Medical Grand Rounds

- Specialty
- Ancient disease of the tropics
- In fact → most serious of post-industrial diseases - cholera, typhus, plague

Smallpox…

Once, the greatest killer – but still a threat

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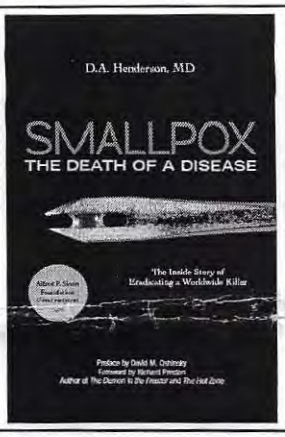
8 December 2009



"There has been no greater medical – or humanitarian – miracle in modern times than the eradication of smallpox…(This achievement) offers a winning blue print for the great medical challenges to come."

David Oshinsky – Winner of the 2006 Pulitzer Prize in History

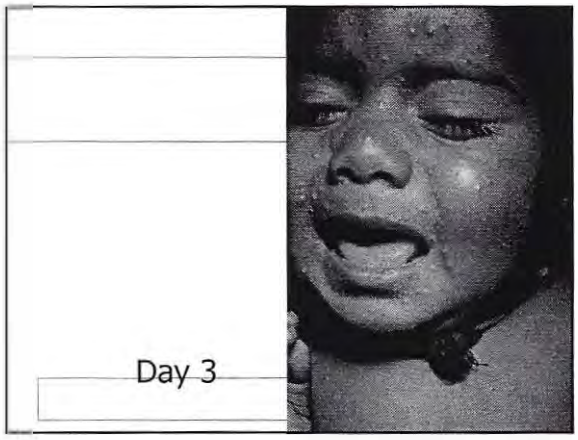
Smallpox, the disease

- Caused by a virus
  - Spread is by face-to-face contact during the time of rash
- Only humans can be infected
  - A chain of infection going back to the Pharaohs 3500+ years
- Death rate is 30%
  - There is no treatment

Sitala Mata

Smallpox in the 20th Century

- Deaths – 300,000,000 before 1978
  - NYTimes: 120,000,000 died either directly or indirectly as a result of armed conflict
- Compulsory vaccination in the U.S. until 1972
  - Last U.S. case was 1949
- International travelers carried a "yellow booklet" documenting vaccination in past 3 years



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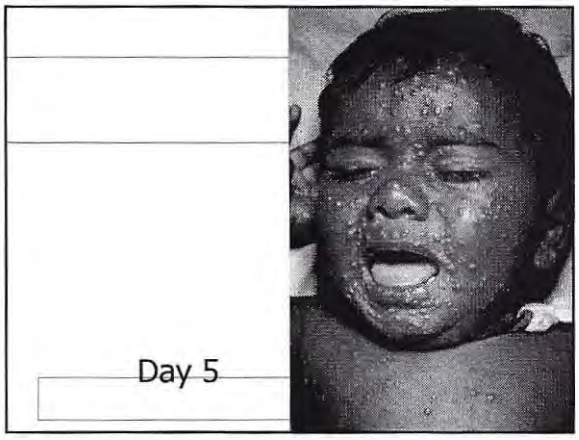

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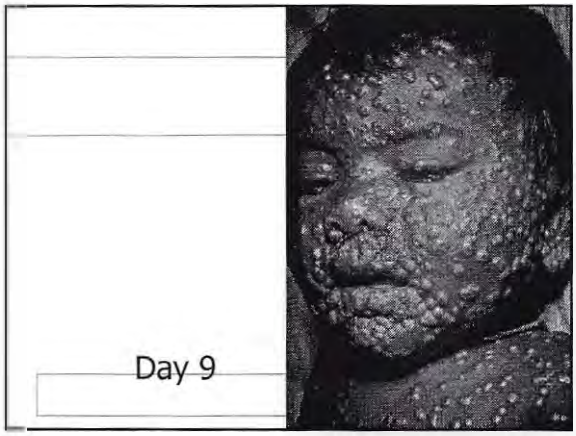

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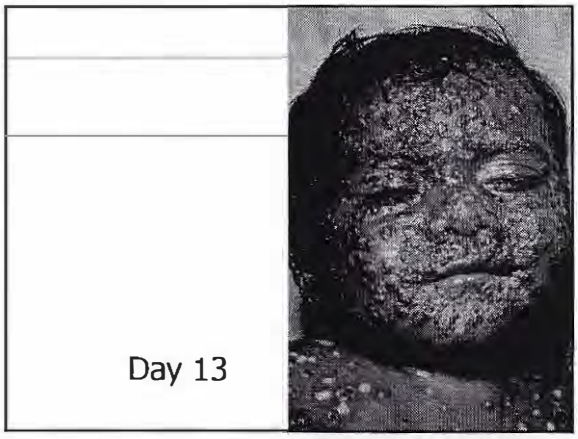

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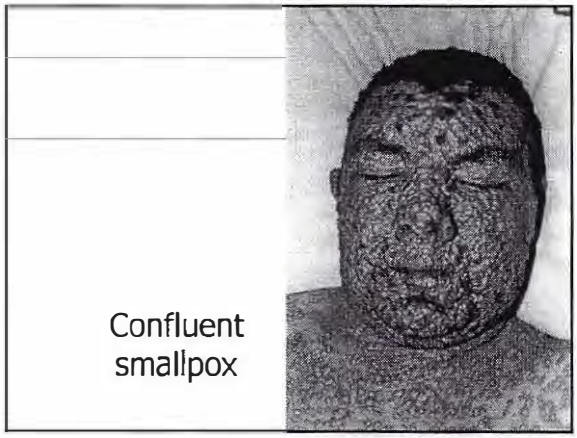
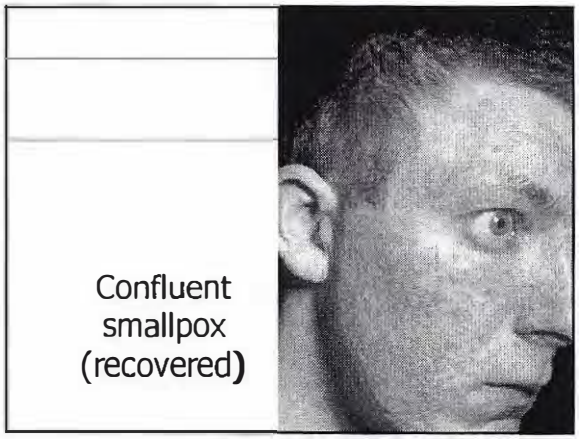


Confluent smallpox



Confluent smallpox (recovered)

Global efforts to eradicate a disease

- Hookworm 1909-23 14 years
  - Treatment, sanitation
- Yellow fever 1915-32 17 years
  - Stop *aegypti* mosquito breeding
- Yaws – 1948-66 18 years
  - Penicillin treatment of patients
- Malaria – 1955-73 18 years
  - DDT insecticide

Smallpox as a target

1953 – Director General proposes

"..a *practical world program, of importance and value to every country…demonstrating the importance of WHO to every Member State"*

Rejected by Assembly as uneconomical and unfeasible

1959 World Health Assembly adopts USSR proposal for a global program but little progress is made

The birth of the WHO global program

- Director General submits a plan to World Health Assembly-- May 1966
  10 year program – WHO budget of $ 2.4 million/year
- Objections by delegates
  - Not feasible
  - Demand for no further increases in WHO budget
- 58 votes needed to pass; 60 voted in favor

A Director is selected

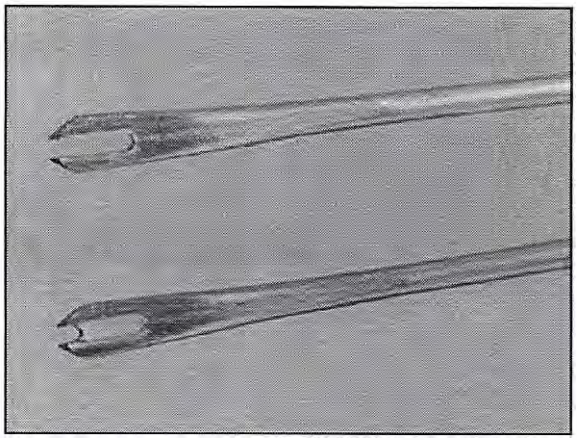
- Director General believed program would fail
  Malaria eradication program was collapsing
  WHO and public health credibility was threatened
- He demanded that an American serve as Director
  - The candidate declined:
    - Responsibilities for new CDC African program
    - Limited resources
      - Not enough even to buy the vaccine required
    - A career option

The Challenge

- Status of smallpox – 1967
  - >10,000,000 cases
  - 2,000,000 deaths
  - 43 countries reported cases
- Program staff
  - Headquarters – 6 professional staff; 3 secretaries
  - Regions – one each in 4 WHO Regions
  - International staff – never more than 150

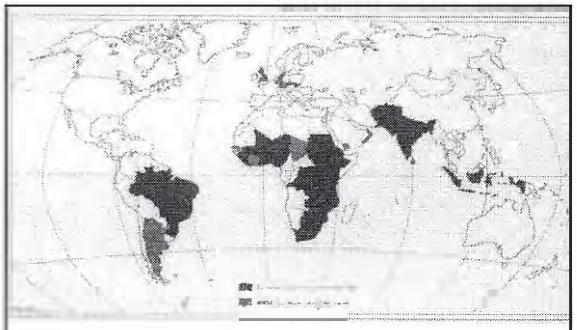
A new technique for vaccination

- Need for a more rapid, effective method
  - Traditional
    scratch through a drop
  - Bifurcated needle—multiple puncture method
    - One-fourth as much vaccine required
    - Training time – 15 minutes
    - Easily sterilized and reused
    - Cost -- $5 per thousand



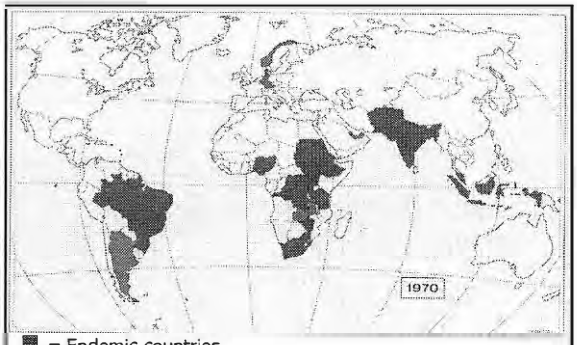
The strategy

- Vaccination of 80% of population
- Surveillance
  - To obtain a weekly report from every health center and hospital
- Containment
  - "Fire-fighting teams"
    - Investigate every case
    - Contain outbreaks with ring-vaccination



= Endemic countries
= Others with cases

Smallpox 1967



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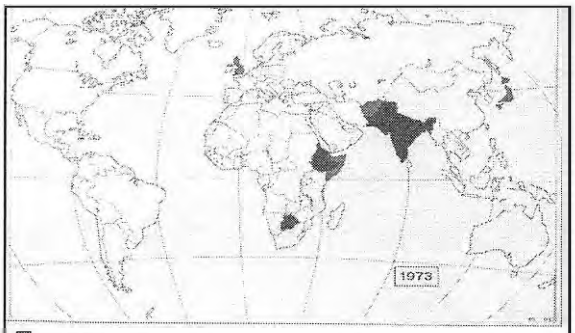
Smallpox 1970



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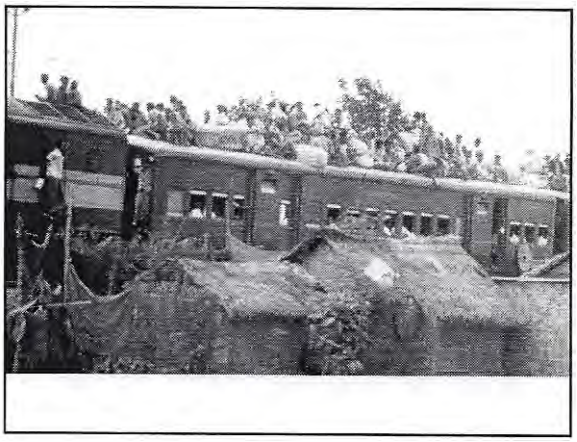
Smallpox 1973



India – the pivotal challenge

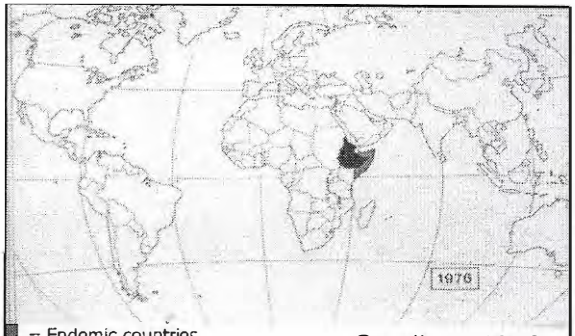
1973-75

- India –55 million and "the home of smallpox"
- A new strategy
  - Search every village in 10 days; 120,000 staff
  - Containment teams for every outbreak
  - By the third round, every house was being visited
- Catastrophic problems Jan to May 1974
  - Gasoline crisis
  - Railroads, airlines, finally health workers on strike
  - Worst floods in three decades
  - India detonates an atomic weapon—May 1974

Indian Independence Day
August 15, 1975

Prime Minister Indira Ghandi

- Salutes India-- 28th Anniversary of Freedom
- Announces India's freedom from smallpox for the first time in recorded history



= Endemic countries
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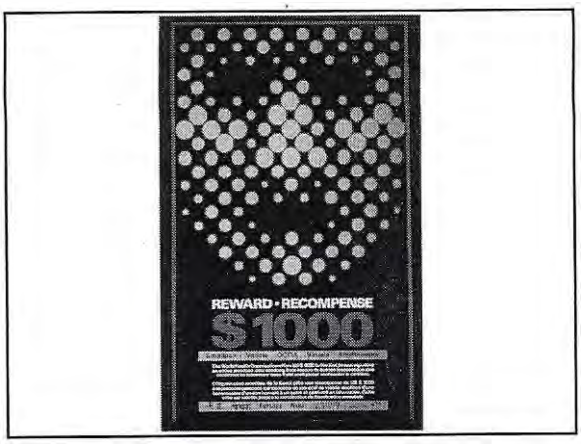
Smallpox 1976

The Final Chapter

- Ethiopia -- 25 million people
  - Size of France and Germany combined
  - Few roads – travel on foot and with donkeys
  - Marxist revolution and continuing civil wars
  - Teams kidnapped on nine different occasions
  - Program helicopter captured and held for ransom
  - Smallpox staff -- only foreigners allowed out of Addis
- Somalia
  - Nationwide epidemic – government suppressed reports
  - A race to finish before the Hajj migration

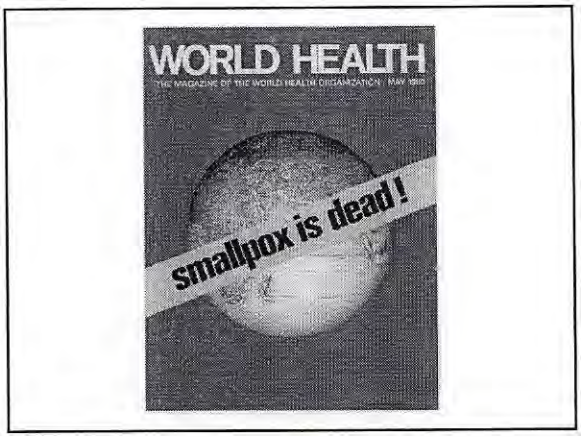
Ali Maalin - 26 October 1977



World Health Assembly --1980

- Declares solemnly that the world and all its peoples have won freedom from smallpox
- Smallpox vaccination should be discontinued in every country

» *Thirty-third World Health Assembly, 8 May 1980*



Meanwhile, horizons expanded

- 1974--Expanded Program on Immunization
  A global program to vaccinate all children with smallpox, measles, polio, DTP vaccines
  Target: 80% coverage by 1990
  Achieved: 1990
- 1985 – Polio eradication in the Americas
  Achieved: 1991
- 1996 – Measles eradication in the Americas
  Achieved: 2002
- 2001 – Rubella eradication in the Americas

The Threat of Biological Weapons

- Biological Weapons Convention—1972
  - Cessation of research on offensive weapons
  - Destruction of existing stocks
- 1992 USSR Bioweaponeer Alibek defects
  - USSR program: 50 laboratories; 60,000 staff
  - Preferred agents: smallpox, anthrax, plague
  - Smallpox production capacity – 20+ tons per year
  - Laboratory research staff disperse – late 1990s

A new reality– September 11, 2001

- September 16 meeting with Secretary
  - A possible second attack --smallpox or anthrax
  - Status of country
    - None <30 years of age have ever been vaccinated
    - Waning immunity
    - 75% of population susceptible
  - Vaccine availability
    - 15 million doses in storage
    - No vaccine manufacturer in the world
    - Earliest date for producing a new vaccine —5+ years

Post 9/11

- Vaccine – 200 million doses ready in 18 months
- Vaccine to be used only in emergency
  - Balance of risk of reactions and ability to respond
- Diagnostic labs increased from 2 to >100
- Reporting strengthened
- Increased rapid response capability

Coda

- From the book's introduction:

"We are only beginning to realize the potential of public health...It is a field begging for fresh, resourceful ideas and a new generation of professionals who are not constrained by 'knowing' what can't be done. So it was with so many who contributed so much to making smallpox eradication a possibility. Their stories, as well as mine, constitute the heart of the book."