Disease Eradication
Dracunculiasis
(Guinea Worm Disease)

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How do we change the world?

“Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.”

Margaret Mead
What drives disease eradication efforts?

*Frank Richards’ ‘ACE’ Principles*

- Accomplishment
- Closure
- Equity
- Compassion
This systematic review of diseases as possible candidates for eradication is an important follow-up to the successful eradication of smallpox in 1977, a campaign that ranks among the finest achievements of CDC, in conjunction with other organizations. The World Health Organization has now targeted two other diseases for eradication: dracunculiasis (Guinea worm disease) is scheduled to be eradicated by the end of 1995 and poliomyelitis by the end of the year 2000. The substantial progress already evident toward achieving these two goals confirms the wisdom of the Charles A. Dana Foundation in making a grant in 1988 to establish the secretariat of this Task Force. In addition to endorsing the two targets of dracunculiasis and poliomyelitis eradication, the Task Force has helped to chart logical next steps for humankind’s use of the powerful weapon of eradication. It has done this by identifying four other diseases as potential long-term targets for eradication—rubella, mumps, cysticercosis, and filariasis—and by establishing clear criteria that can be used in an ongoing process of evaluation of candidate diseases and conditions in the light of new discoveries.

As the world gains more confidence with successful disease eradication campaigns, I hope we shall have the courage and foresight to embrace other appropriate targets for eradication and work diligently to achieve them.

David Satcher, M.D., Ph.D.
Dracunculiasis
(Guinea Worm Disease)

1. Human drinks unfiltered water containing copepods with L3 larvae.
2. Larvae are released when copepods die. Larvae penetrate the host's stomach and intestinal wall. They mature and reproduce.
3. Fertilized female worm migrates to surface of skin, causes a blister, and discharges larvae.
4. L1 larvae released into water from the emerging female worm.
5. Female worm begins to emerge from skin one year after infection.
6. Larvae undergo two molts in the copepod and becomes a L3 larvae.

= Infective Stage
= Diagnostic Stage
Drancunculiasis
(Guinea Worm Disease)

A and B: The female guinea worm induces a painful blister (A); after rupture of the blister, the worm emerges as a whitish filament (B) in the center of a painful ulcer which is often secondarily infected. (Images contributed by Global 2000/The Carter Center, Atlanta, Georgia).
Prevention of Guinea Worm Disease

• Surveillance (case detection) and case containment
• Vector control using a chemical larvicide (Abate)
• Provision of safe drinking water
• Health education and community mobilization
Criteria for Certification of Guinea Worm Disease Eradication

International Commission for the Certification of Dracunculiasis Eradication

• Adequate active surveillance systems confirm the absence of Guinea Worm disease for ≥3 years.
• A “rumor log” of suspected cases maintained for a 3-year period: particulars, origin, and final diagnosis of each suspected case.
• All confirmed cases imported from endemic countries traced to their origins and fully contained.
### TABLE 1. Criteria for assessing eradicability of diseases and conditions

**Scientific Feasibility**
- Epidemiologic vulnerability (e.g., existence of nonhuman reservoir; ease of spread; natural cyclical decline in prevalence; naturally induced immunity; ease of diagnosis; and duration of any relapse potential)
- Effective, practical intervention available (e.g., vaccine or other primary preventive, curative treatment, and means of eliminating vector). Ideally, intervention should be effective, safe, inexpensive, long-lasting, and easily deployed.
- Demonstrated feasibility of elimination (e.g., documented elimination from island or other geographic unit)

**Political Will/Popular Support**
- Perceived burden of the disease (e.g., extent, deaths, other effects; true burden may not be perceived; the reverse of benefits expected to accrue from eradication; relevance to rich and poor countries).
- Expected cost of eradication (especially in relation to perceived burden from the disease).
- Synergy of eradication efforts with other interventions (e.g., potential for added benefits or savings or spin-off effects)
- Necessity for eradication rather than control
Number of Reported Cases of Dracunculiasis by year
1989 - 2005

Cases
~3,500,000 (1986)
10,674 (2005)

Villages
23,165 (1993)
2,114 (2005)

Countries
20 (1986)
9 (2005)
Historical Distribution of Reported Cases of Dracunculiasis

Source: Ruiz-Tiben & Hopkins, 2006
Soper Principle

• Near invisibility of a disease in a population is the point that the serious work of eradication actually begins
• There is *no* acceptable prevalence or incidence figure
The Peculiar Epidemiology of Dracunculiasis in Chad


Division of Parasitic Diseases and Malaria, Centers for Disease Control and Prevention, Atlanta, Georgia; The Carter Center, Atlanta, Georgia; The Carter Center, N’Djamena, Chad; LifeSource Biomedical, Centreville, Virginia; The Wellcome Trust Sanger Institute, Hinxton, United Kingdom; Ministry of Public Health, N’Djamena, Chad

Figure 2. Map of the Guinea worm-endemic area in Chad, noting villages reporting cases of dracunculiasis in humans 2010–2013+ (red dots) and dogs 2012–2013+ (blue dots) (+ provisional: January–June, 2013).
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Figure 3

Strategies to Interrupt the Transmission of Dracunculiasis in Chad (2015)

Humans 9
- Reward Awareness * 77%
- Abate 48%

Dogs 503
- Cook Fish Well*
- Bury Fish Entrails* 80%
- Tethered Infected Dogs * 79%

Copepods/Aquatic Animals
- Cloth Filters
- Safe Drinking Water
- Case Containment

*Enhanced health education

Source: CDC. Guinea Worm Wrap Up #239, March 25, 2016
Mr. Carter said around 88 million cases have been avoided in the last 30 years, meaning it's cost around $3 (£2) to prevent each case. – BBC News
The possibility for one generation to eradicate a disease is very motivating. It is also very difficult. The many failed eradication attempts outnumber the one current success (smallpox), although two eradication campaigns for polio and Guinea worm are tantalisingly close to their goals. The early stages of a well-planned eradication campaign generally go well; it is the last stage where technical, biological, social and political problems occur. This paper considers the opportunities and pitfalls in planning for eradication of a disease.
Thank you!
Auxiliary Slides
The rare Guinea Worm faces extinction. Yet despite growing public support for environmentalism and preservation of endangered species, few people will speak out on the Guinea Worm's behalf. In fact, the United Nations and several prominent U.S. agencies are leading a quiet campaign to eradicate this dwindling species forever from the planet. Is the Guinea Worm the world's most endangered species?
The Tortoise and the Hare: Guinea Worm, Polio and the Race to Eradication

B. Sutton & D. Canyon

*Provisional numbers*
Social Justice and Disease Eradication

*Bailey et al, 2014*

- Disadvantage ‘clusters’
- Justice requires dismantling ‘clusters of disadvantage’ involving multiple dimensions of well-being
- Three key dimensions of well-being (‘benefits’)
  - Agency
  - Association
  - Respect
Ethics of Guinea Worm Eradication

- Beneficence
- Non-maleficence
- Justice
- Autonomy
1980

smallpox is dead!
Spectrum of Disease Control

Control

Regional elimination

Elimination “as a public health problem”

Global elimination

Eradication

Extinction