

Dec. 1967 1st int meeting

Nov. 26

Smallpox: Death of a Disease

...its eradication and legacy

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"There has been no greater medical – or humanitarian – miracle in modern times than the eradication of smallpox... (It is the saga of a) day-to-day struggle for international cooperation in a divided world; it offers a winning blue print for the great medical challenges to come."

David Oshinsky – 2006 Pulitzer Prize in History

Smallpox – most feared disease of history

- Virus -- Spreads by face-to-face contact during rash
- Man is the only host
 - A chain of infection going back 3500+ years
 - Only disease for which there are deities
- No treatment; death rate = 25 to 30%
- Permanent immunity after recovery



Tou-Shen Niang-Niang



Pan-chen

Sitala Mata



World's 5 most important historic sites

(from BBC World History Series, Oct. 2012)

- Yellow River, China
- Great African Rift Valley
- Athens, Greece
- Los Alamos, New Mexico
- ?

The Drama of 1796 – Berkeley, England the world's first vaccine

Cast of characters --1796

Edward Jenner
Blossom
Sarah Nemes
Jimmy Phipps

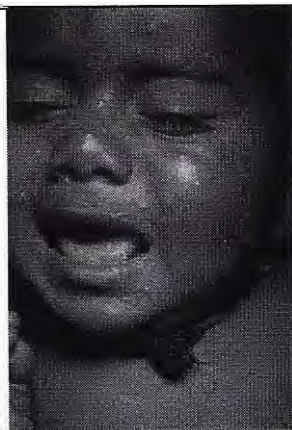
Vaccinia virus transferred from arm to arm until 1870s

- Grown on the flank of a calf or sheep until 2002
- Tissue culture vaccine from 2002

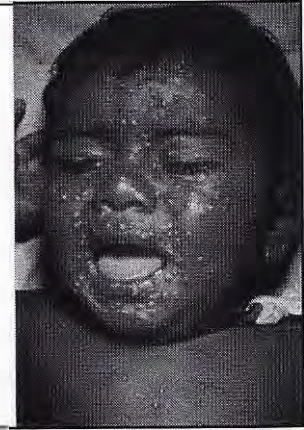
Summary objectives

- To portray the principal clinical features of smallpox, a disease last seen in 1978 but a continuing threat
- To identify the landmarks of the eradication campaign and research contributing to its success
- To highlight the legacies and subsequent opportunities for public health

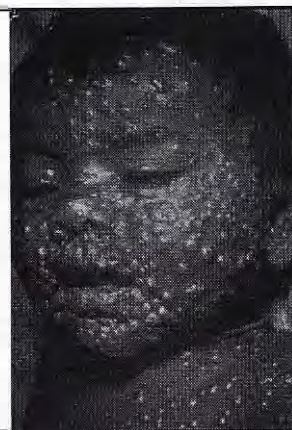
Day 3



Day 5



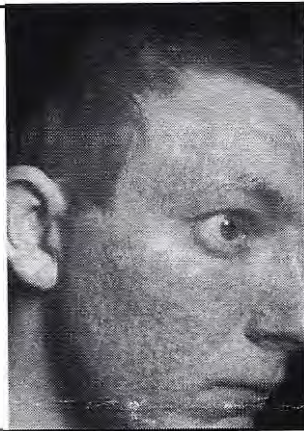
Day 9



Confluent
smallpox



Confluent
smallpox
(recovered)



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- ?	29 years +
• Poliomyelitis	1988- ?	27 years +

Global smallpox eradication

- World Health Assembly agrees to a proposal to start some sort of global effort
- 1959 -1966 National programs encouraged
 - Strategy: mass vaccination (few countries complied)
 - Budget of <\$100,000 per year
 - Six staff members

The WHO Eradication Program

Assembly requires DG to submit a plan --1966

- Strategy
 - 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 needed for approval; 60 voted in favor

Program leadership

- Director General believed program would fail (malaria eradication was collapsing)
- Demanded an American serve as Director
 - The candidate reluctantly agreed:
 - Limited resources -- ~\$50,000 each for 50 countries
 - Insufficient even to buy the vaccine required
 - Not all countries interested in participating

The Challenge

- Status of smallpox -- 1967
 - >10,000,000 cases
 - 2,000,000 deaths
 - 43 countries reported cases
- Program staff
 - Headquarters -- 5 medical; 5 support staff
 - International staff -- never more than 150
- Communication -- mail, personal contact

1st major regional smallpox conference

Bangkok – December 1967

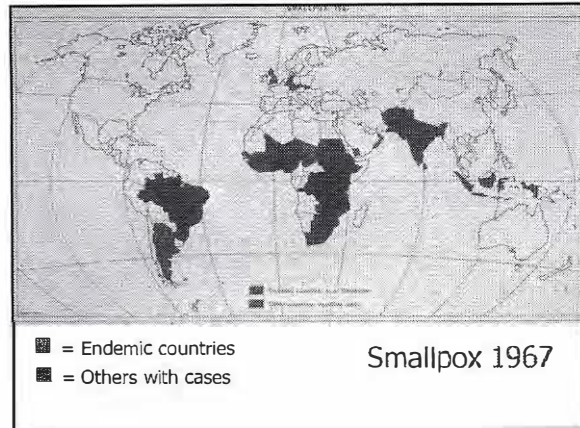
11 Asian countries

Indonesia, India, Pakistan, Malaysia,
Afghanistan, Nepal, Philippines, Viet Nam,
Laos, Burma, Thailand

Thailand had become smallpox-free in 1962

1898 survey—95% of teen-agers with scars

Smallpox accounted for 90% of all blindness

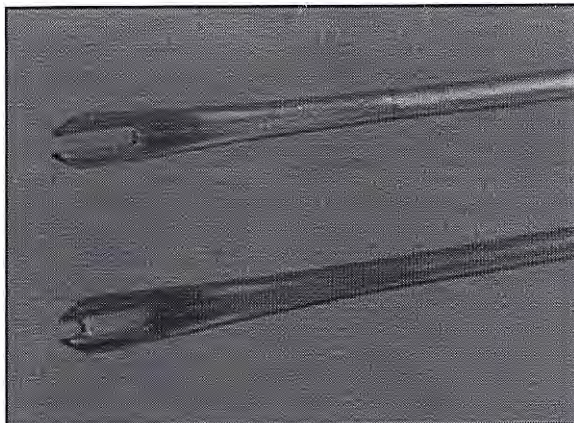


Vaccine Shortages

- Heat-stable, potent vaccine is essential
 - 300 million doses needed annually
 - 42 labs producing vaccine
 - Labs in Netherlands and Canada test vaccine
 - Only 10% meets international standards
- National capacity has to be developed
 - Production manual and research
 - On-site consultant assistance

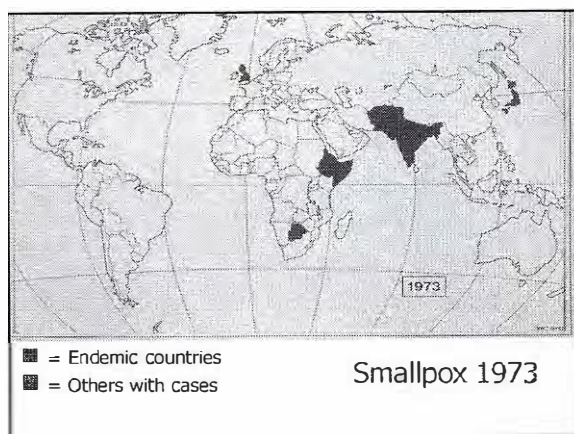
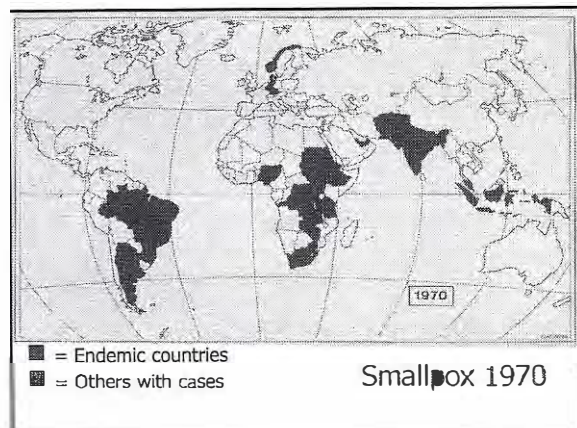
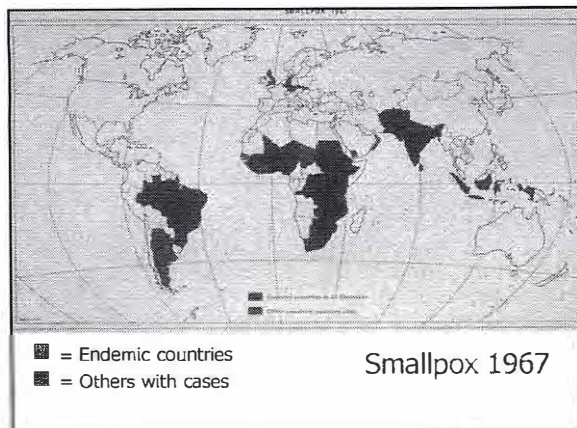
Vaccination methods

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



Surveillance-containment strategy

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



India -- the pivotal challenge

1973-75

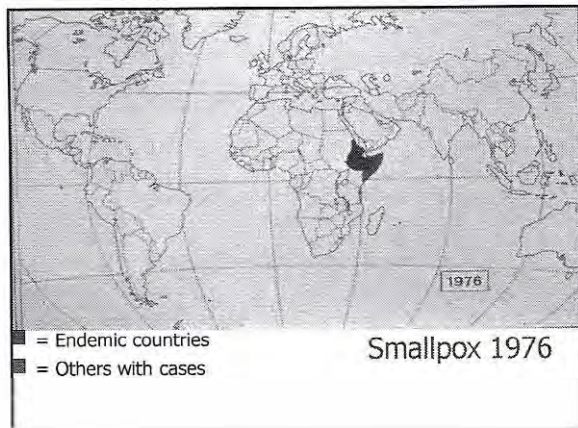
- India – the “home of smallpox”?
- Population – 550,000,000
- Surveillance-containment strategy--not working
- June 1973 – search every village—later, every house
 - 130,000 health staff in 10 days
 - Results of first search – October
- Spring 1974 – the darkest days
 - Gas crisis + strikes by airlines,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

Indian Independence Day

August 15, 1975

Prime Minister Indira Gandhi

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



The last strongholds

Ethiopia and Somalia

- **Ethiopia**
 - Country – about the size of Thailand
 - 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
 - No foreign staff outside of Addis except smallpox teams
 - Civil war, floods, kidnapping, hostages, famine
- **Somalia – the final chapter**



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*

The legacy – 1974 --the Vaccine Era begins

- The genesis
 - African vaccinators average 500/day with cooperative village leadership
 - One year: 4 person team = 400,000 vaccinations
 - Smallpox – the only nation-wide vaccination program in developing countries
 - Smallpox unit sponsors international meeting to advocate for a broadened agenda

Expanded Program on Immunization-1974

- WHO global program for vaccination for all children --smallpox, measles, DPT, polio
- Surveillance of vaccine-preventable diseases
- 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-rubella	51	80	92	93
Polio*	57	75	90	92
HepB*	—	—	70	88
Hib*	—	—	75	90

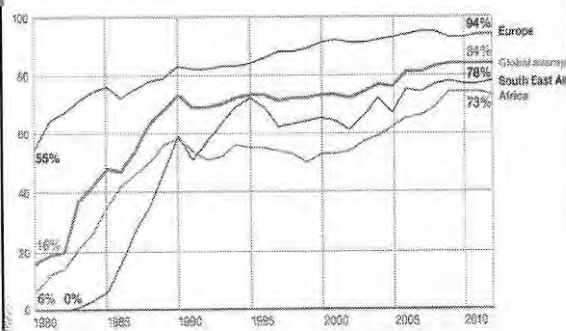
* 3 Doses

Transmission interrupted:

Polio (1991); Measles (2001); Rubella (2009)

Growth in measles vaccination coverage

Measles Containing Vaccine (MCV) coverage, 1990-2012 (%)



EPI – 40 years after its beginning

Global vaccine coverage DPT, measles, polio, tuberculosis

1974 – 5%

2014 – 83%

Hepatitis B and H. influenzae – in 190 countries

also: Rotavirus, yellow fever, pneumococcal, rubella

For the future: malaria, AIDS, cervical cancer, Ebola, dengue, tuberculosis

Surveillance and monitoring

700 laboratories in 184 countries for surveillance of measles and other diseases

Coda

- From *Smallpox: 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."

