

## DRACUNCULIASIS ERADICATION: ALMOST A REALITY

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**Abstract.** The idea of a global campaign to eradicate dracunculiasis was first proposed by the Centers for Disease Control and Prevention in 1980, during the advent of the International Drinking Water Supply and Sanitation Decade (IDWSSD) (1981-1990). In 1981, the Steering Committee of the IDWSSD adopted eradication of dracunculiasis as a subgoal of their efforts to provide safe drinking water to unserved populations. In 1988, African ministers of health voted to eradicate dracunculiasis by the end of 1995, a target date that was endorsed by UNICEF in 1989 and the World Health Assembly in 1991. Although nine of 18 endemic countries, India (1980), Pakistan (1987), Nigeria and Cameroon (1988), Ghana (1989), and Mauritania, Benin, Burkina Faso, and Togo (1990) completed national searches for cases of the disease, only four countries, India (1983), Pakistan (1988), Ghana (1989), and Nigeria (1989), actually started eradication programs during the 1980s. The remaining 14 endemic countries began their eradication programs between 1991 and 1995. At the end of 1996, dracunculiasis had not been entirely eradicated, but its incidence had been reduced by 95%, from an estimated 3.2 million cases in 1986 to 152,805 cases in 1996. Sudan reported a total of 118,578 (78%) of the 152,805 cases of dracunculiasis reported during 1996. Insufficient funding and the civil war in Sudan continue to be the major obstacles to overcome. A primary aim of the eradication program in 1997 is to seek to ensure that all cases of dracunculiasis outside of Sudan are contained. In Sudan the challenge is to pursue all appropriate control measures in all accessible areas as vigorously as possible until political circumstances allow access to all of the remaining affected areas.

This paper summarizes the current status of the campaign to eradicate dracunculiasis (Guinea worm disease), as of late 1996. It is an update of the review that was published in this journal in January 1995.<sup>1</sup>

The parasite *Dracunculus medinensis* is transmitted to humans by drinking water contaminated with tiny crustaceans (copepods) containing immature forms of the parasite. One year later, adult female worms up to one meter long emerge through the skin on any part of the body. Each adult worm ejects hundreds of thousands of larvae into the water if a human immerses that part of their body with an emerging worm into water. Affected persons may be incapacitated for 2-3 months or more, and more than half of a village's population may be affected at the same time.<sup>2</sup> The seasonal emergence of the worm often coincides with the harvest or planting season, thus magnifying the socioeconomic impact of the disease on agricultural productivity and school attendance of people living in endemic areas.<sup>3</sup>

Dracunculiasis is best prevented by providing safe sources of drinking water, such as from borehole wells. Other preventive measures include health education, use of cloth filters to remove the copepods from drinking water, boiling drinking water, and use of Abate® (American Cyanamid, now American Home Products, Parsippany, NJ) (temephos) to kill the intermediate host of the parasite in open ponds and other infected sources of drinking water. There is no cure for the infection, and persons do not become immune to this parasite,<sup>3</sup> but each infection lasts only one year in humans. There is no animal reservoir of *D. medinensis*, and the infection is only transmitted to people by drinking contaminated water.<sup>4</sup>

### BACKGROUND

The global campaign to eradicate dracunculiasis began with an initiative taken at the Centers for Disease Control (CDC) in 1980, just before the onset of the International Drinking Water Supply and Sanitation Decade (IDWSSD)

(1981-1990).<sup>5,6</sup> One of the goals of the IDWSSD was to provide safe drinking water to all unserved populations during the 1980s. In 1981, the Steering Committee of the IDWSSD adopted dracunculiasis eradication as a subgoal of their efforts to provide safe water to unserved populations, and CDC continued to advocate for eradicating the disease given the unique opportunity being provided by the IDWSSD activities. In 1981, dracunculiasis was known to still occur in 16 African countries, India, and Pakistan. More than four million cases were estimated to occur annually, with more than 100 million persons estimated to be at risk for the disease. Independently, in 1983, India began its campaign to eradicate dracunculiasis.<sup>7</sup> After 1983, other countries gradually developed interest in dracunculiasis eradication and mobilized to begin ascertaining the extent of the problem.<sup>8</sup>

In 1988, African ministers of health voted to eradicate dracunculiasis by the end of 1995, a target date that was endorsed by UNICEF in 1989<sup>9</sup> and the World Health Assembly in 1991. By the end of the Water and Sanitation Decade in 1990, eradication programs were underway in only four of the 18 affected countries, and five others had completed national searches for cases of the disease (Figure 1). By this time, the program adopted a strategy for achieving eradication that emphasized health education and the use of cloth filters by persons in endemic areas to remove copepods from their drinking water, rather than emphasizing the provision of borehole wells. Health education and use of cloth filters could be extended to endemic communities faster and less expensively than borehole wells, even though the former interventions only protected against dracunculiasis, whereas underground water from wells prevented many other diseases in addition to dracunculiasis. The remaining endemic countries, including Yemen where endemic dracunculiasis was confirmed in 1994,<sup>10</sup> began their eradication programs between 1991 and 1995 (Figure 1).

In 1993, the national eradication programs in Cameroon, Ghana, and Nigeria began adopting the more intensive, in-

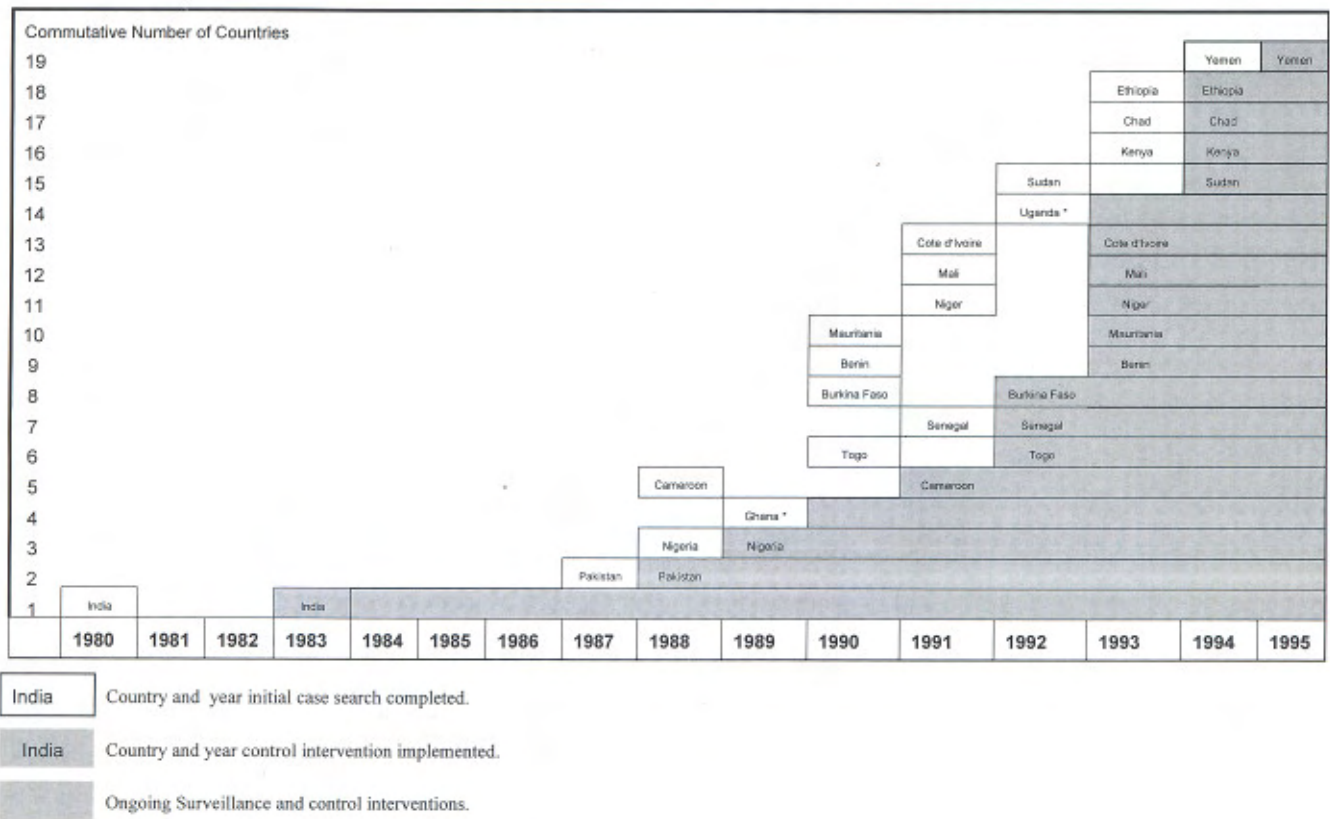


FIGURE 1. Dracunculiasis eradication campaign. Year of initial national case search and of program implementation in 19 affected countries: 1980–1995.

dividual-based strategy of case containment as the next step after implementation of village-based strategies of case reduction (i.e., health education, distribution of cloth filters, vector control, and the provision of safe sources of drinking water). The patient-based case containment strategy, i.e., the focusing of surveillance and control interventions on the increasingly smaller number of affected villages to detect all cases before or within 24 hr of worm emergence and to begin or verify implementation of all possible control measures around each case immediately, is based on the surveillance containment strategy that was used at the end of the Smallpox Eradication Program to accelerate the eradication of that disease. The case containment strategy was pioneered by the Guinea Worm Eradication Program in Pakistan in collaboration with the CDC and Global 2000 of the Carter Center.<sup>11</sup>

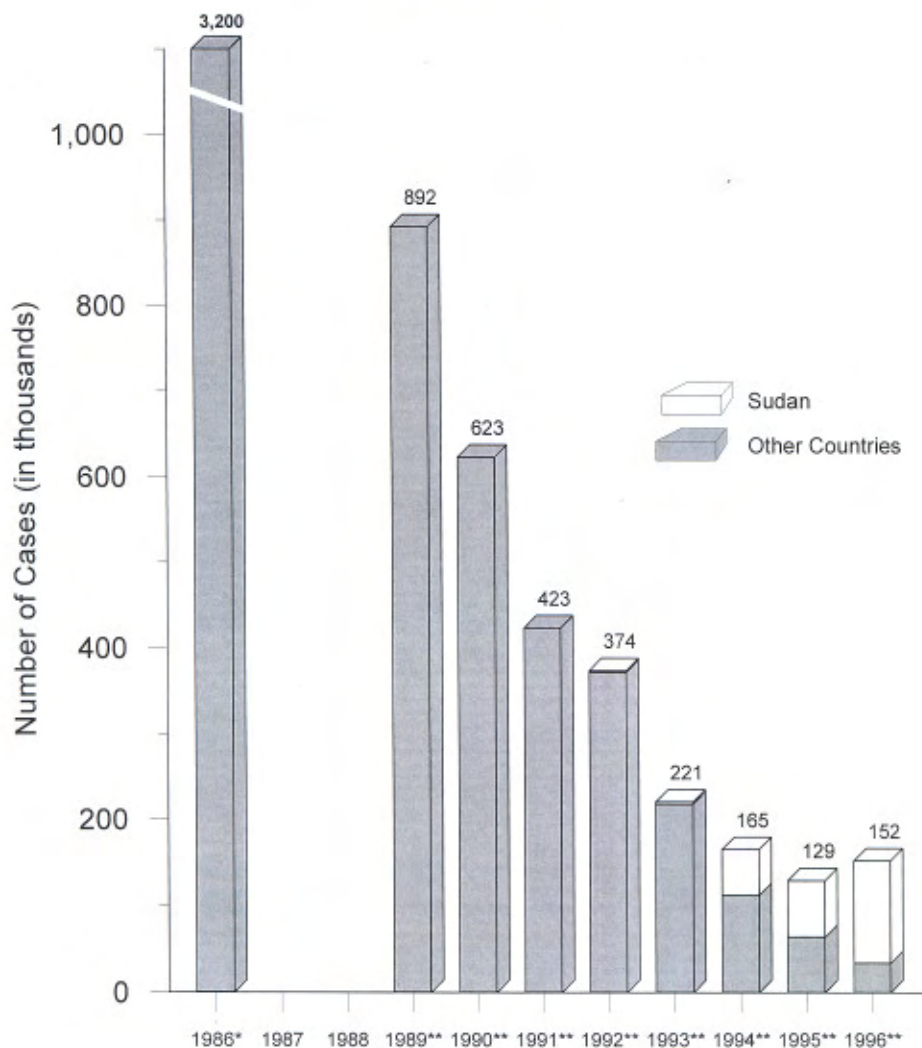
CURRENT STATUS OF THE CAMPAIGN

Although dracunculiasis has not yet been eradicated, its incidence has been reduced by 95%, from an estimated 3.2 million cases in 1986,<sup>12</sup> to 152,805 cases in 1996 (Figure 2 and Table 1). Pakistan has had no case of dracunculiasis since October 1993.<sup>13</sup> Kenya has had no indigenous cases reported since May 1994, and five other countries reported 127 or fewer cases in 1996 (Figures 3–6). The World Health Organization (WHO) recently established a Global Commis-

sion for the Certification of Dracunculiasis Eradication, which met for the first time in March 1996.<sup>14</sup> Recommendations from the second meeting of the Global Commission in January 1997 led the Director-General of WHO to declare Pakistan and 20 other countries free of dracunculiasis transmission.<sup>15</sup>

Outside of Sudan, 34,227 cases of dracunculiasis were reported during 1996, and the number of known endemic villages has been reduced from more than 23,000 in January 1993 to 4,373 in January 1997, which is substantially less than the 7,519 in Table 1, since only 58% of the endemic villages actually reported one or more cases during 1996. During 1994, 1995, and 1996, these other endemic countries have achieved rates of reduction in annual incidence of -51%, -42% and -48%, respectively. During the same period, these programs improved rates of on-time monthly reporting of cases from endemic villages from 77% in 1994 to 89% in 1996, and increased the application of case containment from 0% in 1993 to 65% in 1996.<sup>16</sup> Use of vector control with temephos has increased from 5% of all endemic villages (including Sudan) in 1993, to 20% in 1996. Niger, which was the third most endemic country in 1995, reduced its incidence by 79% in one year, from 13,821 cases in 1995 to 2,956 cases in 1996, thereby lowering its ranking to the fifth most endemic country.

Although the Sudan Guinea Worm Eradication Program (SGWEP) got underway in 1992–1993 with a village-by-



\* Estimated by S. Watts

\*\* Weekly Epidemiological Record Global surveillance summary.

FIGURE 2. Number of cases of dracunculiasis by year: 1989–1996.

village search for cases in areas accessible to the Government of Sudan, the program only began reaching many additional areas in the highly endemic southern part of the country in 1994, when the United Nations' Operation Lifeline Sudan included dracunculiasis eradication activities in its efforts and those of collaborating nongovernmental organizations. In March 1995, the president of Sudan presided at the country's first national conference on dracunculiasis eradication. A four-month long Guinea Worm Cease-Fire that was negotiated by former U.S. President Jimmy Carter between the opposing sides in the 12-year-old civil war began immediately after the national conference. As a result, both sides in the SGWFP greatly expanded operations during 1995, more than doubling the number of known endemic villages in Sudan (to 1,950), increasing the number of cases reported to 64,608, and increasing the number of cloth filters distributed to 230,000 (from 93,000 distributed in 1994).<sup>17</sup>

Seventy-eight percent (118,578) of the 152,805 cases reported worldwide during 1996 were reported from Sudan, as compared with 50% of all cases in 1995, and 33% of all

cases in 1994. More than 95% of the cases in Sudan occur in the southern part of the country, where the civil war is still ongoing. Forty-two percent of the 12,985 known endemic villages in 1996 were in Sudan. The increase in the number of known endemic villages in Sudan after the Guinea Worm Cease-Fire illustrates the momentum created by that cease-fire. A total of 37,665 (32%) of all the cases from Sudan in 1996 were reported to have been contained. In 1996, Sudanese health workers distributed 617,289 cloth filters, without a cease-fire.

#### DISCUSSION

The target date for the eradication of smallpox was 1976, but that goal was attained 10 months later. The target date for the eradication of polio from the Americas was 1990 and from WHO's Western Pacific Region by 1995. However, transmission of polio viruses was halted in 1991 in the Americas, and that goal has not yet been attained in the Western Pacific Region. As with those programs, the global

TABLE 1

Reported cases of dracunculiasis and percentage change in incidence by country (1993, 1994, 1995, and 1996), no. and % of cases contained (1996), and no. and % of endemic villages reporting (1996)\*

Country†	Number of cases reported				Percentage change			Cases contained: 1996		Endemic villages: 1996	
	1993	1994	1995	1996	1993-1994	1994-1995	1995-1996	No.	%	No.	% reporting
Nigeria	75,752	39,774	16,374	12,282	-47	-59	-25	9,288	76	2,294	78
Uganda	42,852	10,425	4,810	1,455	-76	-54	-70	1,191	82	884	100
Niger	25,346	18,562	13,821	2,956	-27	-26	-79	1,726	58	776	99
Ghana	17,918	8,432	8,894	4,877	-53	5	-45	3,558	73	1,296	100
Benin	16,334	4,302	2,273	1,427	-74	-47	-37	1,003	70	325	81
Mali	12,011	5,581	4,218	2,402	-54	-24	-43	1,388	58	428	80
Togo	10,349	5,044	2,073	1,626	-51	-59	-22	1,428	88	249	100
Burkina Faso	8,281	6,861	6,281	3,241	-17	-8	-48	2,119	65	612	89
Cote d'Ivoire	8,034	5,061	3,801	2,794	-37	-25	-26	1,606	57	215	79
Mauritania	5,882	5,029	1,762	562	-15	-65	-68	354	63	255	92
Sudan	2,984	53,271	64,608	118,578	1685	21	84	37,665	32	5,466	48
Chad	1,231	640	149	127	-48	-77	-15	109	86	40	98
Ethiopia	1,120	1,252	514	371	12	-59	-28	315	85	79	99
Senegal	815	195	76	19	-76	-61	-75	11	58	15	100
India	755	371	60	9	-51	-84	-85	9	100	24	100
Cameroon‡	72	30	15	17	-58	-50	13	13	76	6	100
Kenya§	35	53	23	0	51	-57	-100	~	~	~	~
Pakistan	2	0	0	0	-100	~	~	~	~	~	~
Yemen	~	94	82	62	~	-13	-24	51	82	21	90
Total	229,773	164,977	129,834	152,805	-28	-21	18	61,834	40	12,985	76
Total excluding Sudan	226,789	111,706	65,226	34,227	-51	-42	-48	24,169	71	7,519	89

\* ~ = not applicable.

† Countries are arranged in descending order of cases in 1993.

‡ Reported seven imported cases during 1995 and 11 imported cases during 1996.

§ 19 at risk villages under surveillance; all 23 cases were imported.

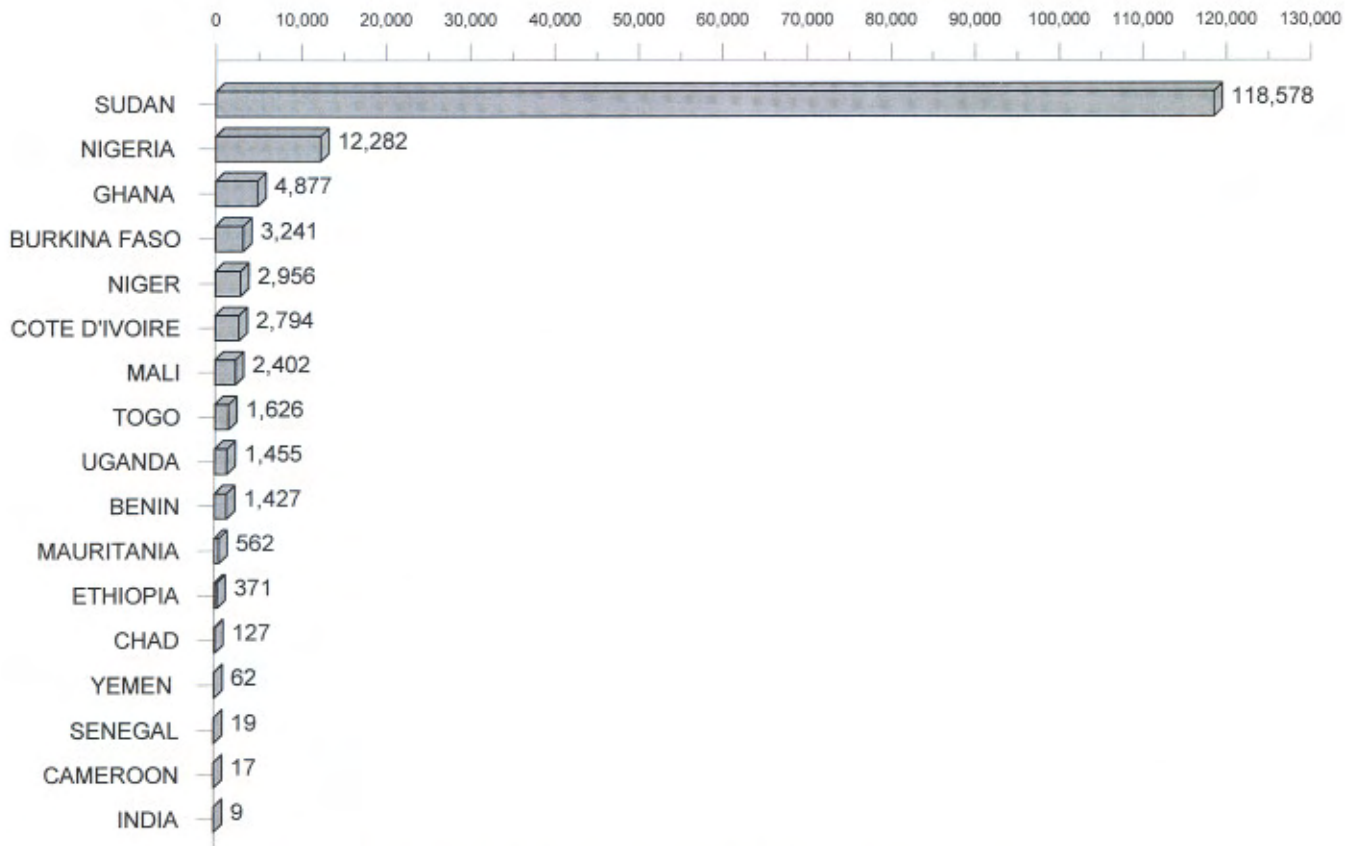
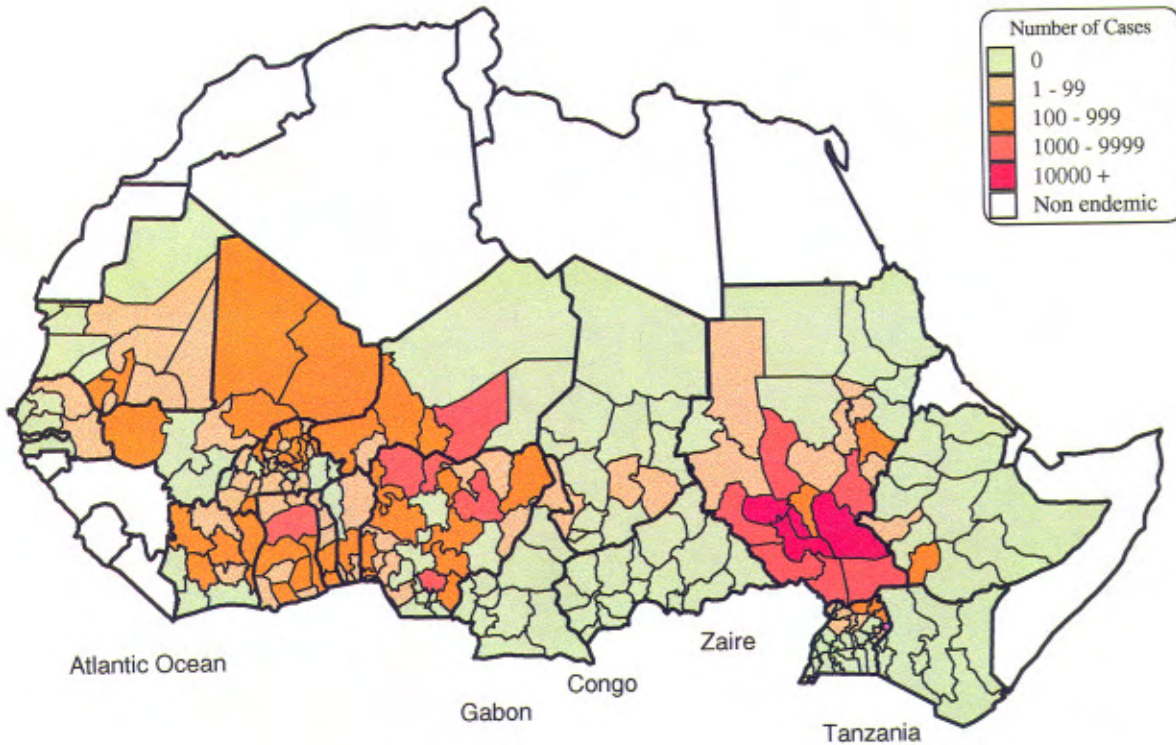
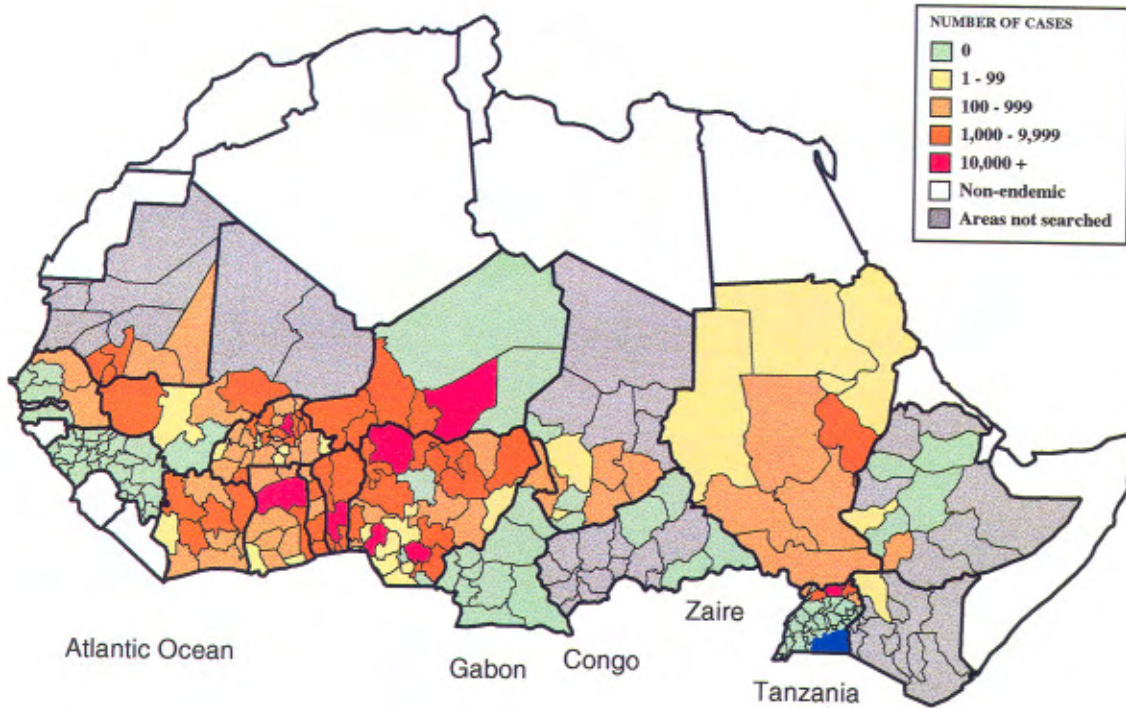


FIGURE 3. Distribution by country of 152,805 cases of dracunculiasis reported during 1996.



FIGURES 4 and 5. **4, (top)** distribution of 229,016 reported cases of dracunculiasis in Africa: 1993. **5, (bottom)** distribution of 152,805 reported cases of dracunculiasis in Africa: 1996.

Dracunculiasis Eradication Program has missed its target (1995) for achieving eradication. Although some have implied that a new target date should be set,<sup>18</sup> doing so at this stage would establish an undesirable precedent. The chal-

lenge is now to complete the job as soon after the target date as possible.

Of the major obstacles to dracunculiasis eradication that were cited by us in reviews in this journal in 1993<sup>6</sup> and

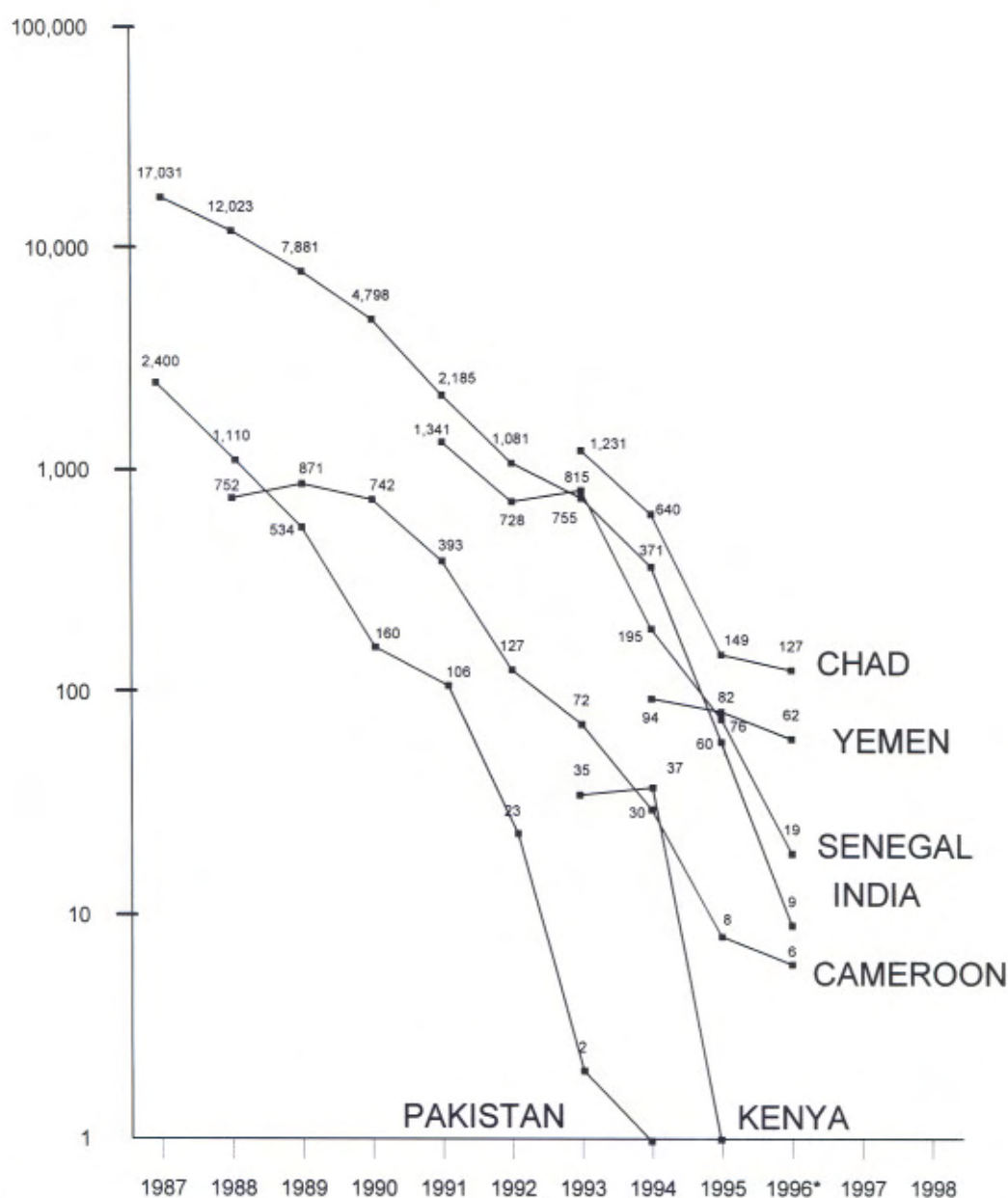


FIGURE 6. Decrease in cases of dracunculiasis in least endemic countries: 1987–1996. \*Cameroon reported 17 cases of which 11 were imported.

1995,<sup>1</sup> i.e., underfunding, the civil war in Sudan, and apathy and lack of urgency on the part of some national and international health officials, the first two are unfortunately still serious concerns. In 1995–1996, for example, the dracunculiasis eradication programs in Ghana, Niger, and Sudan were each seriously impeded by inadequate and delayed funding, the consequences of which will only become known in 1997 because of the one-year incubation period of the parasite. Moreover, it is now clear that the dedicated, experienced health workers on both sides of the conflict in Sudan could do considerably more to eradicate dracunculiasis, despite the war, if more funding were available. However, complete eradication of dracunculiasis, as well as of poliomyelitis (which is targeted for global eradication by 2000), will

require an extended period of peace in Sudan in addition to more funds.

As the attainment of dracunculiasis eradication comes more clearly into view, the success of the campaign has begun to convince some skeptics within some ministries of health and international health organizations that eradication is now imminent. However, the differences between an eradication program and a control program are not always clearly understood. For example, the need to maintain the necessary focus on each case of disease until freedom from dracunculiasis transmission is attained, and to give the required priority to implementing specific control measures for one disease, are inescapable requirements in an eradication campaign. Premature or ill-considered integration into other

broader health activities of surveillance and control measures for a disease that is targeted for eradication is a prescription for failure. Ghana was one of several countries that suffered the consequences of a similar miscalculation during the Yaws Eradication Program. After a dramatic reduction during the mass campaign in the 1950s and 1960s, yaws incidence rebounded almost to previous high levels during the 1970s, soon after control measures were integrated into a primary health care system that was still too weak to implement them.<sup>19</sup>

Integration of surveillance activities makes sense in some less endemic or formerly endemic areas in an eradication program if there is a functioning surveillance system into which surveillance for dracunculiasis can be integrated. One cannot integrate something into nothing. Other options for securing good surveillance are available at the end stage of an eradication program. In Pakistan, for example, widespread publicity about a substantial cash reward for reporting of a case of dracunculiasis helped ensure that all cases were detected, at very low cost, even where routine surveillance was not optimal. If the necessary support and supervision are not available for broader surveillance, then this latter option would be preferable to a poorly or nonfunctioning integrated surveillance system, for documenting the absence of dracunculiasis transmission.

There is also need at this stage of the program to ensure that all activities undertaken ostensibly to help eradicate dracunculiasis actually contribute to attaining that objective. For example, caution is warranted in investing heavily in activities such as precise geographic information system mapping of the location of endemic villages,<sup>20</sup> particularly when such efforts are mistakenly perceived as ends in themselves or even as control measures, rather than, in this example, as a means of illustrating results of the true control measures.

The remarkable reductions in the incidence of dracunculiasis achieved by national eradication programs so far are all the more imposing since they have been made without a curative drug or vaccine against this disease. Almost as impressive as the results already achieved is the broad coalition of agencies and private companies that have joined forces with the national eradication programs in this historic effort. In addition to leadership by former U.S. President Jimmy Carter and former Malian head of state General Amadou Toumani Toure, the DuPont Corporation and Precision Fabrics Group have donated to this effort nylon cloth (for filters) valued at more than \$14 million. Major support has also been provided by UNICEF, WHO, UNDP, The World Bank, Saudi Arabia, and United Arab Emirates; by the USAID and the bilateral assistance agencies of Japan, Norway, Sweden, the Netherlands, United Kingdom, Canada, and Denmark; by the U.S. Peace Corps, the Keidanren, American Home Products (formerly American Cyanamid), the Conrad N. Hilton Foundation, Henry McConnon, and other donors.

A primary aim of the eradication program in 1997, in addition to addressing the obstacles mentioned above, is to seek to ensure that all cases of dracunculiasis that are reported outside of Sudan during 1997 are contained. All of the endemic countries outside of Sudan should be able to interrupt transmission of dracunculiasis within the next two years. To do that will require continued focus on dracunculiasis until the final case is contained in each endemic coun-

try. Such is the price to be paid in any successful eradication campaign, including this one, in return for which all control measures can be stopped, and benefits accrue forever. Endemic countries also need to promptly cross-notify any case that is suspected of having been imported from another country to the health authorities in that other country, through the WHO country representative. In Sudan, the challenge now is to pursue all appropriate control measures in all accessible areas as vigorously as possible until political circumstances allow access to all of the remaining affected areas.

Dracunculiasis is targeted to become only the second human disease and the first parasitic disease to be eradicated. National dracunculiasis eradication programs have demonstrated the ability of properly focused health education to change people's behavior and the social climate of affected villages. They have proven the feasibility of implementing village-based, monthly surveillance in African communities, when health workers are given proper training, motivation, and supervision. They have also shown the importance of health considerations in establishing priorities for providing safe drinking water to communities. They have improved the health, agricultural productivity, and school attendance of people in endemic villages. Most of all, dracunculiasis eradication programs have changed the way people in some developing communities think about their future and their children's future: now they have hope.

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