

Eradication of dracunculiasis from Pakistan

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Summary

In 1986 the World Health Organization targeted dracunculiasis (Guinea-worm disease), which seriously impairs socioeconomic development in 16 African countries, India, Pakistan, and Yemen, to be eradicated globally. The target date for eradication by the end of 1995 was established in 1991. Pakistan eradicated dracunculiasis from the country in October, 1993, after a national campaign which began in 1987 with a nationwide village-by-village search for cases. The infection, which is transmitted by drinking water from ponds containing infected water fleas, was eradicated by using health education, cloth filters, and the cyclopicide, temephos; and in the later stages, by case containment. Methods pioneered in Pakistan's National Guinea Worm Eradication Program are now being applied in remaining endemic countries.

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Introduction

Pakistan (1987 population, 111 million) has become the first country endemic for dracunculiasis (Guinea-worm disease) to eradicate the disease during the ongoing global campaign. We describe how dracunculiasis was eradicated from Pakistan by a National Guinea Worm Eradication Program (GWEP).

The global campaign to eradicate dracunculiasis was initiated by the Centers for Disease Control and Prevention (CDC) in 1980 as a part of the International Drinking Water Supply and Sanitation Decade (1981–1990).¹ The World Health Organization (WHO) targeted the disease for eradication in 1986. The target date for eradication by the end of 1995 was set by African ministers of health in 1988, and endorsed by the World Health Assembly in 1991. At the beginning of the campaign, dracunculiasis was known in India, Pakistan, and 16 African countries. From an estimated total of over three million cases in 1986, only about 165 000 cases of dracunculiasis were reported worldwide in 1994.²

Dracunculiasis is manifest by one-meter-long adult worms of *Dracunculus medinensis* emerging from the body, a year after the person was infected by drinking water contaminated by larvae expelled into the water by adult worms emerging from previous victims. Some of the larvae are ingested by copepods (water fleas), in which they undergo two moults before becoming infectious to human beings. Infected people are often incapacitated for several weeks by secondary infections associated with the emergence of the worm. Less than 1% of victims suffer permanent disability. The disease is rarely fatal, but it prevents large numbers of people from farming or attending school.

Dracunculiasis can be prevented by boiling drinking water or filtering it through a cloth to remove copepods; by educating villagers not to contaminate their sources; by providing clean drinking water from underground sources such as borehole wells that cannot be contaminated; or by using a larvicide, temephos (Abate), to kill the copepods while leaving the water safe for human consumption.³

Search for cases and endemic villages

Pakistan's GWEP began early in 1987, after the USA Carter Center's Global 2000 project and the Pakistan-based Bank of Credit and Commerce International Foundation agreed to support a five-year effort to eradicate dracunculiasis, with technical assistance provided by CDC.

A nationwide, village-by-village search for cases of dracunculiasis was conducted between April and August, 1987, using almost 5000 health workers from malaria, immunisation, and other programs, and over 12 000 school teachers. In addition, 197 health workers conducted special searches in areas known to be at highest risk for the disease. Villagers were asked whether

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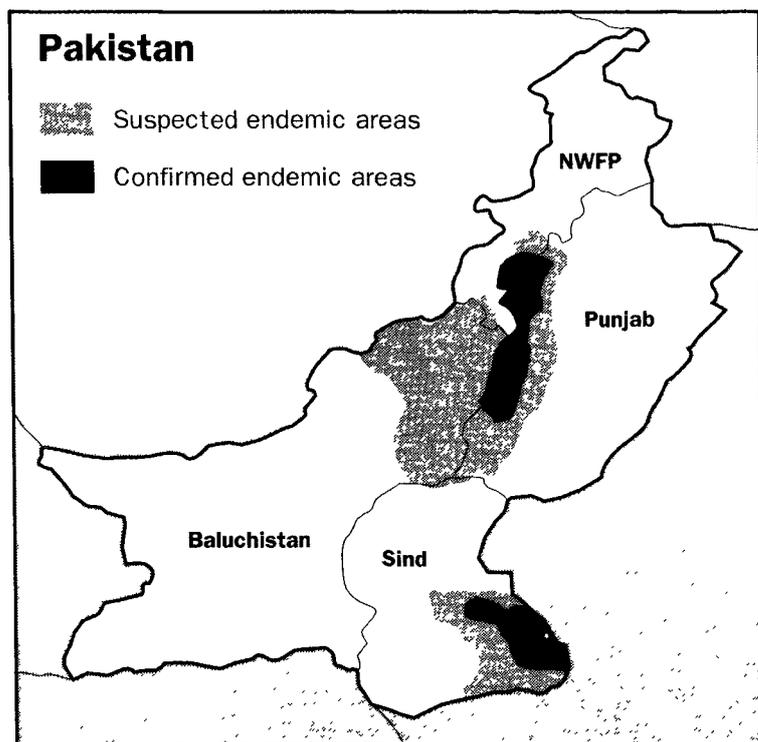


Figure: Suspected and confirmed areas endemic for dracunculiasis in 1987

dracunculiasis had occurred in their village in the past three years, and if so, whether the annual incidence was less than ten, or ten or more. Overall, the searches reached 47 401 of the estimated 50 000 villages in the country, including 4413 high-risk villages covered by the special searches. A validation survey conducted in a sample of 102 villages found a rate of agreement of 83% with the results of the case search.

408 endemic villages were identified in the search, in very remote areas of Bannu and Dera Ismail Khan Districts in North West Frontier Province, Dera Ghazi Khan District in Punjab, and Tharparkar and Sanghar Districts in Sind Province (figure 1). Approximately 2000 cases were estimated to have occurred in the past year, based on a special survey of all villages found to have had ten or more cases and on a sample of the villages with less than ten cases. The total population at risk in endemic areas was about 402 000.⁴

Control measures

Two villages were selected for pilot intervention projects: Agzhar Khel (population about 1200) in Bannu District, and Chachi (population about 200) in Tharkarpar District.⁴ Health education, monofilament nylon or polyester cloth filters, and chemical treatment of drinking water sources with temephos were the main interventions. Results of these pilot interventions were used to further develop and test a computer model for benefit-cost analysis of interventions.⁵

Three provincial managers were seconded from the ministry of health to work full-time in the eradication programme. The first task of the provincial managers was to select and train at least one village health worker in each of the endemic villages identified. The village health workers, who worked part-time, were trained to identify and record cases of dracunculiasis occurring in their village, provide health education, and report data monthly. Later the provincial managers also selected and trained about 35 health workers to carry out applications of temephos.

Month	Year						
	1988	1989	1990	1991	1992	1993	1994
January	0	3	3	1	0	0	0
February	3	2	0	0	0	0	0
March	3	3	1	0	0	0	0
April	16	34	1	1	0	0	0
May	24	40	4	5	0	0	0
June	99	61	28	9	2	1	0
July	354	117	41	23	8	0	0
August	335	190	43	32	4	0	0
September	206	61	26	26	6	0	0
October	56	17	12	6	3	1	0
November	10	6	0	3	0	0	0
December	4	0	1	0	0	0	0
Total	1110	534	160	106	23	2	0

Table 1: Monthly reports from village-based surveillance: number of cases 1988–94

Interventions began in September, 1987, in about 160 endemic villages in Sind. Most health education was done by the village-based health workers, using pictures and drawings with messages in local languages; pamphlets, posters; and locally filmed video recordings. Ponds were treated with temephos monthly. Few new sources of drinking water were developed during the GWEP in Pakistan because the salinity of underground water in endemic areas made it unfit to drink.

After a review of the first year's activities in January, 1988, training for surveillance and control measures in all known endemic villages got underway in February, followed by a national conference in Islamabad in March. Approximately 37 000 nylon filters and 1000 L of temephos were used in the programme in 1988. That year, 462 villages were under surveillance, including 54 endemic villages detected for the first time during that year. The programme conducted an end-of-year survey which led to a resurvey of certain high-risk areas of Punjab, Sind, and Baluchistan early in 1989.⁴ Several village health workers were replaced as a result of poor performance, and the number of villages under surveillance was increased to 530. In order to meet the need for closer supervision of village health workers, a new tier of 48 sector supervisors was recruited and trained, each of whom was responsible for overseeing the work of 8–15 village health workers.

At a programme review in November, 1989, a strategy of even more intensive surveillance and containment measures was developed—case containment—modelled on a strategy used in the latter stages of the Smallpox Eradication Program.^{6,7} Case containment began in 1990 and specified that village health workers should detect each case of dracunculiasis in their village within 24 h of emergence of the worm, and that they should start preventive measures within 24 h of learning of it. Early in 1990, the programme surveyed over 7000 households, 291 village health workers and leaders, and 47 sector supervisors in 235 villages in endemic areas (including all villages that actually had a case in 1989), to assess the performance of the programme. A sample of 407 uninfected villages next to known endemic areas were surveyed to assess the sensitivity of the surveillance system.

Early in 1991, the programme announced and widely publicised its offer of a reward of 1000 rupees (about US\$40) for anyone reporting the first case of dracunculiasis in a village, and a similar reward for the health worker who relayed such information to his or her supervisor. GWEP also ended its monitoring of about 400

Year	Punjab province		Sindh province		North West frontier province		Total	
	No of endemic villages	No of cases reported	No of endemic villages	No of cases reported	No of endemic villages	No of cases reported	No of endemic villages	No of cases reported
1987*	70	—	259	—	79	—	408	2400
1988†	48	307	90	644	18	159	156	1110
1989	65	234	70	232	11	68	146	534
1990	18	47	31	91	7	22	56	160
1991	9	19	20	31	6	56	35	106
1992	1	1	2	4	4	18	7	23
1993	0	0	0	0	1	2	1	2
1994	0	0	0	0	0	0	0	0

*National case search: estimated number of cases that occurred in 1987 or during the previous three years, and the number of villages from which cases were reported. †1988 onwards: cases reported monthly from village-based surveillance.

Table 2: Number of endemic villages and number of cases reported by province: 1987–94

villages that had not had a case of dracunculiasis in the past three years, concentrating instead on the less than 150 recently endemic villages remaining. CDC continued to provide technical assistance, and the provincial managers were re-assigned to the respective provincial health departments, where they continued to oversee control measures against dracunculiasis in addition to other duties. Village health workers were kept in the 35 villages which had one or more cases in 1991.⁸

The cash reward was extended to cover each new case reported in 1992, and the reward was increased to include another 1000 rupees to be given to each patient who complied with case-containment procedures. The reward was increased to 3000 rupees in 1993, after an evaluation conducted by CDC and WHO late in 1992.⁹ A 'rumour registry' was also established in 1993, and the investigation of all rumours about possible cases continues. The likelihood of imported cases is small since India, the only neighbouring endemic country, had only 371 cases remaining in 1994.

Cost of the programme was approximately US\$2 281 900, including \$1 686 900 provided through Global 2000, \$216 400 provided through CDC (US PL-480 funding), \$171 900 provided in kind by the Government of Pakistan, \$140 000 by the Eastern Mediterranean Office of WHO, and \$66 700 by UNICEF/Pakistan.

Results

No cases were subsequently found beyond the areas that were targeted as a result of the search in 1987. Impact of the campaign is summarised in tables 1 and 2. The final cases were reported from the village of Ganju, North West Frontier Province, in June and October, 1993. This village had been the most highly endemic village in Pakistan, reporting 9.3% of the national total of cases in 1988, 40.6% in 1990, and 65% in 1992.

Improvements in implementation of interventions were shown by annual surveys. The end-of-year survey of 3000 households in 114 endemic villages and 92 non-endemic villages in December, 1988, found that 99% of the endemic households sampled had been visited by a village health worker, and 62% had received cloth filters. Two new endemic villages were detected during the survey. In the survey of 7000 households conducted in January and February, 1990, 92% of respondents knew their village health worker, 85–90% had received cloth filters, and one new endemic village was discovered. The latter survey also revealed that treatment of drinking water sources with temephos was well accepted.

Monitoring of case containment indices showed a high level of implementation from the outset: of 121 cases found from January to end of August, 1990, case-

containment measures were begun within 24 h of emergence of the worm in 86%. Knowledge of the reward for reporting of cases was similarly high: over 90% as of October, 1991, and 88–97% in different provinces in October–November, 1992.

Discussion

Annual evaluations of the programme were a key component of the success of Pakistan's GWEP. While the efficacy of health education, cloth filters, and of temephos were documented in the early stages of the programme, the need for case containment became apparent as a result of the systematic annual evaluations. Other important measures taken as a result of the reviews were decisions to discharge some non-performing village health workers in 1989, to add sector supervisors as a means of improving supervision of village health workers, and to reduce the number of villages monitored from 553 to less than 150 at the beginning of 1991 by eliminating villages which had had no cases for the past 3 years. It was disappointing that other agencies were not prepared to use the village health workers who were no longer needed by the GWEP.

Although regular evaluations and consultations added considerably to the cost of the Pakistan programme, for the benefit of a relatively small number of cases eradicated, they allowed methods used in Pakistan to be applied in highly endemic countries of Africa. Six African countries (Cameroon, Chad, Ethiopia, Kenya, Mauritania, Senegal) reported 125 cases or less during the first four months of 1995. Cameroon has already begun offering a cash reward for reporting cases of dracunculiasis, and Kenya is preparing to do so. Offering of such financial rewards for reporting is an effective means of enhancing the sensitivity of the surveillance system in detecting residual cases.

The authors believe there are three other lessons to be learned from the Pakistan GWEP. One is that endemic countries should start doing case containment as soon as possible, because it takes time for health workers to become sufficiently experienced with it to attain maximal effectiveness. The second is the need for an eradication programme to attack the most highly endemic area as hard as possible, and from the beginning, since such areas are likely to pose the greatest challenge to achieving eradication. The third lesson is the importance of mobilising members of the affected communities concerned to rid themselves of dracunculiasis. Persons outside of the communities can help, but the villagers themselves must be convinced to act quickly on their own behalf, using the support provided by outsiders. Most residents of endemic villages will cooperate once they

understand that this parasite is being transmitted to them in their drinking water.

Dr Robert L Kaiser contributed to many of the ideas presented in this paper, which is dedicated to his memory. Dr Mohammad Abdur Rab, Mr James Andersen, and Dr Rubina Imtiaz worked long and hard to help realise the results we report.

References

- 1 Hopkins DR, Foege WH. Guinea worm disease (corr). *Science* 1981; **212**: 495.
- 2 World Health Organization. Dracunculiasis-global surveillance summary, 1994. *Wkly Epidemiol Rec* 1995; **70**: 125-32.
- 3 Hopkins DR, Ruiz-Tiben E. Strategies for dracunculiasis eradication. *Bull WHO* 1991; **69**: 533-40.
- 4 World Health Organization. Dracunculiasis-Pakistan. *Wkly Epidemiol Rec* 1988; **63**: 177-80.
- 5 Paul JE. A field test report of implementation planning and a cost benefit model for Guinea worm eradication in Pakistan. WASH Field Report No 231. Washington, DC: Water and Sanitation for Health Project, 1988 (March).
- 6 Kappus KD, Hopkins DR, Ruiz-Tiben E, et al. A strategy to speed the eradication of dracunculiasis. *World Health Forum* 1991; **12**: 220-25.
- 7 Centers for Disease Control. Update: dracunculiasis eradication-Pakistan, 1990. *Morb Mortal Wkly Rep* 1991; **40**: 5-7.
- 8 World Health Organization. Dracunculiasis: update, 1991-Pakistan. *Wkly Epidemiol Rec* 1992; **67**: 137-38.
- 9 World Health Organization. Dracunculiasis: update, 1992-Pakistan. *Wkly Epidemiol Rec* 1993; **68**: 49-51.

BOOKSHELF

Wrongful death

Sandra M Gilbert. New York: W W Norton. 1995. Pp 352. \$22.50. ISBN 0-393-03721-5.

Mistakes are a constant risk in medicine and fatal mistakes among physicians' worst fears. So too are such mistakes a fear of patients. In *Wrongful Death*, Sandra Gilbert takes the reader inside her experience of the death of her husband. An otherwise healthy and vital 61 year old, he dies of internal haemorrhage in the recovery room following a routine prostatic resection; his packed cell volume was not checked for hours although he was noted to be pale, agitated, and hypotensive. Predictably, on one level *Wrongful Death* is the story of resulting legal action and is highly successful in that respect. We learn much about the strategies, personalities, and barriers involved in malpractice litigation—information unfortunately of present and future value to many physician readers of this book.

But *Wrongful Death* is much more than a history of a lawsuit. At its centre, it is the history of loss and grief and a recounting of the first steps towards the healing of that loss told in the surprisingly measured voice of the skilful writer and poet. Whereas one might expect such a book to be a diatribe against medicine, *Wrongful Death* is, instead, contemplative in tone. Memories of the author's husband are interwoven with the events that immediately preceded his death, together with the history of her lawsuit against the surgeon and the university medical centre which employed the author and her husband as professors of English. The author's skill enables us to believe we know her husband, adding immensely to the impact of his death on the reader and thus to

our understanding of the author's shattering grief and pain.

Sandra Gilbert is without doubt angry. Her trust in her husband's physician has been betrayed and she conveys well the stark sense of violation this causes. Although the tragic outcome of her husband's surgery cannot be undone, the medical "system" seems almost programmed to add to her pain by its instinctive defensive reaction. Here, perhaps, is why this book is so important. The author and her family are told almost nothing about the actual event that led to this surgical catastrophe. The physician and medical centre, obviously anticipating legal risk, preferred to say nothing of substance rather than to accept responsibility and express the remorse that they must have truly felt.

The author comes to see her lawsuit as a part of her own recovery from her loss but for many readers troubling questions will be raised. Must we become dishonest or, at a minimum, emotionally isolated from the injured patient or family when we fear our own legal vulnerability? In so doing, might we in fact add to that risk by forcing the family to pry information from us? Surely our system has become distorted when more time and care are expended in the investigation and defence of malpractice than in the care that has led to such action. One wonders whether the "outcome" would have been materially worse were the surgeon in this case to have simply and immediately expressed his deep sorrow and shame and explained every aspect of the surgery in depth. It is at least possible that he would have felt more

honest and it is certain that the family would have felt less anger. Although physician readers should well ask these questions, many may also come away from the book troubled by the adversarial nature of our medical/legal system which distorts both parties. The physician/surgeon is not alone in defensive "stonewalling". For example, the author too kept secret information and advice she received from a physician friend of the family, and her lawyer claims that lawsuits do not change the behaviour of physicians. What, then, besides revenge and the recovery of money is the point of malpractice suits?

Wrongful Death is the story of the beginning of healing for the author but it raises many more questions about the contemporary practice of medicine than it resolves. Although an engrossing book, it is deeply troubling. Perhaps that is the point.

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Patients or customers: are the NHS reforms working?

Edited by Reginald Murley. London: IEA, Health and Welfare Unit. 1995. Pp 87. £6. ISBN 0-255-36360-5.

Patients in the NHS are not required to pay for services received at "the point of sale" in a manner consistent with normal customer behaviour elsewhere in the UK economy. There are of course many issues surrounding the NHS patient experience that are unfamiliar to the traditional customer. A strong argument can be mounted against referring to consumers of NHS services as customers. Nevertheless, the move towards recognising recipients of health services in a context that