Smallpox: death of a disease

...birth of a new era

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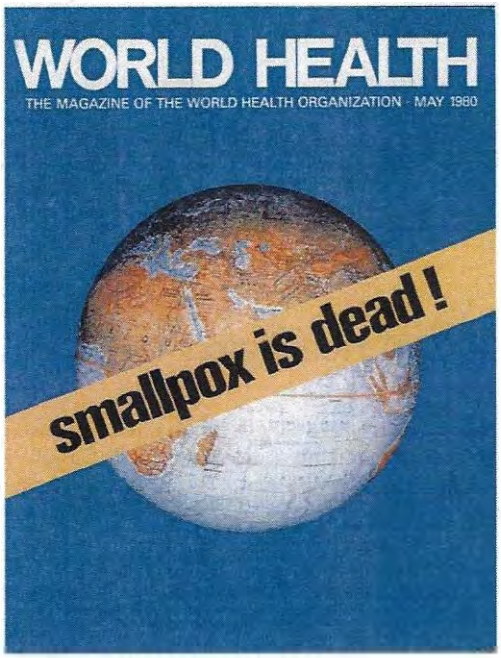
Center for Biosecurity

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*



- *"…we salute this historic milestone as one of the most brilliant accomplishments in medical history"*

  Albert and Mary Lasker Foundation

- *"The success of the eradication campaign is a testament to the difference the global public health community can make when it truly comes together for a common purpose"*

  Secretary of Health and Human Services Thompson

A challenge through the ages

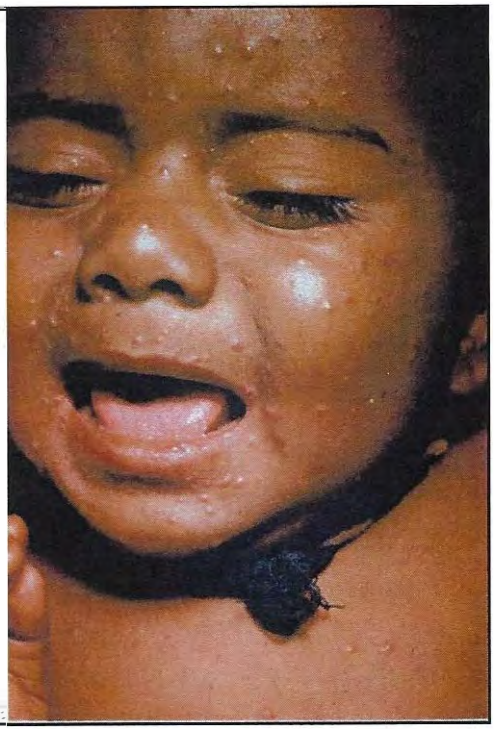
- Smallpox antedates the era of the Pharaohs
  One of the greatest of pestilences of history
- Only disease represented by deities in Asia and Africa
- Primary factor in the European settlement of the Americas

- A contemporary concern – 1967
  > 10,000,000 cases
  2.000,000 deaths
  Reported from 43 countries
  US required school-entry vaccination until 1972

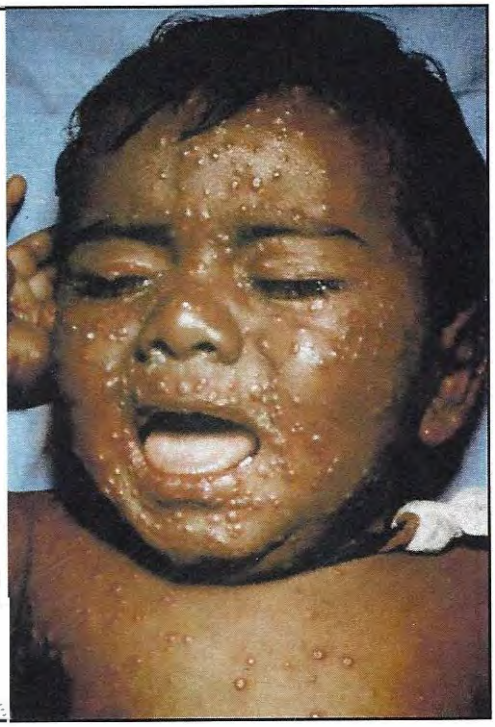
Smallpox, the disease

- Virus – face-to-face spread only during rash
- Man is the only host – no animal reservoir
  Chain of infection going back more than 3500 years
- Death rate was 30%
  - But permanent immunity among survivors
  - Lifetime facial scarring and blindness in some
- A heat stable vaccine protects with one dose

Day 3



Day 5



Day 7

Day 9

Day 13

Global efforts to eradicate a disease

• Hookworm	1909-23	14 years
• Yellow fever	1915-32	17 years
• Yaws	1948-66	18 years
• Malaria	1955-73	18 years
• Smallpox	1967-80	14 years
• *G. worm infection*	*1986- ?*	*24 years +*
• *Poliomyelitis*	*1988- ?*	*22 Years +*

Global smallpox eradication

- 1959 World Health Assembly adopts USSR proposal for a global program
- 1959 -1966
  - Strategy: mass vaccination (few complied)
  - Budget of <$100,000 per year
  - Five staff members

The WHO Eradication Program

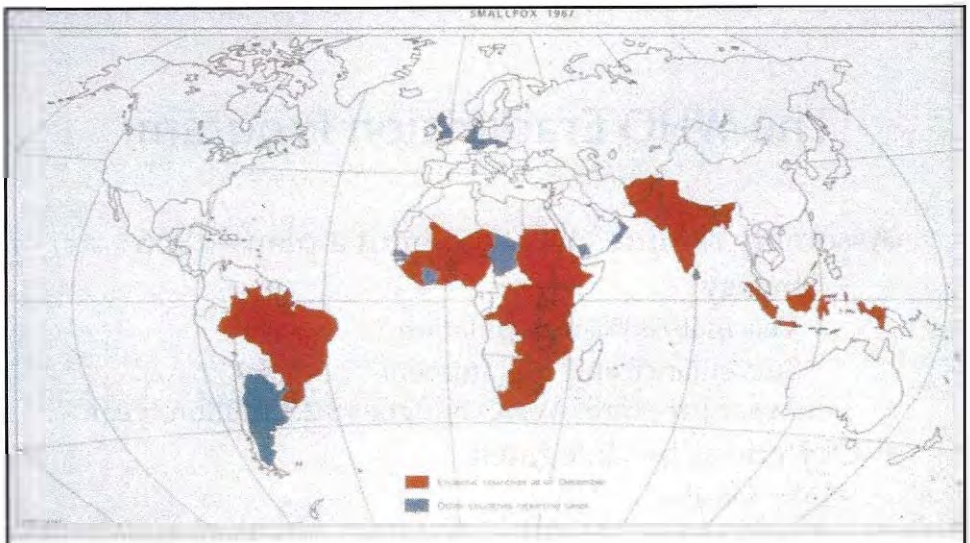
Assembly requires DG to submit a plan --1966

- Strategy
  - Vaccinate 80% of population
  - Surveillance and containment
- 10 year program: WHO budget =$ 2.4 million/year

- Objections by delegates
  - Not feasible
  - Demand for no further increases in WHO budget
- 58 votes for acceptance; 60 voted for approval

Program leadership

- Director General believes program will fail
  (malaria eradication program collapsing)
- Demands an American serve as Director
  - The candidate declines:
    Limited resources -- <$50,000 each for 50 countries
    Not enough even to buy the vaccine required
    Headquarters staff of 10 (including 3 secretaries)
    An uncoordinated WHO regional structure



■ = Endemic countries
■ = Others with cases

Smallpox 1967

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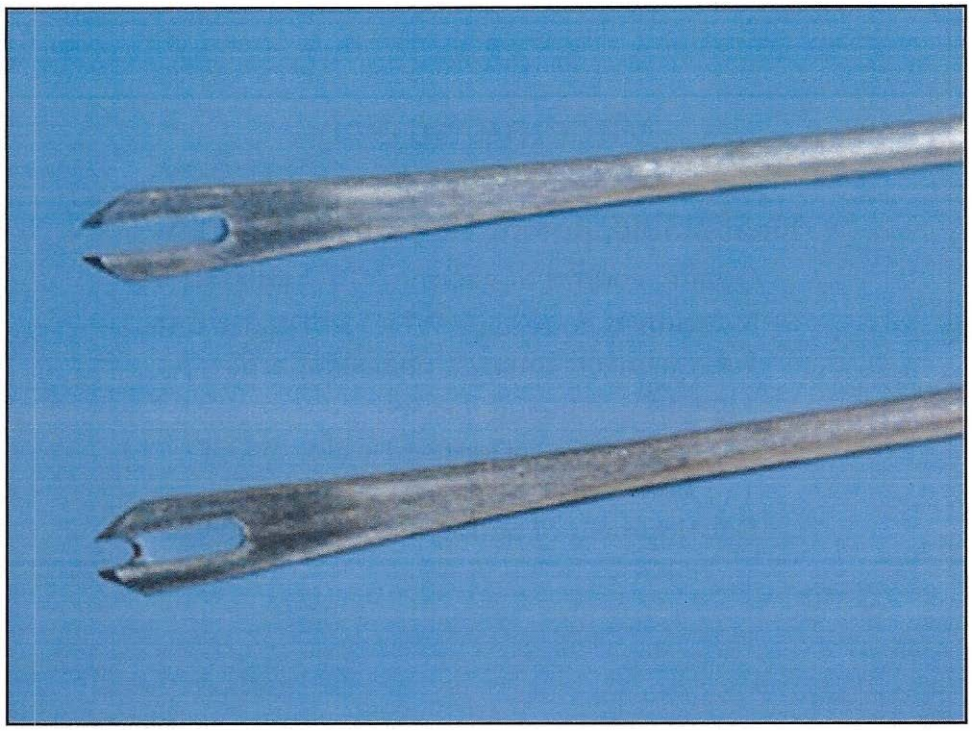
Vaccine Supply

- Heat-stable, potent vaccine is essential
  - Quality control of vaccine – 10% satisfactory
  - No country to receive WHO assistance unless vaccine meets international standards
    - 42 labs producing vaccine
      - Independent international quality control
      - Labs in Netherlands and Canada
  - Development of national capacity

Vaccination

- Target for coverage – 80%
  - Vaccination teams and evaluation teams
- Research to find faster, better methods
  - Jet Injector gun
  - Bifurcated needle—multiple puncture method
    - One-fourth as much vaccine required
    - Training time -- 15 minutes
    - Easily sterilized and reused
    - Cost -- $5 per thousand



Surveillance-containment strategy

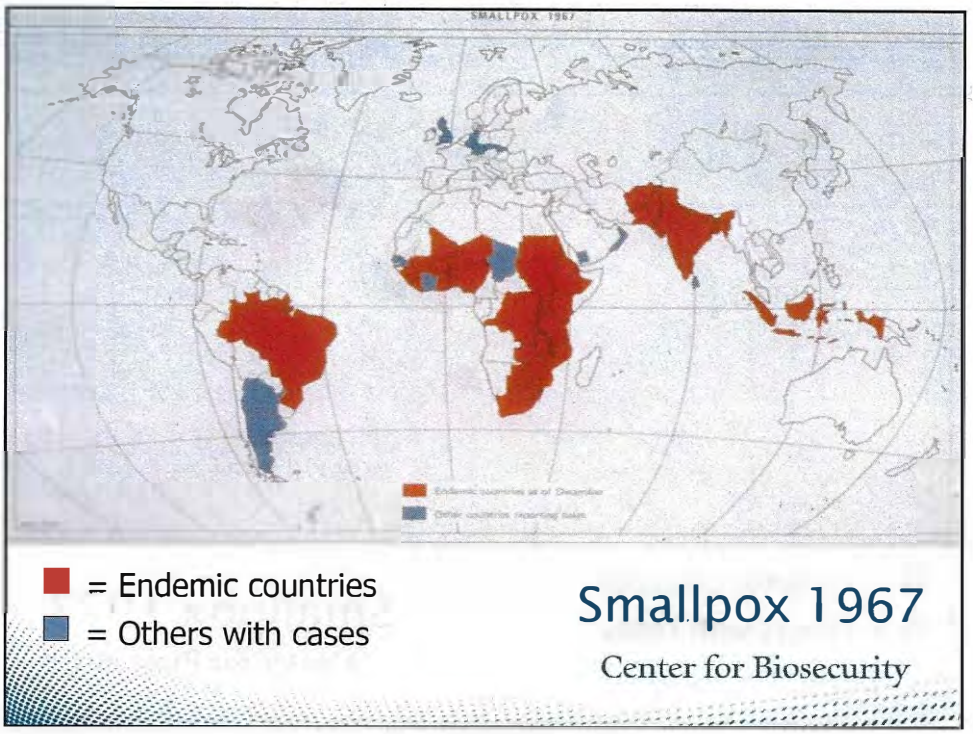
Surveillance – weekly report from every health unit

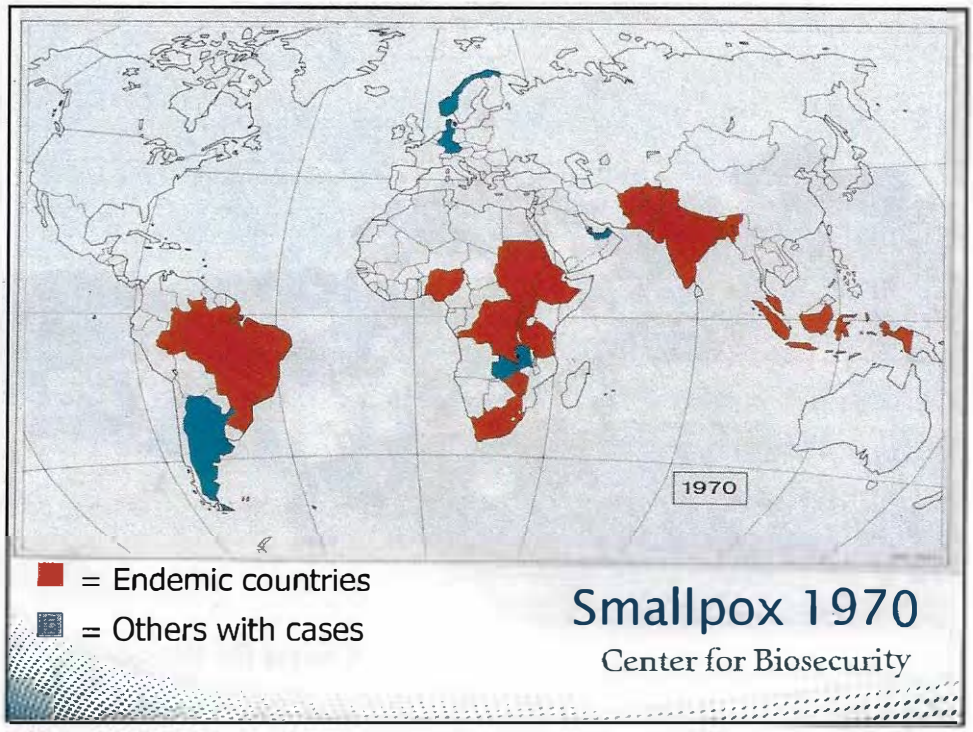
- Concept – get best available data (B.A.D.)
- Reporting of cases required pre-eradication
  - Reporting efficiency (1967) – less than 1%
- Published weekly/monthly reports

Teams – investigate and contain outbreaks

Epidemiological field research

- The textbooks are wrong
  - "Smallpox spreads like a prairie fire"
  - "Revaccination is needed every 3 to 5 years"


= Endemic countries
= Others with cases
Smallpox 1967
Center for Biosecurity


1970
= Endemic countries
= Others with cases
Smallpox 1970
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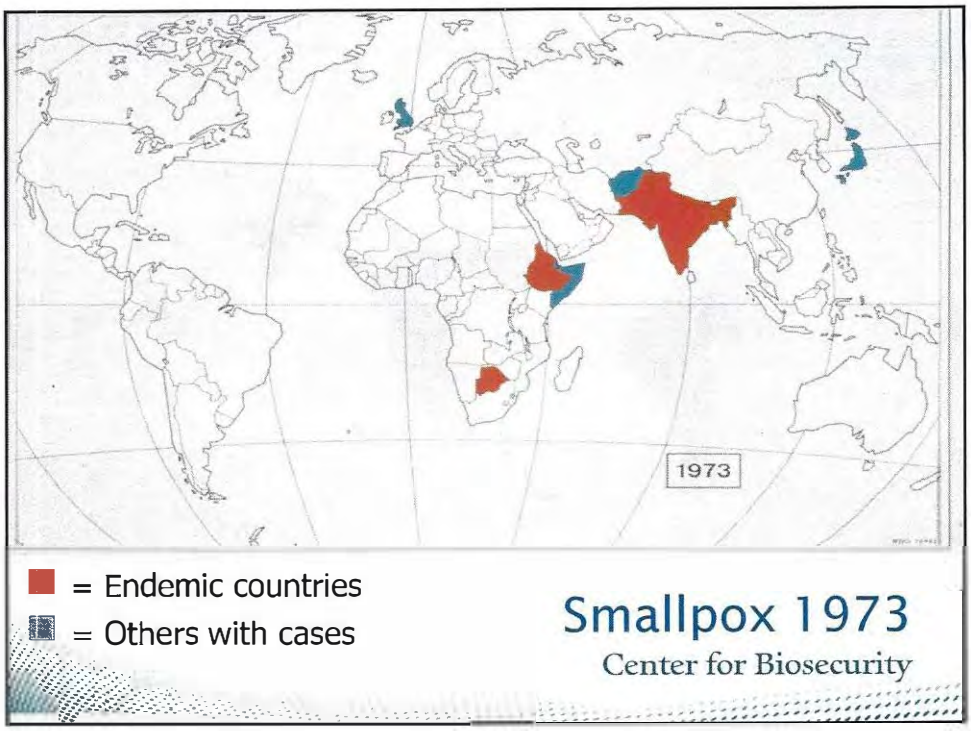
1973
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Smallpox 1973
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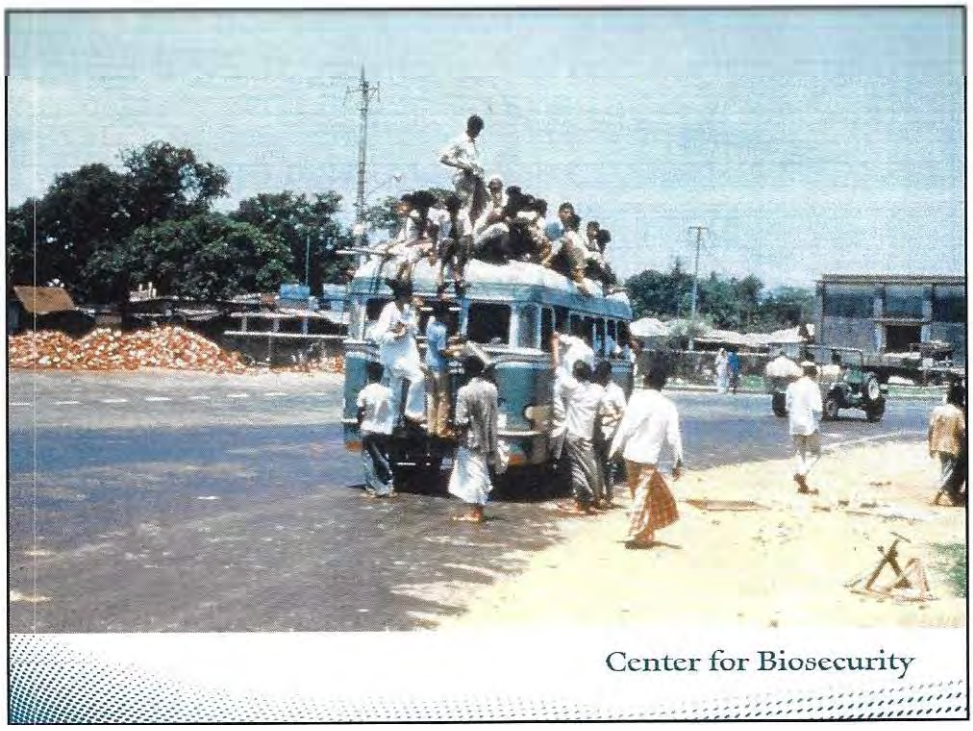
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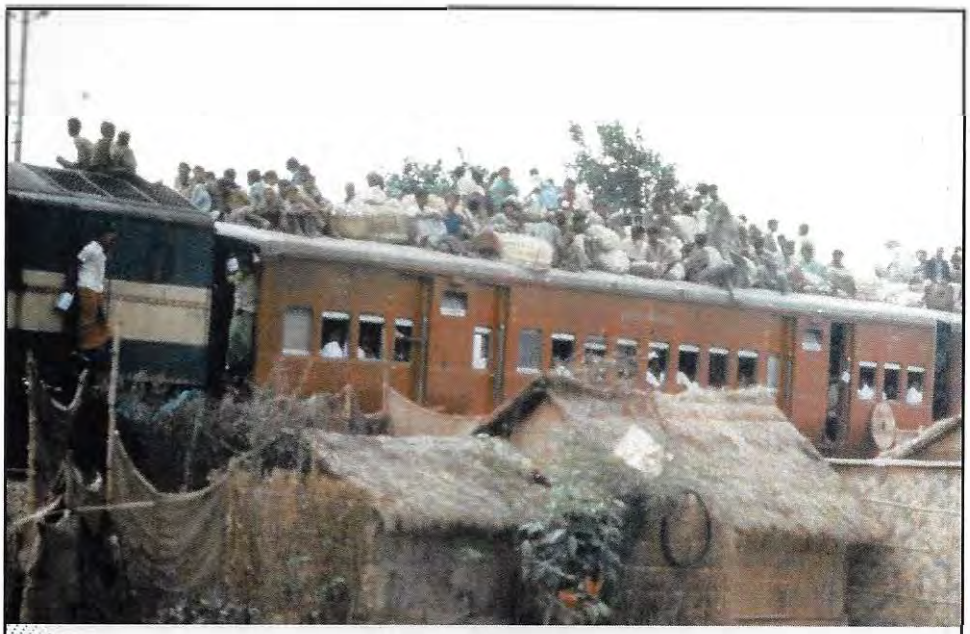

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India -- the pivotal challenge

1973-75

- India – the "home of smallpox"?
  - Population – 550,000,000
  - Surveillance-containment strategy--not working
  - June 1973 – search every village > every house
    - 130,000 health staff in 10 days
    - Results of first search in October
  - Spring 1974 – the darkest days
    - Petrol crisis + strikes by airlines, railway, health staff
    - India explodes a nuclear device
  - Containment methods tightened

Indian Independence Day

August 15, 1975

Prime Minister Indira Ghandi

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

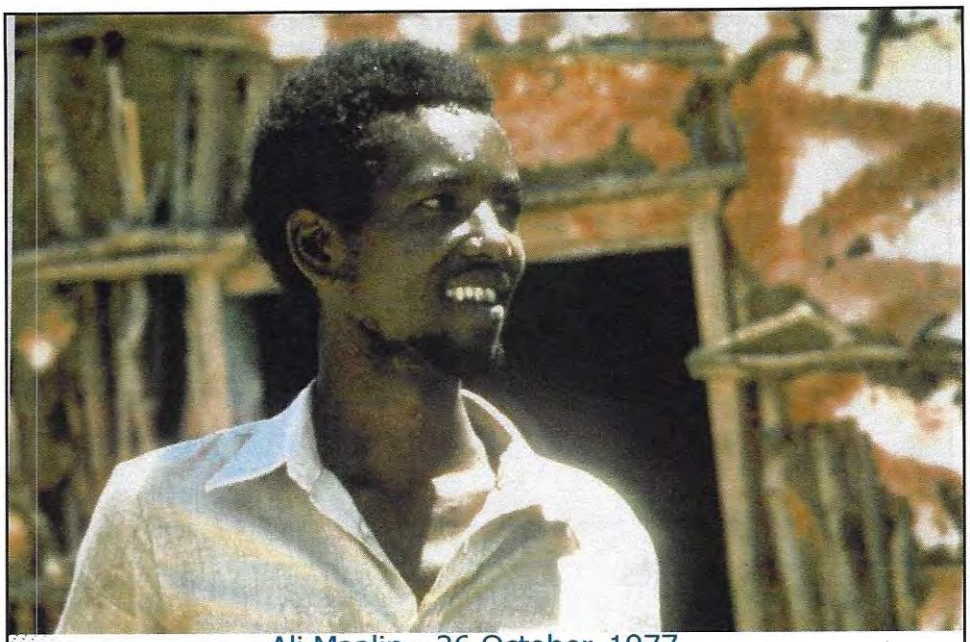
= Endemic countries
= Others with cases

Smallpox 1976

The last strongholds

Ethiopia and Somalia

- Ethiopia
  - Country – twice the size of Texas
    - Largely highland –over 5000 feet
    - Health facilities for 5% of 30 million people
    - Travel largely by donkey and on foot
  - Emperor is assassinated; Marxist take-over
    - No foreign staff outside of Addis except smallpox teams
- Civil war, floods, famine, kidnapping, hostages
- Somalia – the final chapter



Ali Maalin - 26 October, 1977

Legacy – beginning of the Vaccine Era

- The genesis
  - African vaccinators average 500/persons/day with cooperative village leadership

    One year = 400,000 vaccinations/4 person team
  - Smallpox – the only nation-wide vaccine program in developing countries in 1967
  - Smallpox unit convenes international meeting to expand the goals - 1970

Expanded Program on Immunization- 1974

- A global program for vaccination for all children --smallpox, measles, DPT, polio
- Surveillance for polio and later, measles
- UNICEF and Rotary make this a high priority
- Target: 1990 – 80% coverage

Vaccine coverage (%) -- the Americas

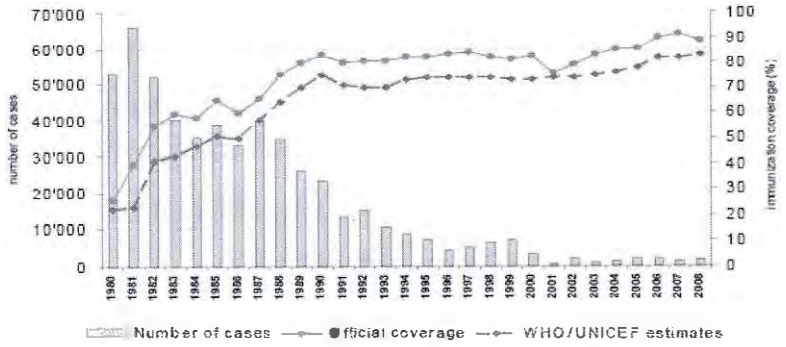
	1980	1990	2000	2008
DTP*	50	74	91	92
Measles	51	80	92	93
Polio*	57	75	90	92
HepatitisB*	--	--	70	88
Hem. influenzae*	--	--	75	90

* 3 Doses

Transmission interrupted:
Polio (1991); Measles (2002);Rubella (2008)

Poliomyelitis

Poliomyelitis global annual reported cases and Pol3 coverage, 1980-2008



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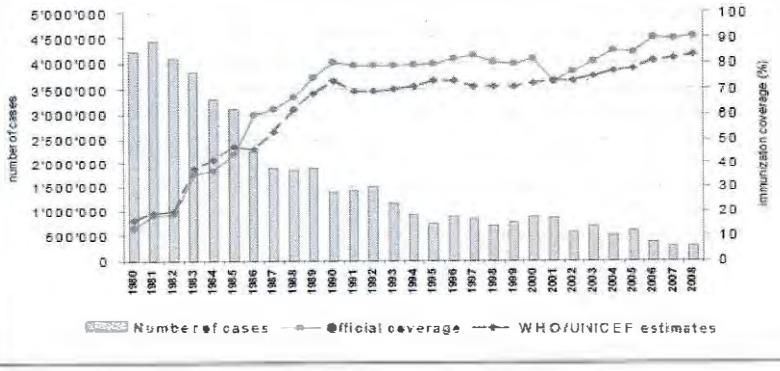
Measles

Measles global annual reported cases and MCV coverage, 1980-2008



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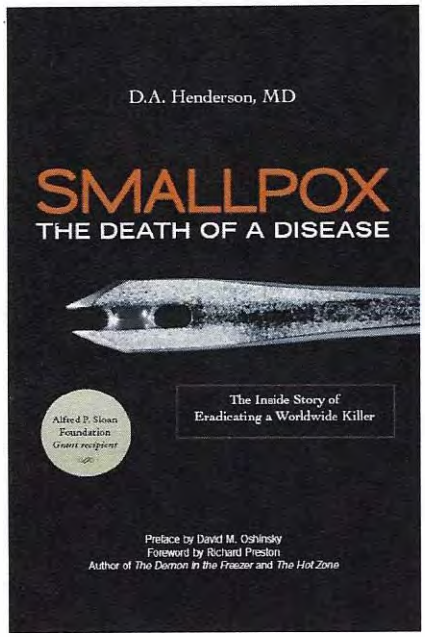
Important lessons learned

- Vaccines – the best cost-benefit medical intervention (World Bank)
- With a common goal – differences diminish
  - U.S.-Soviet cooperation throughout Cold War
  - Civil war conflicts
    - "Days of tranquility"
    - Employment of adversaries (rebel groups)
    - Administrative staff
- Everyone must spend at least on-third time in the field

Coda

- From *Smallpox: the death of a disease*

"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."


D.A. Henderson, MD
SMALLPOX
THE DEATH OF A DISEASE
The Inside Story of
Eradicating a Worldwide Killer
Alfred P. Sloan
Foundation
Grant recipient
Preface by David M. Oshinsky
Foreword by Richard Preston
Author of The Demon in the Freezer and The Hot Zone