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Analysis

Tackling malaria today

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In most countries where malaria is endemic, elimination is still not feasible, and the best strategy is steady progress towards universal coverage with key interventions

Once again, after an interval of 40 years, local elimination and global eradication of malaria (see box for definitions) is a focus of international health.[1] In 2007, the African Union called for elimination of malaria from the continent,[2] and the Bill and Melinda Gates Foundation challenged partners to adopt the goal of eradication.[3] In this article, we draw on lessons from the first global malaria eradication campaign to argue that in most countries, time limited elimination remains unfeasible with existing tools, and we argue that for these countries it is better to consider how to achieve sustained progress in reducing the burden of malaria.

Definitions[4]

Control—Reduction of disease incidence, prevalence, morbidity, or mortality to a locally acceptable level as a result of deliberate efforts. Continued intervention measures are required to maintain the reduction

Elimination of disease*—Reduction to zero of the incidence of a specified disease in a defined geographical area as a result of deliberate efforts. Continued intervention measures are required

Elimination of infection—Reduction to zero of the incidence of infection caused by a specific agent in a defined geographical area as a result of deliberate efforts. Continued measures to prevent re-establishment are required

Eradication—Permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts. Intervention measures are no longer needed

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Extinction—The specific infectious agent no longer exists in nature or in the laboratory

*WHO has defined malaria elimination as "the interruption of local mosquito borne malaria transmission."5

Why the first global eradication campaign could not achieve its goal

The global malaria eradication campaign of 1955-69 relied on indoor spraying with insecticide as the main tool, and failed for reasons that were technical as well as operational.6 The most serious obstacles were encountered in the African savannah and in tropical forests in South Asia and South America.7 In these environments it was impossible to interrupt transmission with the available tools, even when these were carefully and thoroughly applied.

Tropical Africa has the world's most efficient malaria vectors, giving the parasites an exceptional capacity to spread. With more than 100 infectious bites per person per year, the basic reproduction number, R_0 (secondary cases produced from one primary case, in one cycle of transmission), ranges from 50 to over 500.8 As a result, most people remain infected most of the time. Evidence generated between 1955 and 1977 by large scale projects showed that indoor spraying of insecticides could reduce transmission but, even if combined with mass drug administration, was not enough to eliminate malaria in the African savannah.9 10 11 12 13 Spraying is still a highly efficacious intervention; the potential added benefit of combining it with other interventions such as insecticide treated nets to achieve elimination remains to be investigated.

In forested areas of South Asia and South America, vectors tend to bite and rest outdoors, and mobile human populations live in dwellings without sprayable walls. Spraying with insecticide had little impact; insecticide treated nets, possibly as hammock nets, may be more appropriate but have so far not interrupted transmission in these environments.14

Lessons from the global eradication campaign and the recent past

Malaria-free status has been achieved in many areas in tropical Asia and America not only through malaria interventions but also through environmental and economic changes, such as deforestation, urbanisation, and housing improvements. Elsewhere, progress has been hampered or reversed by technical factors such as resistance to insecticides or drugs and operational factors including lack of development of basic health services and the ravages of war and civil unrest.

One important, generally applicable lesson is that in situations where vector control can interrupt transmission, complete elimination and its maintenance depend critically on high quality surveillance and thus on the capacity of the health services to rapidly detect and prevent transmission of any malarial infection, whether locally acquired or imported.

Another lesson is that in malaria vector control operations, especially insecticide spraying, it is difficult to maintain high levels of coverage and quality for more than about five years because of waning popularity, complacency, and resistance to insecticide. Concern about these constraints was one reason for initiating the time limited global eradication campaign.15

The epidemiology of malaria is like a spring; transmission can be suppressed, but will rebound when pressure is released. Failure to sustain transmission control may lead to epidemics. In Ethiopia, Solomon Islands, Sri Lanka, and the Madagascan highlands, resurgence of malaria after it had been nearly eliminated brought epidemics with high mortality.[16] There is no tipping point beyond which it gets easier to suppress transmission —but there is a point of no return, beyond which uninterrupted effective transmission control must be maintained until malaria is eliminated.

What can we expect from research on novel tools?

New investments in research towards eradication offer enormous possibilities for new vaccines, new pharmaceuticals, and new ways of attacking parasites and mosquitoes.[2] Nevertheless, none of the interventions likely to be implemented in the next decade offers a clear prospect of a decisive breakthrough that will make eradication possible. Thus, in areas with high R_0, even a very effective vaccine would need to be applied with coverage rates close to 100%, and in combination with other interventions, to achieve elimination. In these conditions, some vaccines could have paradoxical effects,[17] making surveillance more difficult, since people who have been vaccinated would no longer be susceptible and thus could not act as sentinels. It is not unthinkable that in the next generation or two, new technologies could make global malaria eradication feasible. With currently available tools, however, that goal is as unfeasible now as it was 50 years ago.

Where could malaria elimination be envisaged today?

On the basis of the experiences of the past and an assessment of new tools, the World Health Organization has recently formulated "contextual prerequisites for malaria elimination."[4] These prerequisitesinclude clear evidence that elimination by using existing interventions in the specific eco-epidemiological setting, is feasible, as well as evidence for political commitment, especially budgets at national and local levels, and cross border cooperation.

In certain countries where malaria is endemic, these conditions are fulfilled: the United Arab Emirates, which has recently been certified malaria-free, and Oman, which is approaching this status, are good examples. Several countries in North Africa, central and western Asia, and the Americas could follow them. On the other hand, in the intense transmission conditions of most of tropical mainland Africa, these conditions are not fulfilled. In many areas of Asia and the Americas, elimination remains difficult to realise. Countries like Malaysia, Mexico, Thailand, and Vietnam have achieved near elimination in developed, densely populated areas, but foci of transmission persist, mostly among ethnic minorities and migrants in remote areas, where vectors are more efficient and intensive surveillance is hard to sustain. Progress will depend as much on overcoming the geographical and cultural barriers as on identifying locally effective interventions.

Potential risks of promoting elimination

Inequitable allocation of resources

The idea of "shrinking the map" assumes that after elimination, funds that are currently used for vector control in the target areas would be freed for use elsewhere.[2] This alluring vision must not lead to neglect of high burden areas, especially tropical Africa, where over 80% of malaria deaths occur. A repeat of the 1950s, when the attitude to Africa was "wait and study," would be shameful. Within African countries, resources should not be diverted from high burden areas to places where elimination seems realistic. In most Asian and American endemic countries, vector control is nowadays highly targeted,

and the main challenge is to overcome operational or technical problems in high burden focal areas with scattered and mobile populations,[18] so the savings from elimination in low burden areas could be disappointing.

Resistance to insecticides and drugs

The global eradication campaign confirmed that the capacity of vector populations to evolve resistance to successive classes of insecticide can exceed the human capacity to develop new insecticides. Donors are investing to ensure a pipeline of candidate insecticides, but the new ones are unlikely to be as good as those we have now.

The ambition to eliminate malaria in areas where vector control is difficult could lead to the adoption of mass drug administration in an attempt to suppress transmission. This was practised in the 1950s and 1960s, the extreme example being chloroquinised salt.[19] Such approaches could put current treatments at risk.[20] Resistance to drugs based on artemisinin is emerging as a threat to global malaria control and should be dealt with urgently.[21]

Inefficient combined interventions

The availability of ample resources can lead to the belief that it would be unethical not to rapidly scale up all possible interventions for people at high risk. Unless the combinations are synergistic, though, the incremental benefit falls with each added intervention, and overall cost effectiveness declines. Moreover, other programmes may suffer from the competition for skilled personnel. It was recognised in the 1960s that "the use of a combination of two methods makes for increased work and often leads to inefficiency in both; it also complicates the administration and organization of the programme."[6] These threats apply equally to monitoring and surveillance, increasing the risk of setbacks and even rebound epidemics.

Most donors understand such risks, and some are strongly committed to a sustained, long term effort, but they cannot ensure that health systems can maintain complex combined operations over decades, nor can they prevent social instability and conflict, which can lead to rapid breakdown of health services.

The case for sustained progressive malaria control

The funds available for tackling malaria are greater than ever before, so decision makers in countries where malaria is endemic are faced with some big choices, often under political pressure. Countries in which elimination is either not feasible or uncertain offer the greatest opportunities to reduce the global burden of death and disease due to malaria, as has been shown in the past two decades in several countries that have applied evidence based interventions with high coverage within their health systems. We propose five guiding principles for this balanced, long term approach of sustained progressive malaria control.

Firstly, prioritise universal coverage of a few interventions.[22] Make effective case management continuously and universally accessible for all populations at risk. For falciparum malaria, this should be based on artemisinin based combination therapy and rapid diagnostic tests, which will improve care for all febrile diseases. For prevention, long lasting insecticidal nets are now usually the basic intervention. Furthermore, be uncompromising in pursuing complete coverage: seek out underserved groups using tools such as geographical information systems, population surveys, and databases.[23] [24] Identify barriers to access and use complementary approaches to overcome them.

Secondly, plan for this coverage as part of general health development with the full machinery of micro-

planning, training, supervision, logistics, communication, surveillance (including drug and insecticide resistance), monitoring, and evaluation and implementation research.[25] Seek opportunities, and define indicators, for using malaria control (or elimination) to strengthen the health system, without compromising equity, effectiveness, and efficiency; for example, malaria case management should be part of integrated management of childhood and adult illness, and preventive interventions should be combined with maternal and child health and immunisation programmes.

Thirdly, pay decent salaries to health staff for good work.[26]

Fourthly, consider additions and alternatives to the basic package of interventions and strategies, when and where there is evidence that they would improve cost effectiveness or sustainability, or both. Introduce special interventions and finance these as part of local economic development schemes.

Finally, revise planning at frequent intervals, always seeking greater impact year by year, using all available data.

In most countries where malaria elimination has been achieved and sustained, success came through gradually accumulated experience and a succession of increasingly ambitious objectives. Eradication remains a long term goal, but there is now an unprecedented opportunity to break the malaria-poverty cycle in many high burden areas. It must not be lost.
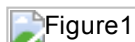

Fig 1 Preparation for indoor spraying with insecticide in Venezuela, 1951. In 1961 the northern part of Venezuela satisfied WHO's criteria for eradication, but the disease remains endemic in the southern part of the country, with 37 062 reported cases in 2006

Summary points

- Interventions need to be scaled up, whether the goal is time-limited elimination of malaria or long term control

- Nevertheless, there are important practical differences between elimination and control, notably in the relative priority given to high and low burden target areas, the choice and timing of interventions, and the need for integration with general health services

- On the road to elimination there will be no tipping point, beyond which the task gets easier to sustain; instead we must anticipate a point of no turning back, beyond which any relaxation would be dangerous

- In high burden areas, where elimination is currently not feasible, health impact will be maximised by aiming to develop universal coverage in the context of health systems

Notes

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Footnotes

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