

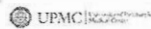
Epidemiological Surveillance

The Tipping Point for Smallpox Eradication

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11 December 2008

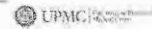
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Summary of Presentation

- Smallpox: the disease and the vaccine
- Global eradication is launched
- A new concept: surveillance and containment
- Program summary
- Final thoughts

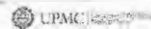
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"That disease was the most terrible of all the ministers of death. The horror of the Plague...visited our shores only once or twice within living memory but the smallpox was always present, filling the churchyards with corpses...and making the eyes and cheeks of the betrothed maiden objects of horror to the lover."

Macauley, 1850

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A Disease for the Ages

- An ancient disease; the most serious of all
- Deities – Africa and Asia
- One of the most important factors in the settlement of the Americas
- U.S. required vaccination for all children
- Vaccination certificates for all travelers
- More deaths in 20th century than due to war

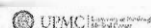
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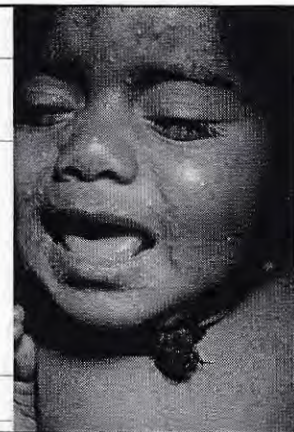
Smallpox – Clinical Features

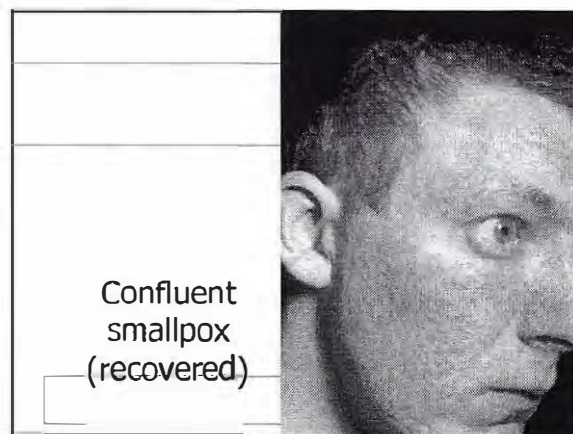
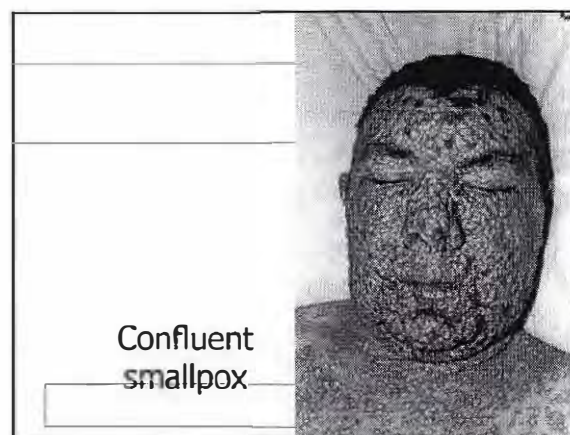
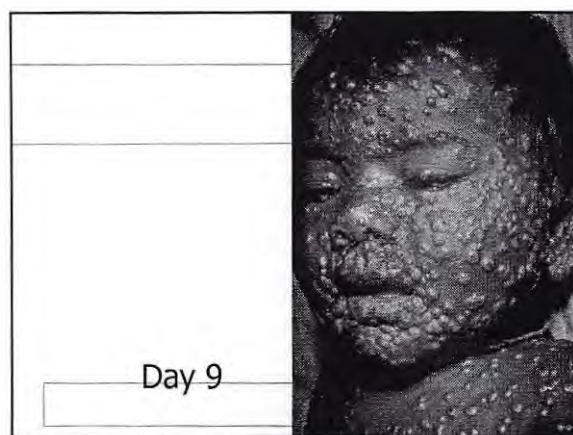
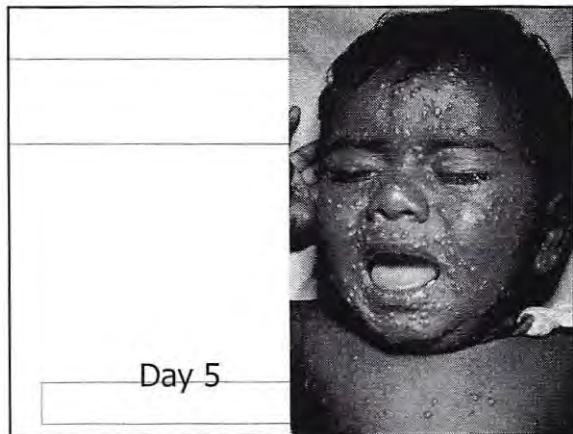
- Virus disease; man is the only host
- Incubation period – 7 to 17 days
- Fever, flu-like symptoms then rash
- No sub-clinical infections
- No treatment available
- Case-fatality rate – 30%

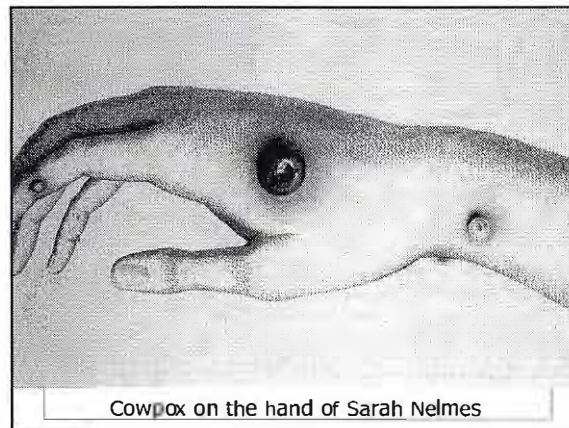
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Day 3







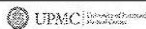
Cowpox on the hand of Sarah Nemes

Arm to arm vaccination

1800-1870s

- Source: vaccinia pustule
 - Arm to arm transfer of vaccinia
 - Sometimes contaminated with syphilis
 - When transmission failed
 - New strains from cows or horses
- Sporadic occurrence
No cowpox cases in Europe - 183666

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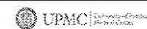


Vaccine grown on animal skin

1870 to 1980

- Animal-grown: calves, sheep, water buffalo
- Method:
 - Scarification of skin
 - Growth of vaccinia for 6 to 9 days
 - Sacrifice animal, scrape pustular matter, purify
- Vaccine stability was poor
 - Vaccine use limited in developing countries
- Freeze-dried vaccine--late 1950s

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Global smallpox eradication approved

- 1959 USSR proposal for eradication adopted by World Health Assembly
- 1959 -1966
 - Strategy: mass vaccination
 - Surveillance: none
 - Budget of \$60,000 to 100,000 per year
 - One staff member in HQ and 5 in the field

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WHO's "intensified" program - 1967

- Assembly requires DG to submit a new plan
 - Strategy-proposed 1966
 - Surveillance and containment
 - Large scale vaccination
 - 10 year program --budget of \$US 2.4 million/year
- Objections by delegates
 - Not feasible
 - Demand for no further increases in WHO budget
- 58 votes needed for acceptance; 60 vote for
- A program director is appointed

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Surveillance and Containment

- Weekly report from all health centers and hospitals
 - Age, sex, village, date of onset, vaccination status
 - Team to visit immediately and search for cases
 - Develop a simple graph of smallpox spread*
 - Vaccinate household and 30 nearby households
- Data to be compiled and analyzed weekly
- Surveillance reports to be made widely available at least monthly
- Outcome: program tactics changed frequently

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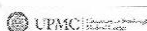


Figure 16. Smallpox Surveillance Diagram, a standard chart used for tracing chains of infection during field investigations. Cases were entered on the grid by date of onset. A line was drawn between cases to depict how the disease spread. One case seldom infected more than two to five others.

Source: WHO

What did we discover?

- Cases were primarily unvaccinated children
 - Why not vaccinated adults?
 Outcome: vaccination priority -- children
- Smallpox spread slowly --not like a "prairie fire"
 - Spread occurred primarily in households*
 - School or work-centered outbreaks -- rare
 - Transmission across borders -- infrequent
 - Cases tended to be concentrated within country
 Outcome: more emphasis on surveillance-containment

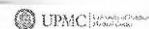
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Epidemiology of Smallpox Transmission Patterns in Europe: 1958-1973

- Outbreaks: 34
- Cases: 573
 - Transmission in hospital: 277 (48%)
 - Transmission in home: 143 (25%)
- Hemorrhagic cases -- a threat to hospitals
 - Germany (1970) 16 cases
 - Yugoslavia (1972) 38 cases

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What else did we discover

- Problem groups
 - Moslems in India
 - Women in purdah in Afghanistan
 Outcome: Moslem vaccinators/village contacts
- Environmental infection -- traditional beliefs
 - "Smallpox infected" houses
 - Infected letters, packages
 - Exhumed bodies
 Outcome: Ignore the threat -- relax!

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And what else?

- Seasonal changes in smallpox are major
 - During summer low, many fewer cases
 - Cases virtually disappear from rural areas
 Outcome: Intensified program in summer
- Quality control is essential-- "trust but verify"
 - Vaccine--manufacturer and field
 - Vaccinator productivity
 - Surveillance--timeliness, completeness of reporting
 Outcome: several quality controls in every program

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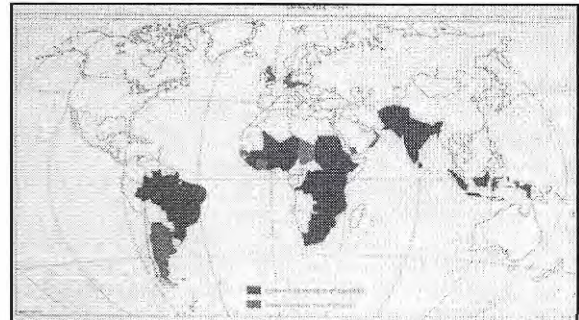


The Challenge

- Global status of smallpox – 1967
 - 10,000,000 – 15,000,000 cases
 - 2,000,000 deaths
 - 43 countries reported cases
- Program staff
 - Headquarters – 4 MD, 2 admin, 3 secretaries
 - Regions – one MD each in 4 WHO Regions
 - International staff – never more than 150
 - Building national capacity was critical

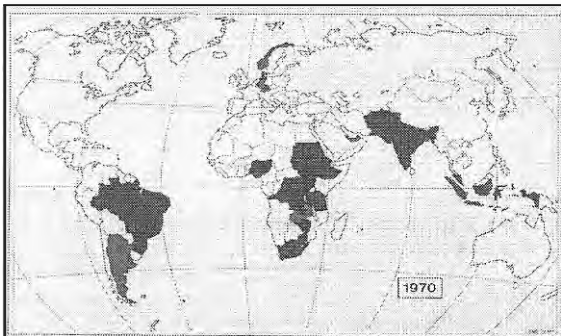
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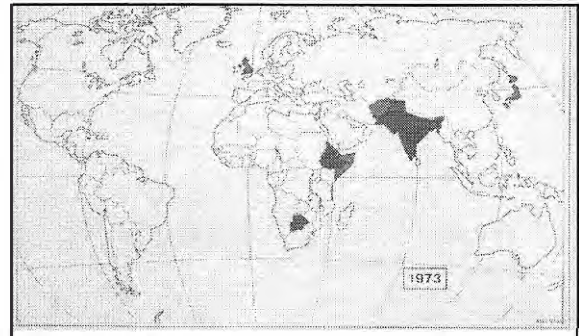
■ = Endemic countries
■ = Others with cases

Smallpox 1967



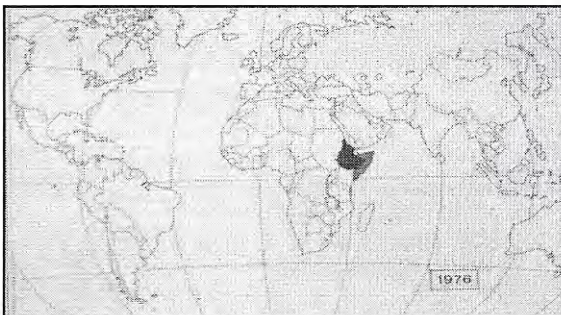
■ = Endemic countries
■ = Others with cases

Smallpox 1970



■ = Endemic countries
■ = Others with cases

Smallpox 1973



■ = Endemic countries
■ = Others with cases

Smallpox 1976



Ali Maalin - 26 October, 1977

Concluding thoughts

- A program without surveillance is like a ship without a rudder
- An effective health program without competent epidemiology is a rare species