each may require a very different configuration of the cyberenvironment. By the same token, their impact on malaria management can vary. We can similarly analyze the other combinations to develop priorities for the cyberenvironment. Thus the ontology can be a structured tool for the design, development, and implementation of the cyberenvironment.

Conclusions

The ontology can be used to approach the design and development of a cyberenvironment with a logical, systematic, and transparent approach. It can also be generalized for surveillance of other diseases.

References

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Timing	Surveillance		Information	[information for] Malaria Management
Ad hoc	Detection	[of]	Entomological	Medical management
Post hoc	Collection		Parasitological	Treatment of active malaria cases
On-demand	Analysis		Socio-economic	Treatment of asymptomatic cases
Periodic	Interpretation		Clinical management	Prophylactic medication
Real-time	Application		Epidemiological	Personal protection
Predictive			Ecological	Use of insecticide treated bed nets
			Climate	Use of interior residential spraying
			Geographical	Use of insecticide treated clothing
			Financial	Mosquito (vector) control
				Mosquito source control
				Adult mosquito control
				Strategic management
				Resource allocation
				Education
				Outcomes assessment

Illustrative Cyberenvironment Capabilities

Ad hoc collection of entomological information for prophylactic medication.
On-demand interpretation of socio-economic information for resource allocation.
Periodic analysis of epidemiological information for mosquito source control.
Predictive application of climate information for use of interior residential spraying.

Funding and sustainability

Funding is critical, but external funding that facilitates high cost health services without any ability for these services to be sustainable into the future is a disservice to society ... and that is, in the main, the funding model that is being used for global health ... and for malaria.

There are many issues to be addressed ... there is some cause for encouragement ... and as much cause for concern. While the increase in funding for malaria related initiatives from 2000 to 2009 is impressive ... there is absolutely no assurance that these levels of funding will continue, and there are questions about whether or not these funds have been used in the most appropriate way. s but this funding may not be sustainable at either the recent 2008 levels nor the higher levels needed for malaria control in the future according to WHO.

Country government budget		Country government budgets for health are very small almost everywhere in developing countries, and especially in malaria endemic countries in Africa. Where the US cost of healthcare is running at $10,000 ... the African country government budget is maybe $10. This has unsurprising consequences: 1. Public 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.
Personal funding		In most places, people are on their own ... they can pay for health services that are available if they have the money. Only affordable services can be supported this way ... and most donor plans for health service are not affordable within the norms of the local economy. The only possible outcome of this arrangement is a poor health outcome.
Local taxes ... community level funding		Local taxes and community level funding is rarely on the agenda ... yet it is the most likely way for sustainable community progress to be made. The benefits accrue to people in the community ... and it is reasonable that these benefits are funded from local resources.
Private philanthropy		Private philanthropy is a potential source of funding ... and it usually flows to causes that are popular or for which the philanthropy has some connection. Philanthropy is an important source of funding, but dangerous to rely on as a source of long term sustainability.
Official development aid (ODA)		Official development assistance (ODA) or official relief and development assistance (ORDA) are important sources of funding. There are several different flows: (1) from bilateral development agencies like USAID (USA), DFID (UK), SIDA (Sweden) etc.; from multilateral institutions like the World Bank, Global Fund for Aids, Tuberculosis and Malaria (GFATM), UN, etc.; and (3) emergency appeals arising from humanitarian crisis.
Humanitarian emergency aid		Specific humanitarian aid has received much of the funding that has flowed from the global north to the global south, and has been helpful in mitigating some of the suffering ... however, in almost every case these funds are consumed in an emergency

		mode and usually in very expensive ways ... such as, for example, flying food to affected areas, premium pricing (in effect profiteering) on most emergency goods purchases, etc.
Local resources and national private resources		There is often a lot more local wealth and private resources than might be apparent from the prevalence of poverty and the general appearance of squalor ... but this is rarely tapped as a source of funding for important local programs. The idea of public private partnership has proved very effective for local improvement of public space for the benefit of neighborhoods ... as for example in recent times in New York City.
Patient fees		Patient fees are the natural way for health services to be paid for ... but this natural arrangement does not work well when there is a high level of disease and a low capacity to pay for even the most affordable of health service.
Microfinance for health		The intersection of microfinance and health is emerging as a potential way forward where government finance is insufficient to fund good health, and individuals do not have immediate access the funds to pay for health services ... the cost of micro-finance loans is small relative to the value of the service.
The challenge of affordability		The value of good health is very high ... the cost of good health varies from quite small to very large depending on many variables. Decisions about health care have the potential to reduce cost and make care much more affordable ... but this is a only achieved when costs are optimized.

Sustainability

The IMM strategy incorporates sustainability as a core issue. Experience shows that malaria can be substantially reduced in an area ... as in Zanzibar several times ... but malaria rebuilds in the community very rapidly as soon as control measures are terminated.

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.
More 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.

Accountability

Training

Other

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.

Malaria Control District

Decoupling data and operations

XXXXXXXXXXXXXXXXXXXXXX

Health intervention performance ... the DALY metric

The disability-adjusted life year (DALY) metric was developed in part to make it possible to create meaningful comparable summary data. The international health community has embraced the DALY metric as a way to compare and contrast the cost effectiveness or different approaches to malaria control ... but there are weaknesses in the DALY metric as set out below:

About flaws in the DALY metric

Abstract: The disability-adjusted life year (DALY) initially appeared attractive as a health metric in the Global Burden of Disease (GBD) program, as it purports to be a comprehensive health assessment that encompassed premature mortality, morbidity, impairment, and disability. It was originally thought that the DALY would be useful in policy settings, reflecting normative valuations as a standardized unit of ill health. However, the design of the DALY and its use in policy estimates contain inherent flaws that result in systematic undervaluation of the importance of chronic diseases, such as many of the neglected tropical diseases (NTDs), in world health. The conceptual design of the DALY comes out of a perspective largely focused on the individual risk rather than the ecology of disease, thus failing to acknowledge the implications of context on the burden of disease for the poor. It is nonrepresentative of the impact of poverty on disability, which results in the significant underestimation of disability weights for chronic diseases such as the NTDs. Finally, the application of the DALY in policy estimates does not account for the nonlinear effects of poverty in the cost-utility analysis of disease control, effectively discounting the utility of comprehensively treating NTDs. The present DALY framework needs to be substantially revised if the GBD is to become a valid and useful system for determining health priorities.

King CH, Bertino A-M (2008) Asymmetries of Poverty: Why Global Burden of Disease Valuations Underestimate the Burden of Neglected Tropical Diseases. PLoS Negl Trop Dis 2(3): e209. doi:10.1371/journal.pntd.0000209

Based on CA methodology the DALY has even more substantive flaws. Specifically there is a need to think of the global health crisis as multiple systemic problems that are compromised by the complex situation of a resource poor environment, the absence of infrastructure and diverse incoherent interventions. The DALY may have value as a simplified way of aggregating poor data ... but the DALY is not an useful way to manage resources effectively to solve a global critical health crisis.

Cost and cost efficiency

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Interventions - cost													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Total													
Interventions - quantity													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Interventions – unit cost													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													
Interventions – cost efficiency (actual cost as % of standard cost)													
Surveillance													
IRS													
Source control													
Adulticiding													
Medical													
ITN													
Education													

This is a table of standard costs that shows the enormous variability in the per month remuneration of staff based on job function and to what group of staff they belong.

Standard cost by work type (US$ per month)
Inclusive of ALL benefits

	International	Local Int Scale	Local Private	Local Government
Program manager	20,000	12,000	8,000	6,000
Malaria control area manager	15,000	10,000	6,000	5,000
Malaria control zone manager	10,000	5,000	3,000	2,000
Junior government staff				1,000
MD (experienced)	20,000	12,000	8,000	4,000
MD (early career)	12,000	7,000	4,000	3,000
Nurse	3,000	1,000	600	300
Nurse assistant		600	300	200
Village health worker		200	100	50
Senior Scientist	15,000	6,000	4,000	2,000
Mid-level scientist (international)	10,000	3,000	2,000	1,500
Junior scientist (international)	6,000	2,000	1,500	1,200
Technician		500	300	200
Junior technician		300	200	150
M&E consultant	20,000	6,000		
M&E staff assistant		3,000	2,000	1,000
IRS spray supervisor		600	600	600
IRS sprayer		300	300	300
IRS driver		300	300	300
ULV Aircraft pilot	10,000	6,000		
Aircraft maintenance	7,000	3,000	2,000	
ULV vehicle driver		500	500	200
ULV operator		500	400	200
Chemical supervisor	10,000	4,000	2,000	600
Chemical handler		2,000	1,500	400
Laborer		300	200	150
Admin supervisor				
Admin clerk				
Accountant supervisor	10,000	2,000	1,500	1,000
Accountant clerk	6,000	400	350	200
Community data collector		200	100	150
Messenger		200	100	150
Driver		200	100	150
Security guard		200	100	150