Guinea worm eradication - Is the target attainable?

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WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

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The challenge of eradication

It is not often that humanity decides to eradicate a disease. It has only happened twice before; we failed with malaria, but succeeded with smallpox. If we do not achieve it with guinea worm, we shall only have ourselves to blame. Water engineers should be delighted at the choice of a disease in whose eradication they can play an important role, and which we can hardly fail to vanquish in the end.

Why can Guinea worm be eradicated, when malaria could not? The disease is different from malaria in several ways. The parasite does not live beyond its one-year transmission cycle, so that there are no long-term carriers. The disease is easily diagnosed, and cases are easily prevented from passing it on to others. Moreover, it does not have a vector which can fly about, transmitting infection over distances.

However, the most compelling evidence that Guinea worm is eradicable is that it has already disappeared, with or without human assistance, from a number of countries. In addition to Central Asia and most of the Middle East, these include at least two African countries, Gambia and Guinea, where the last indigenous cases were seen some 20 - 30 years ago. In these countries, there has been no health education aimed specifically at the disease, so that the credit for its elimination is doubtless due mainly to improvements in drinking water supply.

Even in those countries where the disease is still endemic, water supply has no doubt had an important impact. Here in Ghana for example, it has been suggested that the relatively low incidence of Guinea worm in Upper Region is associated with the large number of boreholes drilled there in the last two decades. However, such associations need to be interpreted with caution. Sanmatenga, in neighbouring Burkina Faso, is the province with the most boreholes, but also the most endemic for Guinea worm.

Why building water supplies is not always enough

There are three potential reasons why water supply improvements are not always sufficient on their own to eradicate Guinea worm disease. *The first* of these reasons is that the water supplies themselves may not continue to function, especially if arrangements are not made to ensure their maintenance.

A cautionary illustration of this is provided by the Ivory Coast, which in the 1970s was in the vanguard of African countries providing rural water supplies. Between 1973 and 1985, 12,500 new boreholes were installed in rural areas, at considerable expense. As a result, the annual number of Guinea worm cases reported fell from 67,123 in 1966 to only 1,889 in 1985 (Anon 1987). In 1991, however, the national case search found an estimated 12,690 cases (République du Côte d'Ivoire 1992). The search methods may not have been exactly comparable, but another factor behind this recrudescence of the disease became clear last year, when UNICEF carried out a survey of handpumps in three of the most endemic subprefectures of the country. They found that over half of them were out of order, in spite of a recently-concluded handpump rehabilitation project in the area.

The second reason is that the water supplies, although functioning, may not be used by most of the affected population. The most common cause of such non-use is that the new source of water is not conveniently situated, close enough to people's homes. In many of the sahelian settings where Guinea worm is endemic, such as the Mossi Plateau of Burkina Faso, the settlement pattern is so dispersed that a "village" is not a cluster of households but an administratively-defined area of land including many scattered homesteads. With Burkina's mean population density of 33 per km^2, an average "administrative village" of 1000 people covers an area of 30 km^2. In such circumstances, to speak of a village being "covered" by a single borehole, or even by two or three, is clearly absurd.

The allocation of water supplies to villages by government rural water supply programmes often begs the question of defining a village. Even when the settlement pattern is relatively nucleated, an official village often includes a number of outlying hamlets, which may or may not be permanently inhabited; they may only be occupied during peak periods of agricultural activity. Unfortunately, these periods, principally the rainy season, often coincide with the peak season for transmission of guinea worm disease.

The provision of water supplies to small hamlets is often hard to justify, for two reasons. First, it is expensive in terms of cost per head. A borehole costing $10,000 dollars for only 80 people is not a very cost-effective option, especially if they will not be there to use it all year round. Second, the maintenance of water supplies in small and often transient communities is even harder to sustain than in larger and more permanent ones; they are less likely to be able to have the funds, the skills or the degree of organisation to carry out repairs successfully.

On the other hand, the prevalence of Guinea worm disease is often significantly higher in the smaller villages. In one study of the disease in Northern Zou Province, Bénin, it was found that villages of 100 or fewer inhabitants typically had 3 to 4 times the rate of infection of the largest villages, with populations of 800 or more (Tempalski 1991).

This may explain why water supply programmes which are targeted to areas endemic for guinea worm often fail to reach the specific villages which are most affected. In the Bénin project for which the above data were collected, villages with a population below 150 (and thus likely to have a high incidence of guinea worm) were specifically excluded from the borehole programme (Yellott 1990).

The third reason why water supplies on their own are not always sufficient to eliminate dracunculiasis is that they are not always used *exclusively*. A great deal of guinea worm infection is acquired by casual use of unprotected sources when away from the home, particularly when working in the fields. This is borne out by the common findings, particularly in communities where the incidence is relatively low, that adults, particularly farmers, are more commonly infected than children (Belcher 1975; Cairncross & Tayeh 1988), and that people who travel away from their village of residence are also at greater risk of infection (Tayeh 1992).

In these circumstances, provision of a water supply only prevents the infection which is acquired at home. It tends to turn a high-incidence village (where, say, 20% or more of the population are infected) to a low-incidence village (typically 10% or less), but not to eliminate the disease.

What kind of water supply?

It has long been known that ponds are ideal sources of guinea worm transmission (Onabamiro 1952, Scott 1960). Transmission is particularly intense in the last weeks before a pond dries up. The cyclopoid population is increasingly concentrated in an ever-decreasing volume of water, and the infected cyclopoids, which tend to sink to the bottom (Onabamiro 1954), are increasingly likely to be scooped up as the village pond becomes a shallow puddle.

Compared with the endemic areas of India, where large numbers of stepwells facilitate transmission, the number of ponds per head of population in Africa may seem very small, suggesting that chemical treatment of the water to kill the cyclopoids might be a viable strategy, as it has been in India and Pakistan. However, it presents a number of practical problems.

First, the peak season for guinea worm transmission is in the rainy season, when access to endemic villages and their ponds is difficult. Treatment would have to be applied monthly at least to be effective; probably once a week. Second, it is much harder to calculate the volume of an irregular pond than of a rectangular Indian stepwell, although this is essential in order to estimate the dose of insecticide required. Moreover, the pond volume varies with time; rainfall after the treatment could dilute the insecticide to harmless levels.

Third, the high suspended solids content of an African pond diminishes the efficacy of an emulsified insecticide such as temephos, which tends to be adsorbed onto the suspended particles. Chemical treatment of ponds under African conditions, even by highly qualified research teams, has been found to be of questionable effectiveness (Guiguemdé *et al.* 1990, Sullivan 1991).

What is less often documented is that many, if not most of these ponds are *man-made*. Hafirs, rehabilitated in Sudan for drinking water supply, and small dams, built in Ghana for agriculture or livestock watering, have been implicated as important sources of the disease (Tayeh and Cairncross 1991). However, the traditional man-made ponds are far more common. A similar technique is found across much of the African endemic belt; a depression is dug in the path of a small ephemeral watercourse, and the excavated earth is piled on the downstream side to make an improvised dam. Often, clay is used to make an impermeable lining to the reservoir. The result, a sort of dew pond, is known as a "dugout" here in Ghana, a "boullie" in Burkina Faso, and an "atapara" in northern Uganda.

Man-made ponds seem to be more important in transmission than natural ponds. Steib and Mayer (1986) working in Burkina Faso, found that only 9% of guinea worm patients had drunk from large natural ponds and 5% from small natural ponds, but that 85% had obtained their drinking water from small man-made ponds in the previous year. Such small man-made ponds are often dug near fields. They do not last throughout the dry season. Since the fields remain in the same place only for a limited number of years, new ones are continually being dug. Steib and Mayer (1986) found as many as ten per village, although the number may be less in other parts of the region.

If water engineers were willing to develop low-cost methods of improving these sources, such as infiltration wells or trenches, or simple sand filters such as those developed in Bangladesh and West Bengal (DPHE 1989, AIIHPH 1993), they could help not only to reduce the incidence of Guinea worm, but to prevent it entirely.

However, the rural water agencies in many endemic countries have been reluctant to consider technologies other than boreholes for application on a wide scale. Indeed, they have often planned on the basis of quite inadequate numbers of boreholes, particularly when they are to be equipped with hand pumps. A recent borehole project aimed at guinea worm control in a highly-endemic area of Nigeria, for example, provided less than one handpump on average for over 1000 people. Even the best handpump is unlikely to last very long under such heavy use - unless some of the potential users are put off by the queue and decide to collect pond water instead!

The other strategy

The strategy which has appeared recently to be producing the quickest results in a number of countries has little to do with water supply improvements. It is to set up a network of village workers who carry out monthly surveillance of cases, and also offer health education to their neighbours on prevention of disease. There is a good scientific basis for linking surveillance with health education, because recent research has shown that those suffering from Guinea worm in one year are at least five times more likely than others to have it again a year later (Tayeh *et al.* 1993). The cases detected by surveillance are therefore the ideal targets for health education.

The most obvious component of the health education is the distribution of cloth filters to remove cyclopoids from water. However, there is circumstantial evidence to suggest that the dramatic reductions in cases recently found in Ghana, Nigeria and elsewhere have resulted not primarily from the use of filters (the reductions have often started to occur *before* most of the filters were distributed), but from other changes in behaviour, possibly relating to the contamination of water sources by those who have the disease.

Whatever the reason for their success, these networks of village surveillance workers are an immensely powerful tool. In Ghana, more than 90% of the village volunteers are sending in monthly reports on time, and they are willing to collect information on subjects other than Guinea worm. It would be sad indeed if this system were to be dismantled when the Guinea worm is eliminated, and not be extended to support other health initiatives, such as the eradication of polio.

Geographic information systems

One question raised by the masses of data collected by village-based surveillance is the lack of a good database on the villages in the endemic countries, or on their locations. The question is complicated by the problems of defining a village, mentioned above, and by the way villages move and change their names. However, computer-based geographic information systems (GIS) make such evolving datasets easier to handle (Clarke *et al.* 1991).

Once the data on village locations have been entered into a computer using a GIS, other information from case searches or from monthly surveillance returns can easily be added. From the database, it is easy to print maps at any scale, showing the areas needing priority targeting for disease control, the high-incidence villages lacking water supplies, the locations of health centres and schools which can be used to support health education, and so on.

Such maps have applications which can go far beyond the health sector. Made available to implementers at local level, they can be extremely valuable aids to programming. At national level, they are an effective means to convince decision-makers. The challenge is to create the sustainable capacity to maintain and use these systems, hitherto largely dominated by expatriates, and to generate demand at local level for the maps they can produce.

The water sector has much to offer here. In most of the francophone endemic countries, the water ministries have already compiled geographic databases of the locations of all villages, with and without boreholes, often using the satellite-based global positioning system to verify the precise locations of villages where maps are unreliable. I imagine that there have been similar developments in the English-speaking countries. Water ministries could provide a great service to other sectors if they helped to disseminate such data and the skills needed to manage them.

Which target?

Whether or not Guinea worm will be eradicated by 1995, it is clear that it will not be with us for many more years; the number of cases has fallen substantially in each of the last few years, as the other contributors to this session can tell you.

I would suggest, however, that we should be aiming for a more ambitious target, which is to use the eradication of Guinea worm as a means to establish sustainable systems which will serve us long after the Guinea worm has gone. These would include handpump maintenance systems, systems for providing water to small villages, including the low-cost upgrading of existing water sources, systems to monitor whether water supplies are used, systems for village-based public health surveillance and the one-to-one delivery of health information, and systems for the management and analysis of information about individual villages at national level.

Whether the endemic countries will reach *that* target is a more challenging question to answer. To a great extent, it is up to all of us.

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