Smallpox: Death of a Disease

…but not of the virus

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Smallpox in history

- Last case –1978 in Somalia
- Most serious of the pestilential diseases
- Ramses V and three other mummies died of smallpox 3500+ years ago
- Smallpox gods in Asia and Africa

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Sitala Mata

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T'ou-Shen Niang-Niang Pan-chen

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Smallpox, the disease

- Virus disease –
  Transmitted by face-to-face contact
- No treatment -- death rate was 25 to 30%
- Permanent immunity upon recovery
- Man is the only host
  A chain of infection going back >3500+ years

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Smallpox in the 20th century

- Deaths – 300,000,000 died
- NYTimes: 120,000,000 died directly or indirectly as a result of armed conflict
- Compulsory vaccination in the U.S. until 1972
  Last case in U.S. – 1949
- This year celebrates the 35th smallpox-free year

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Summary objectives

- To portray the principal features of smallpox, a disease last seen in 1978 but still a threat
- To identify the principal landmarks of the eradication campaign
- To remind: death of the disease was not death of the virus

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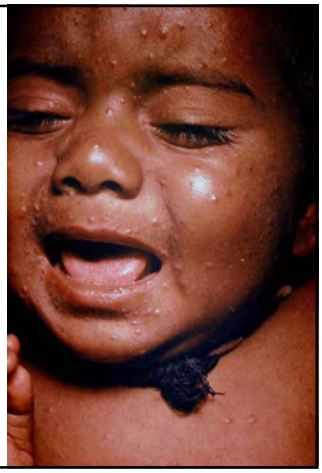
Day 3



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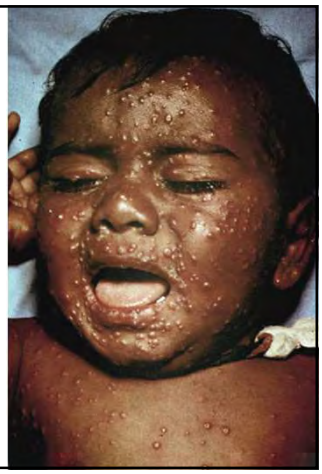

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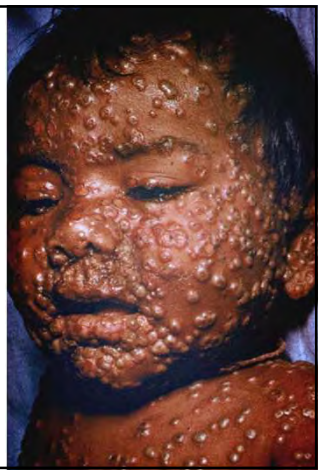

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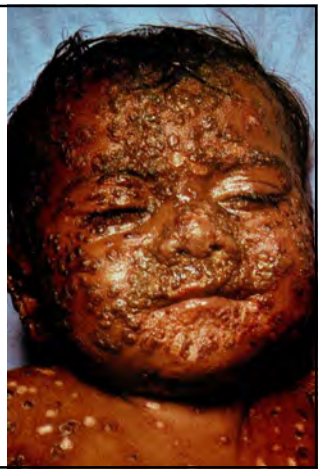

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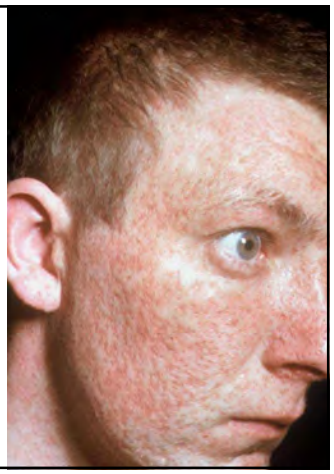
Confluent smallpox (recovered)



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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- ? 26 years +
- Poliomyelitis 1988- ? 24 Years +

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The WHO Eradication Program

Assembly requires WHO to submit a plan --1966

- Strategy
  - Systematic mass vaccination to reach 80%
  - Surveillance and containment
- 10 year program --budget of $ 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

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Program leadership

- Director General believes program will fail
  (malaria eradication 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
    Doubts by WHO leadership

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The Challenge

- Status of smallpox – 1967
  - >10,000,000 cases
  - 2,000,000 deaths
  - 43 countries reported cases
- Program staff
  - Headquarters – 10 (includes 6 support staff)
  - Regions – one each in 4 WHO Regions
  - International staff – never more than 150

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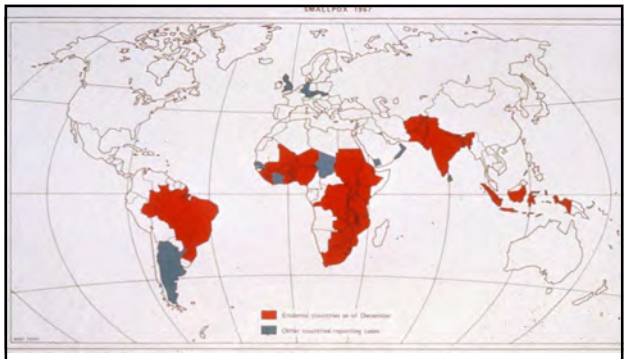

= Endemic countries
= Others with cases

Smallpox 1967

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Vaccine Supply

- Heat-stable, potent vaccine is essential
  - Quality control of vaccine from 42 labs
    Independent international quality control
    Labs in Netherlands and Canada
  - Development of national capacity
    Production manual and consultant assistance

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Vaccination methods

- Research to find faster, better methods
  - Bifurcated needle—multiple puncture method
    - One-fourth as much vaccine required
    - Training time -- 15 minutes
    - Reusable after sterilization
    - Cost -- $5 per thousand
- Target for coverage – 80%
  - Evaluation teams

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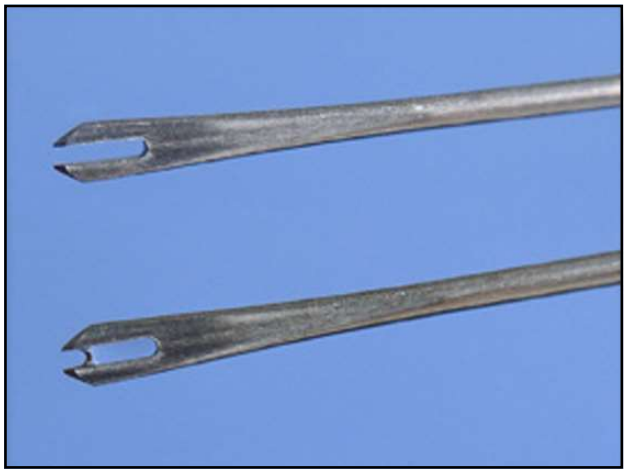

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Surveillance-containment strategy

- Operational plan
  - Surveillance – weekly report from all health units
  - Teams – to investigate and contain outbreaks
  - Epidemiological research on smallpox
    - The textbooks prove to be wrong
      - "Smallpox spreads like a prairie fire"
      - "Revaccination is needed every 3 to 5 years"

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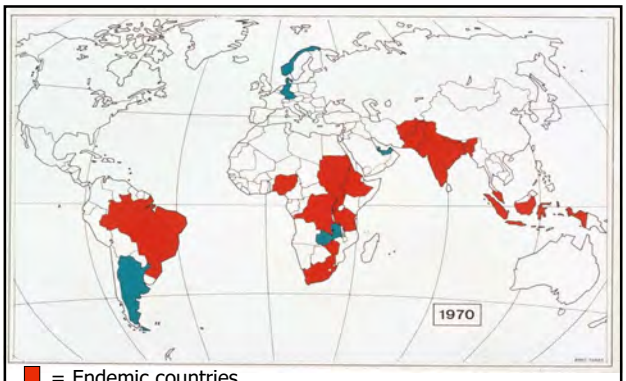

= Endemic countries
= Others with cases

Smallpox 1970

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= Endemic countries
= Others with cases

Smallpox 1973

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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

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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 – October
  - Spring 1974 – the darkest days
    - Gas crisis + strikes by airlines, railway, floods
    - India explodes a nuclear device

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= Endemic countries

= Others with cases

Smallpox 1976

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The last strongholds

Ethiopia and Somalia

- Ethiopia
  - Country – about size of Texas
    - Largely highland –over 5000 feet
    - Health facilities serve 5% of 30 million people
    - Travel largely by donkey and on foot
  - Emperor is assassinated; Marxist take-over
- Civil war, floods, famine, kidnapping, hostages
- Somalia – the final chapter

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Ali Maalin - 26 October, 1977

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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*

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A defector provides details -- 1992

- Deputy Director of USSR bioweapons program
  - 60 laboratories with 50,000 staff
  - Priorities – smallpox, anthrax, plague
- USSR dissolves – 1992-1993
  - Laboratory staffs cut by half or more
  - Many scientists leave the USSR for Europe, U.S., other countries

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Sept. 11, 2001 and a changed world

- Sunday, September 16 – an evening meeting
- Intelligence intercepts
- Decision to create an Office of Emergency Preparedness with Asst. Secretary as director
- The first of 22 anthrax cases becomes known two weeks later

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Priorities

- Soviet program ranked smallpox and anthrax as the most effective bioagents. It had facilities to produce multi-ton amounts of both
- As aerosols, the organisms could infect and cause large numbers of serious casualties.
- Smallpox had the additional attribute of being able to spread from person to person

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The threat of a smallpox virus release

- 75% of U.S. population was susceptible
  - Persons under 30 years --not vaccinated 45% of population
  - Vaccinees pre-1972-- little or no immunity
- World population
  - No better protected

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Emergency decisions

- Top priority -- procure more vaccine, needles
  - Quantity?
  - Calf or cell culture?
- Obtain 300 million doses—how rapidly?
- Interagency production committee to review vaccine procurement every 2 weeks

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Strategy for smallpox vaccine use a balance of risks

Probability that smallpox would be used as a weapon – unlikely but potentially catastrophic if not able to be controlled by vaccination

Frequency of adverse reactions – entirely acceptable if exposure to smallpox is reasonably likely

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Effectiveness of Outbreak control

- Smallpox spreads slowly
- Patient transmits only after rash appears
- Most contacts are in home or hospital
  - Few or none at work, school, etc
- Vaccine protects even when given 3-4 days after infection

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Smallpox vaccine stockpile
status today

- Stockpile — No. of doses
  - Acambis/Baxter (Vero cell 2003) — 220 million
  - Imvamune (Tissue cell 2010) — 2 million*
  - *Requires 2 doses and 42 days for protection—possible use for epidemic control unknown
- Production capacity — None
  - Manufacturing facility under final construction

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Preparedness for a biological event

More than 11 years have passed since the World Trade Tower and anthrax attacks

Significant progress has been made

- Federal funds for state and local preparedness
- Communications – 24/7
- Diagnostic laboratory network
- Hospital preparedness for casualties
- Stockpile—vaccines, antibiotics, medical supplies

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Operationally --are we really ready?

Imagine– 8 cases of smallpox in Hagerstown

? Agreed upon, written, rehearsed overall strategy known to national, state, local jurisdictions

? Vaccination priorities by risk group, geographic location, occupation. Who will vaccinate?

? Screening procedures for those with possible contra-indications and at varying risk of contact

? Plans for isolation and surveillance of contacts

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Final thoughts

- Try the Internet –"CDC Smallpox emergency response"
- Are we better prepared to deal with anthrax?
- Should you be concerned?
- Do I sleep better than in October 2001?

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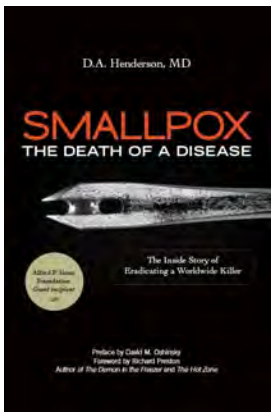

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