IMMC INTEGRATED MALARIA MANAGEMENT CONSORTIUM

A Fast Commentary on the Vector Control Information on the CDC Malaria Website

Website information downloaded March 1, 2007

http://www.cdc.gov/malaria/control_prevention/vector_control.htm

CDC Content source: National Center for Infectious Diseases, Division of Parasitic Diseases. Date: August 15, 2006

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Summary of Conclusions

There are three main conclusions:

1. What is particularly striking is the absolute absence of any cost and result information expressed in numerical or financial terms. The arguments are all logical, but no analytical results or management information at all are presented. This is usual ... but it also makes a mockery of results based decision making. If the CDC, a well respected organization, is not making cost effectiveness information part of the information set, then who will?
2. There is no reference to the importance of multiple interventions in order to accelerate the results, and in so doing, also reduce the overall program costs. In the IMMC approach, case management interventions have an impact on the overall results being achieved. IMMC considers vector control and case management to be operating in one single system where everything is inter-related.
3. There is no explicit reference to the importance of time. Even though child mortality in Africa due to malaria is catastrophic, there is no sense that it is considered to be an emergency.

	General Information	
	What CDC says:	**IMMC comment**
1	Vector control aims to decrease contacts between humans and vectors of human disease. Control of mosquitoes may prevent malaria as well as several other mosquito-borne diseases.	Agreed
2	Elimination of malaria in an area does not require the elimination of all *Anopheles* mosquitoes capable of transmitting the disease.	This is an important point. The parasitic infection of the mosquito is the issue to be addressed.
3	In North America and Europe, *Anopheles* mosquitoes capable of transmitting malaria are still present, but the parasite has been eliminated. Socio-economic improvements (e.g., houses with screened windows, air conditioning) combined with vector reduction efforts and effective treatment have led to the elimination of malaria without the complete elimination of the vectors.	IMMC thinks of two stages: (1) reducing the level of parasitic infection in the vector; and, (2) keeping the level of parasitic infection very low.
4	Vector control for the prevention of malaria includes: • Insecticide-treated bed nets • Indoor residual spraying • Source reduction (larval control).	IMMC considers that source reduction should include environmental clean up, including structural changes to the infrastructure in certain cases. There are also circumstances where various forms of ULV adulticide treatment are cost effective interventions.

	Insecticide-Treated Bed Nets	
	What CDC says:	**IMMC comment**
1	Insecticide-treated bed nets (ITNs) are a form of personal protection that has repeatedly been shown to reduce severe disease and mortality due to malaria in endemic regions. In community-wide trials in several African settings, ITNs have been shown to reduce all-cause mortality by about 20%.	IMMC does not consider a 20% reduction in mortality a success ... this would be considered an unacceptable result in Europe or North America.
2	Untreated bed nets form a protective barrier around persons using them. However, mosquitoes can feed on people through the nets, and nets with even a few small holes provide little, if any, protection. The application of a residual insecticide greatly enhances the protective efficacy of bed nets. The insecticides used for treatment kill mosquitoes and other insects.	Agreed
3	The insecticides also have repellent properties that reduce the number of mosquitoes that enter the house and attempt to feed.	IMMC has emphasis on mosquito behavior ... a repellent affect keeps more mosquitoes outside where they may be susceptible to ULV fogging.
4	In addition, if high community coverage is achieved, the numbers and longevity of mosquitoes will be reduced. When this happens, all members of the community are protected, regardless of bed net ownership. To achieve such effects, high community coverage is required, as for indoor residual spray.	The operative word is IF. The cost of achieving and maintaining high community coverage needs to be factored in, and then costs need to be compared for this and other interventions
5	There are several types of nets available. Nets may vary by size, material, and/or treatment. Most nets are made of polyester but nets are also available in cotton, polyethylene, or polypropylene.	What are the relative costs both in terms of initial purchase and then in terms of lifetime use.

	Insecticide-Treated Bed Nets	
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6	Currently, only pyrethroid insecticides are approved for use on ITNs. These insecticides have very low mammalian toxicity but are highly toxic to insects and have a rapid knock-down effect, even at very low doses. Pyrethroids have a high residual effect: they do not rapidly break down unless washed or exposed to sunlight.	IMMC is concerned that any program using only one class of insecticide is an invitation to accelerated resistance, and should be discouraged.
7	To maintain the efficacy of ITNs, the nets must be retreated at intervals of 6-12 months, more frequently if the nets are washed. Retreatment is done by simply dipping nets in a mixture of water and insecticide and allowing the nets to dry in a shady place. Kits for retreating nets are available in most countries.	How much does this cost? What is the lifetime cost of the use of ITNs?
8	The need for frequent retreatments is one of the most difficult barriers to full implementation of ITNs in endemic countries. The additional cost of the insecticide and the lack of understanding of its importance result in very low retreatment rates in most African countries.	What is the cost of retreatment? What is the impact on performance with infrequent retreatment ? How much does it cost to get adequate community understanding?
9	Several companies have developed long-lasting ITNs that theoretically retain lethal concentrations of insecticide for the life of the net (3-5 years). CDC is currently testing several of these products in Atlanta and Kenya.	IMMC is interested in seeing the results of these tests.
10	Manufacturers' information on ITNs: • Siamdutch Mosquito Netting Co • Permanet (Vestergaard Frandsen)	
11	Travelers to malaria-risk areas may also use ITNs as one of several precautions against	

	Insecticide-Treated Bed Nets	
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	malaria.	
12	For information on ordering insecticide-treated bed nets: www.travmed.com, phone 1-800-872-8633, fax: 413-584-6656; or www.travelhealthhelp.com, phone 1-888-621-3952	

	Insecticide-Treated Bed Nets (ITNs): Commodity or Public Health Intervention?	
	What CDC says:	**IMMC comment**
1	Insecticide-treated bed nets (ITNs) are now an important method for controlling malaria. Their protective effect will be strongest if they are used by a high proportion of the population at risk. How to achieve this high coverage is currently the object of a debate.	IMMC would like to see cost and results being the primary determinant of program design. When the best performance program is identified, then there is the question of funding and the balance of this that should be done by beneficiary communities and how much from the public purse.
2	Should ITNs be sold as a commodity, using social marketing to stimulate their sale? Sale of ITNs might increase their value to the users and might ensure their sustainability (ITNs would continue to be available after donor agencies have left).	
3	Should ITNs be provided free of charge to the groups most at risk? Like vaccines, ITNs are a public health intervention that decreases death and disease. Thus, like vaccines, ITNs might deserve to be given free to those who need them most.	
4	The debate has not been settled. But in Africa, where 90% of malaria deaths occur, many of those suffering most from malaria - the rural poor - cannot afford even the modest cost (US$ 5) of an ITN. Rural areas where ITNs are sold through social marketing have not achieved the desired coverage (i.e., 60% of children under 5 and 60% of pregnant women using ITNs).	IMMC takes the view that $5 is not a modest cost to a poor person in Africa. Cash of (say) $20 will cover primary school costs for a full year. $5 of cash is NOT a modest amount.
5	Initial trials of free distribution of ITNs	Interesting that campaigns

	Insecticide-Treated Bed Nets (ITNs): Commodity or Public Health Intervention?	
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	during immunization campaigns or at antenatal clinics have been very successful. Coverage of children under 5 years of age has increased from less than 10% to over 80% in one week, in trials during immunization campaigns in Ghana and Zambia.	for immunization have been very successful ... while many other health initiatives seem to fail.
6	Upcoming trials will determine how successful this approach is on a larger scale and over a longer term.	Are these trials being done by an independent entity, or by an organization already contracted to perform bednet distribution?
7	If ITNs are adopted as a public health intervention (like vaccines), their full scale deployment will require sustained political and financial commitment from donors and from governments of malaria-endemic countries.	IMMC's position is that there is nothing wrong with a long term commitment to a program if it is (1) the most cost effective; and, (2) really works.
8	Many countries have adopted a combination of approaches, where nets are sold through the private market and also distributed free or heavily subsidized to groups at risk of severe malaria (pregnant women and children under 5). Balancing these strategies so that they complement each other may prove to be the best way to rapidly increase coverage among vulnerable populations while ensuring that this very effective malaria control intervention is sustained over the long term.	How much does it cost to maintain these non-market, non-government hybrid programs? Who benefits?

	Indoor Residual Spraying	
	What CDC says:	**IMMC comment**
1	Many malaria vectors are endophilic, resting inside houses after taking a blood meal. These mosquitoes are particularly susceptible to control through indoor residual spraying (IRS). As its name implies, IRS involves coating the walls and other surfaces of a house with a residual insecticide. For several months, the insecticide will kill mosquitoes and other insects that come in contact with these surfaces.	The argument for IRS is strong, but has substantial costs, and requires the acceptance of the people in the community to let spray teams into their homes. How much does it cost to do the spraying?
2	IRS does not directly prevent people from being bitten by mosquitoes. Rather, it usually kills mosquitoes after they have fed, if they come to rest on the sprayed surface. IRS thus prevents transmission of infection to other persons.	The prevention of transmission to another is a valuable aspect of IRS ... and it suggests that ITN and IRS in combination might be faster in bringing down mosquito levels than either on its own ... and the cost effectiveness perhaps optimized in a combination program.
3	To be effective, IRS must be applied to a very high proportion of households in an area (usually >70%).	Which should not be a problem ... but how big an area needs to be treated in order for there to be meaningful results?
4	IRS with DDT and dieldrin was the primary malaria control method used during the Global Malaria Eradication Campaign (1955-1969).	... and the campaign was very effective with a lot of success.
5	The campaign did not achieve its stated objective but it did eliminate malaria from several areas and sharply reduced the burden of malaria disease in others.	... the campaign was discontinued before the overall objective was achieved, but it had a lot of success prior to being

	Indoor Residual Spraying	
	What CDC says:	**IMMC comment**
		discontinued.
6	Resistance to DDT and dieldrin and concern over their environmental impact led to the introduction of other, more expensive insecticides.	Was this after the US EPA decision to ban use of DDT or before?
7	As the eradication campaign wore on, the responsibility for maintaining it was shifted to endemic countries that were not able to shoulder the financial burden. The campaign collapsed and in many areas, malaria soon returned to pre-campaign levels.	This is a sad example of expediency on the part of donors and the international development agencies ... and lack of realistic planning at the technical and financial levels.
8	As a result of the cost of IRS, the negative publicity due to the failure of the Malaria Eradication Campaign, and environmental concerns about residual insecticides, IRS programs were largely disbanded other than in a few countries with resources to continue them.	This is an almost complete abdication of professional responsibility on the part of development agency staff, scientists and development planners ... political expediency more important than human life.
9	However, the recent success of IRS in reducing malaria cases in South Africa by more than 80% has revived interest in this malaria prevention tool.	Yes ... but there were other examples of success over the years that the development assistance community has chosen to ignore.
10	It has also reignited the debate over whether or not DDT should have a place in malaria control.	More than this ... the well publicized success of IRS using DDT in South Africa is an embarrassment to almost all the expert malaria community that has failed to stand up to environmental PR that had rather little basis in good science.
11	With support from the Global Fund to fight	At long last ... but it is not yet

	Indoor Residual Spraying	
	What CDC says:	**IMMC comment**
	AIDS, Tuberculosis and Malaria as well as the President's Malaria Initiative, several countries have initiated IRS programs—many using DDT in their arsenal of insecticides—for the control of malaria.	clear what is the best way to optimize cost effectiveness. Is it with standalone IRS or in combination with other interventions. The IMMC model suggests that multiple interventions is the optimum approach.

	Insecticide Resistance	
	What CDC says:	**IMMC comment**
1	Insecticide-based control measures (e.g. indoor spraying with insecticides, ITNs) are the principal way to kill mosquitoes that bite indoors. However, after prolonged exposure to an insecticide over several generations, mosquitoes, like other insects, may develop resistance, a capacity to survive contact with an insecticide. Since mosquitoes can have many generations per year, high levels of resistance can arise very quickly. Resistance of mosquitoes to some insecticides has been documented within just a few years after the insecticides were introduced.	This we know ... but it is probably worse because in many cases both ITN and IRS are using the same family of insecticides.
2	There are over 125 mosquito species with documented resistance to one or more insecticides. The development of resistance to insecticides used for indoor residual spraying was a major impediment during the Global Malaria Eradication Campaign.	Resistance can be managed with a proper base of scientific information that is integrated with operations and the detail of how the interventions are carried out. This is not an academic exercise to prepare a peer reviewed paper, but information to manage day to day decisions.
3	Judicious use of insecticides for mosquito control can limit the development and spread of resistance. However, use of insecticides in agriculture has often been implicated as contributing to resistance in mosquito populations. It is possible to detect developing resistance in mosquitoes and control programs are well advised to conduct surveillance for this potential problem.	Use of insecticides for all purposes should be carefully done ... and the data obtained to identify potential problems and determine actions that will achieve success.
4	Related Sources: • Evaluating Mosquitoes for Insecticide	

	Insecticide Resistance	
	What CDC says:	**IMMC comment**
	Resistance (Web-Based Instruction) • Insecticide Resistance and Vector Control. Brogdon WG, McAllister JC (1998) Emerging Infectious Diseases 4:605-613 • Download PDF version formatted for print (143 KB/9 pages)	

	Source Reduction (Larval Control)	
	What CDC says:	**IMMC comment**
1	Source reduction is the method of choice for mosquito control when the mosquito species targeted are concentrated in a small number of discrete habitats. The larval habitats may be destroyed by filling depressions that collect water, by draining swamps, or by ditching marshy areas to remove standing water.	Source reduction by removing habitats is a valuable intervention.
2	Container-breeding mosquitoes are particularly susceptible to source reduction as people can be educated to remove or cover standing water in cans, cups, and rain barrels around houses.	This can be done with community participation.
3	Mosquitoes that breed in irrigation water can be controlled through careful water management.	This can be done, but is not easy to do.
4	For some mosquito species, habitat elimination is not possible. For these species, chemical insecticides can be applied directly to the larval habitats. Other methods, which are less disruptive to the environment, are usually preferred: • Oils may be applied to the water surface, suffocating the larvae and pupae. Most oils in use today are rapidly biodegraded. • Biological control agents include toxins from the bacterium *Bacillus thuringiensis* var. *israelensis* (Bti). These products can be applied in the same way as chemical insecticides. They are very specific, affecting only mosquitoes, black flies, and midges. • Insect growth regulators such as	Chemical or biological agents can be used. How much does it cost? In most cases costs can be reduced by having good information about mosquito behavior.

	Source Reduction (Larval Control)	
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	methroprene. Methoprene is specific to mosquitoes and can be applied in the same way as chemical insecticides. • Mosquito fish (*Gambusia affinis*) are effective in controlling mosquitoes in larger bodies of water. • Other potential biological control agents, such as fungi (e.g., *Laegenidium giganteum*) or mermithid nematodes (e.g., *Romanomermis culicivorax*), are less efficient for mosquito control and are not widely used.	
5	Source reduction is an ideal approach to mosquito control. Mosquito larvae are concentrated in defined areas, and source reduction eliminates mosquitoes before they reach the stage that is responsible for disease transmission.	
6	Unfortunately, source reduction is not always feasible. The larval habitats may be small, widely dispersed, and transient. *Anopheles gambiae*, one of the primary vectors of malaria in Africa, breeds in numerous small pools of water that form due to rainfall. The larvae develop within a few days, escaping their aquatic environment before it dries out. It is difficult, if not impossible, to predict when and where the breeding sites will form, and to find and treat them before the adults emerge. Therefore, larval mosquito control for the prevention of malaria in Africa has not been attempted on a large scale.	

	Other Vector Control Methods	
	What CDC says:	**IMMC comment**
1	*Fogging or area spraying* is primarily reserved for emergency situations: halting epidemics or rapidly reducing adult mosquito populations when they have become severe pests.	Interesting choice of words. Malaria in Africa is an epidemic ... and malaria is a severe pest. Fogging and area spraying are commonly used in the United States ... so it is interesting to find it hardly ever applied in Africa.
2	Fogging and area sprays must be properly timed to coincide with the time of peak adult activity, because resting mosquitoes are often found in areas that are difficult for the insecticide to reach (e.g., under leaves, in small crevices).	Yes ... this is absolutely true, but in most cases it is possible to find the best time to carry out treatment. Night time application is quite usual.
3	*Personal protection measures* include the use of window screens, ITNs (see above), and repellents (such as DEET) and wearing light-colored clothes, long pants and long-sleeved shirts.	To be encouraged, but not a public health policy intervention.
4	Well-constructed houses with window screens are effective for preventing biting by mosquitoes that bite indoors and likely contributed much to the elimination of malaria from the United States and Europe.	Possibly ... but various human activities including the habitat changes, and the impact of eradication programs should not be ignored.
5	*Sterile male release* has been successfully applied in several small-scale areas. However, the need for large numbers of mosquitoes for release makes this approach impractical for most areas. *Genetic modification of malaria vectors* aims to develop mosquitoes that are refractory to the parasite. This approach is still several years from application in field settings.	How much does this cost? Is it cost effective?

	Other Vector Control Methods	
	What CDC says:	**IMMC comment**
6	Related Sources of Information • Division of Vector-Borne Infectious Disease • American Mosquito Control Association • UC Integrated Pest Management Online • Entomology at Rutgers • Ohio State University Extension Fact Sheet	