

# **SMALLPOX REVISITED**

## ***A Consequence of Public Health Success***

**Satellite Conference**

**Thursday, November 7, 2002**

**9:00-11:00 a.m., Central Time**

***Produced by***

***The Alabama Department of Public Health***

# Objectives

- Identify clinical features of Smallpox
- Describe the transmission methodology
- List the steps in surveillance and containment
- Describe the steps in the Alabama Plan



**Smallpox**

# Smallpox: Clinical Features

- Incubation 7-17 days (most 12-14 d)
- Prodrome - lasts 2-4 days
  - Fever, malaise, headache, backache, vomiting
- Exanthem (rash) – lasts 3-4 weeks
  - Begins on face, hands, forearms
  - Spread to lower extremities then trunk over ~ 7 days
  - Synchronous progression: macules → papules → vesicles → pustules → scabs
  - Lesions on palms/soles





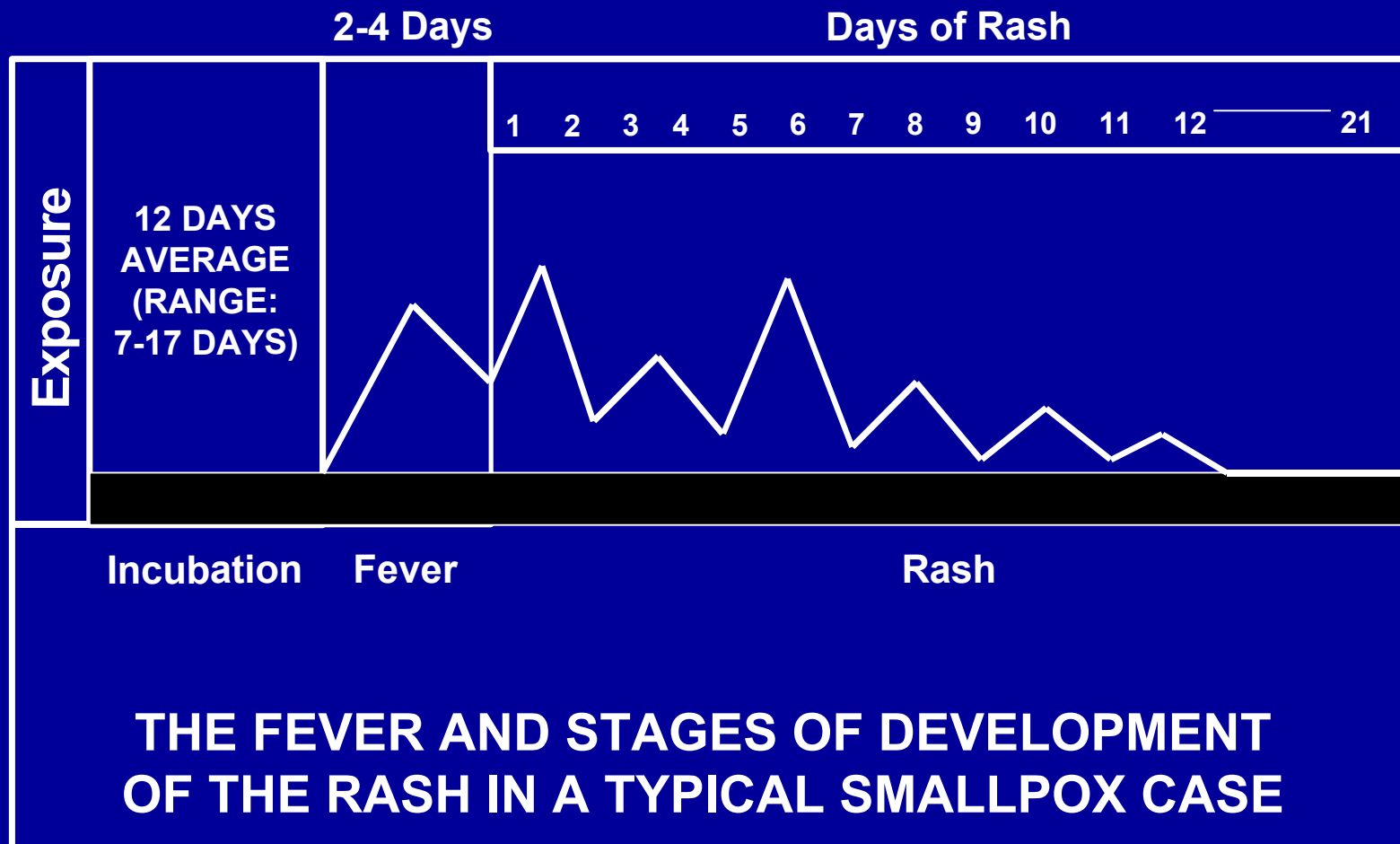
# Smallpox: Clinical Features



WHO



# Progression of Smallpox Rash



# Smallpox - Semiconfluent

- Pustules confluent on face but discrete elsewhere





# Hemorrhagic - Late Smallpox<sup>+</sup>



+ in Fenner F et al. Smallpox and its Eradication, p35



# Smallpox Transmission

- **Common:** Person – to –person by airborne droplets
  - Face-to-face contact (6-7 feet)
  - Should be able to interrupt by droplet mask protection (N-95)
- **Rare:** airborne over long distance
- No carrier state
- **Rare:** as fomites
  - Bedclothes, linens, blankets
- **Not transmitted by:** food, water

# Secondary Attack Rate for Smallpox Among Unvaccinated Persons†

2° Attack Rate(%)	# Studies
36 - 47	5
73 - 88	3
Average	58%

† in Fenner F et al. Smallpox and its Eradication, pp200

## Mode of Acquisition of Variola Major from Smallpox Importations in Europe, 1950 – 1971<sup>+,\*\*</sup>

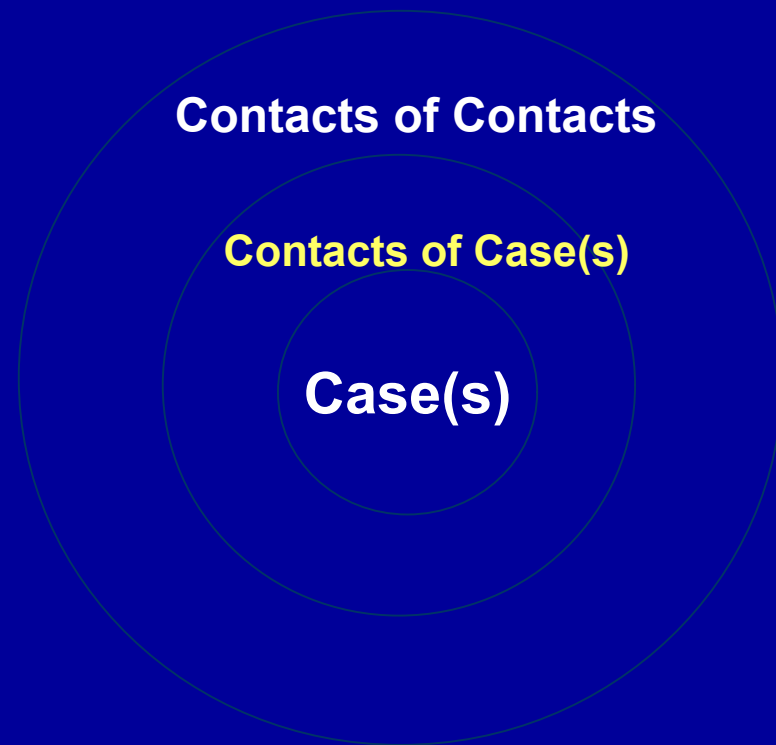
Mode	Cases	%Total
Hospital Transmission	359	55%
Family and intimate contacts	129	20%
Work-related	51	8%
Casual contacts	63	10%
Miscellaneous	6	1%
Unpredictable cases	44	7%

<sup>+</sup> Excludes 28 importations of unknown or unreported mode of transmission.

<sup>\*\*</sup>J Infectious Diseases 1972; 125: 161-169.

# Surveillance and Containment (Ring Vaccination)

- Find and isolate cases
- Identify and vaccinate contacts
- Provide a ring of immunity around each case
- Focused vaccination to those who needed it most
- Minimized vaccine adverse events
- Used to eradicate smallpox





# Bifurcated Needle



(Needle-shielding, safety bifurcated needles are in development)

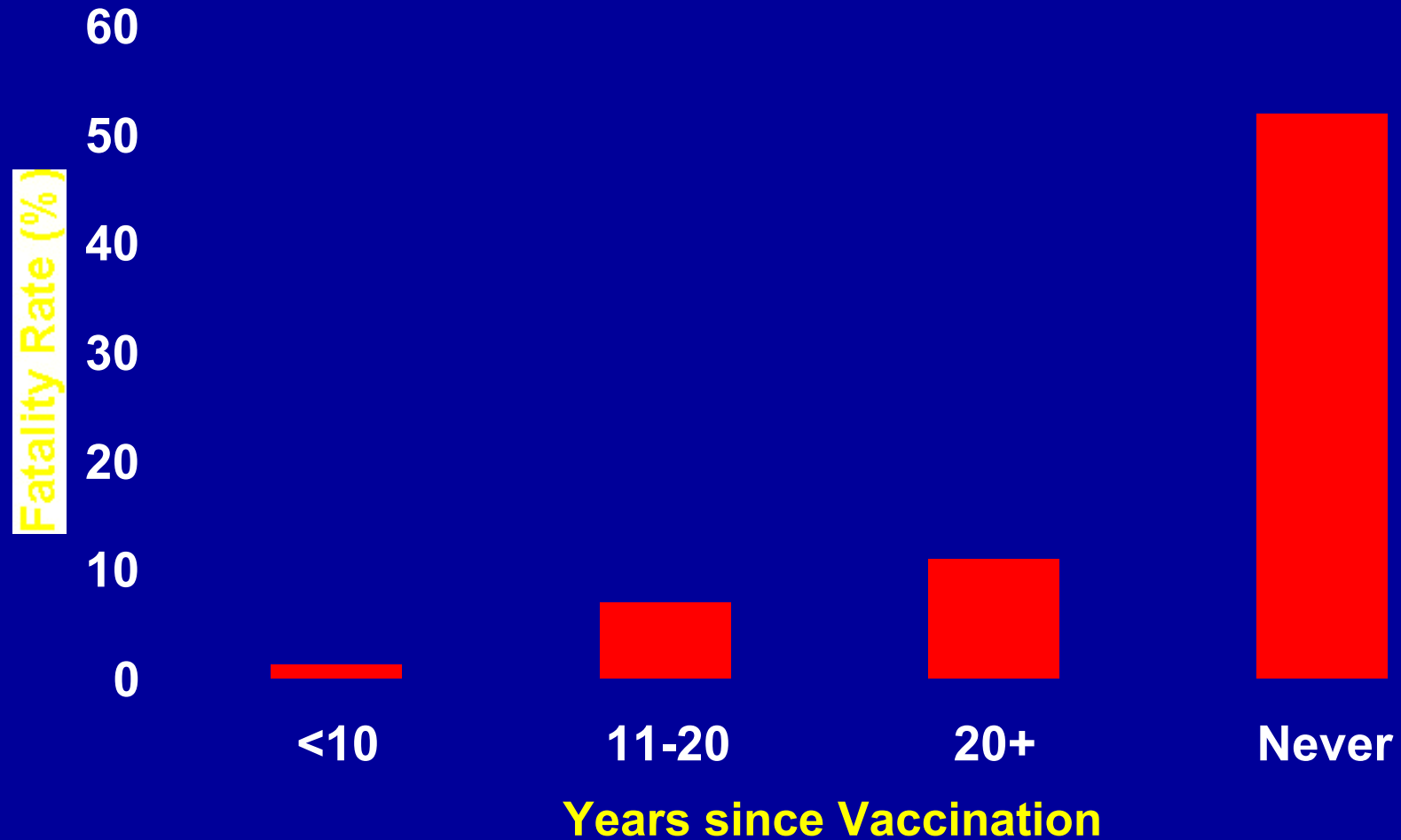
# Smallpox Vaccine Supply United States

- **Calf-lymph derived vaccines** – produced when smallpox vaccination recommended
  - Wyeth Dryvax (1:5) 77 M doses
  - Aventis Pasteur 85 M doses
- **Cell culture derived vaccines (Acambis-Baxter)**
  - Sept. 30, 02 140 M doses
  - Dec. 31, 02 200 M doses (cumulative)
- **Total Available by Jan. 1, 2003 362 M doses**
- **Bifurcated Needles** – a sterile needle for every dose
- **Diluent: Dryvax @ 1:5**
- **Protocols: vaccine handling, dilution and administration**

# **Efficacy of Pre-Exposure Vaccination**

**91% - 97%**

# Smallpox Fatality Rate by Time Since Vaccination - Europe, 1950-1971\*



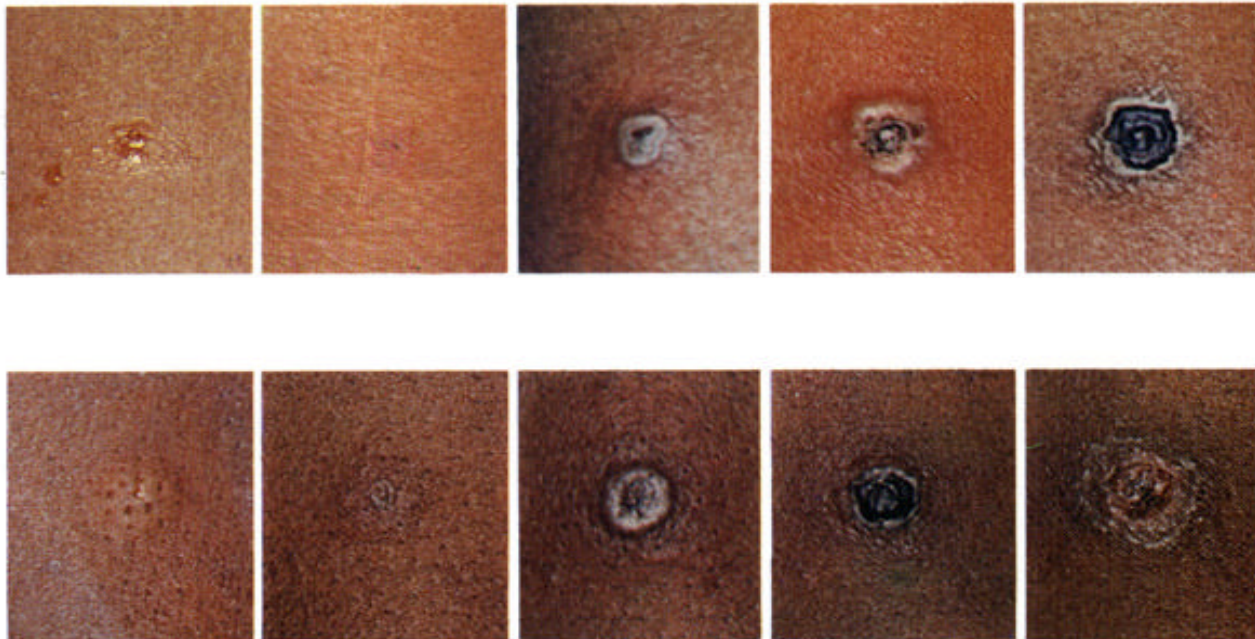
\*Mack TM. J Infect Dis 1972;125:161-9.



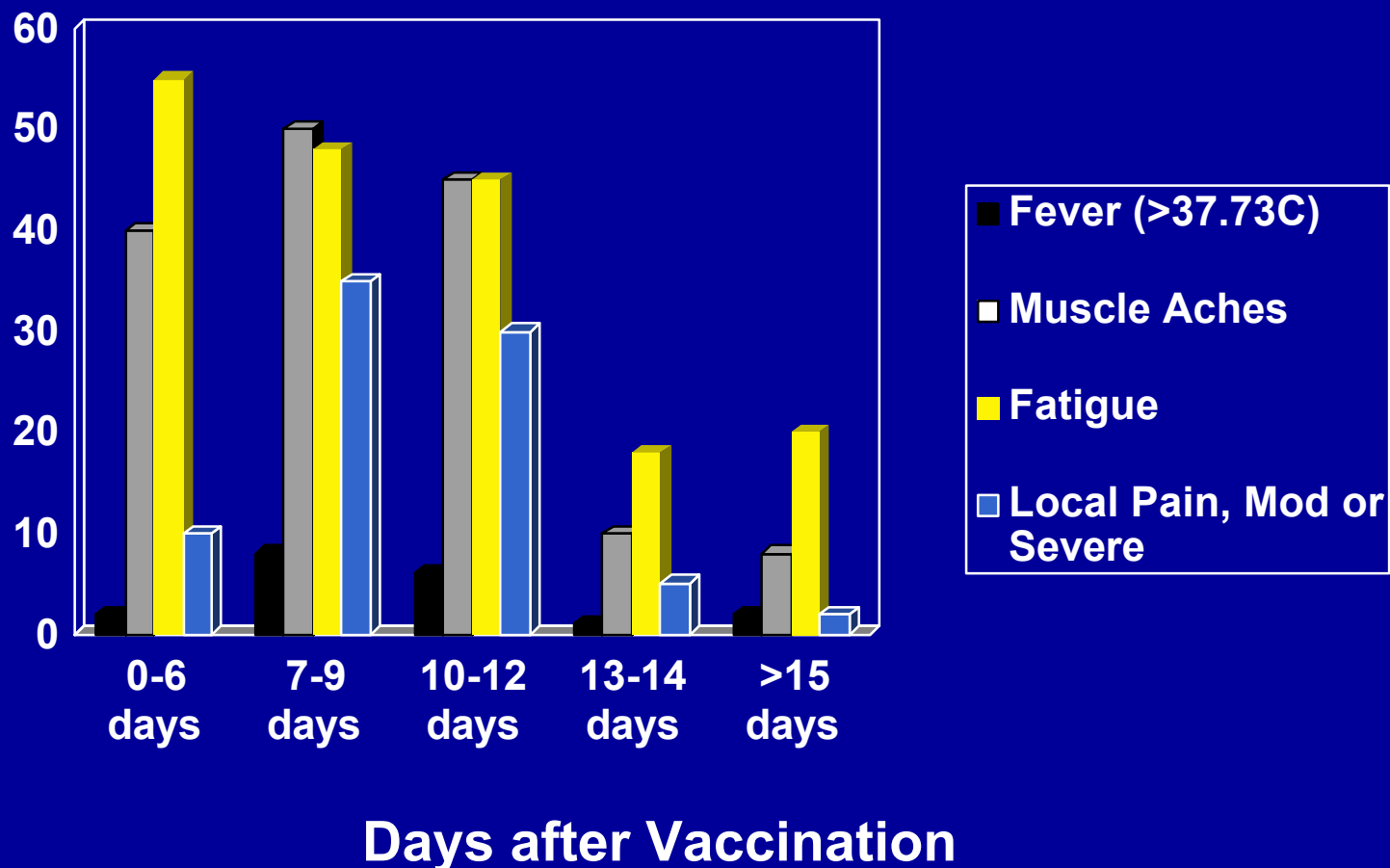
# Estimated Protection from Smallpox Vaccination

Vaccination Status	Protection (%)	
	Disease	Death
<b>Pre-exposure</b>		
≤ 3 years	>95	>95
4- 10 years	~95	~95
<b>Post exposure</b>		
≤ 7 days	21-91	
	Often modified	
<b>Long-term</b>		
≤3 years	~100	~100
3-10 years	~90	~100
10 – 20 years		~80
20+ years		~70

# Normal Response To Smallpox Vaccination



# Systemic Signs and Symptoms Associated with Smallpox Vaccination



# Satellite Lesions from Smallpox Vaccination



Frey et al. NEJM 2002; 346:1265-74



# Induration from Smallpox Vaccination



Frey et al. NEJM 2002; 346:1265-74

# Vaccination Complications

- Non-infectious rashes - - erythema multiforme
- Bacterial superinfection
- Auto-inoculation or contact inoculation
- Eczema vaccinatum
- Generalized vaccinia
- Progressive vaccinia / vaccinia necrosum
- Post-vaccination encephalitis
- Congenital vaccinia: rare
- Miscellaneous: hemolytic anemia, arthritis, osteo, pericarditis, myocarditis

# Erythema Multiforme

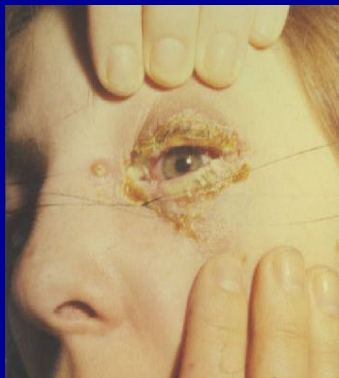




# Auto- or Contact Inoculation



Inoculation into diaper rash from vaccinated sibling and parent





# Eczema Vaccinatum



**Scarring after healing**

**Source: contact**

# Generalized Vaccinia



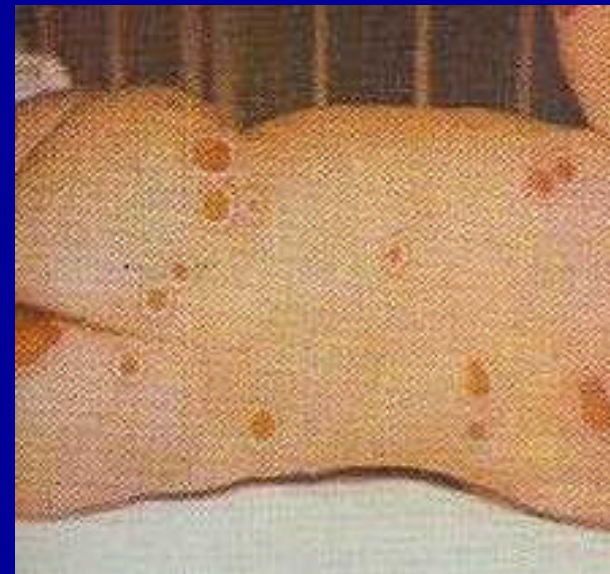
Note that all lesions are  
“normal” and  
nonprogressive

GENERALIZED VACCINIA  
- BENIGN

## Progressive Vaccinia

Note that the lesions have no inflammation, and progress in size without limitation.

Child had severe combined immunodeficiency (SCID) and despite rigorous and extensive antibody and antiviral chemotherapy, died with overwhelming viremia.



# Congenital Vaccinia

- Rare event (47 cases in literature)
- Primary vaccination in susceptible woman
- Usually results in stillbirth or death soon after delivery
- No congenital anomalies linked to maternal vaccination



# Post-Vaccination Encephalitis

- Highest risk in children < 1 year of age



# Adverse Events from Smallpox Vaccination

1960's

- Increased awareness resulted in population based studies of physician reported cases
- Occurred in spite of exclusions for known contraindications to vaccination
- Reason that smallpox vaccination stopped in 1971

# Adverse Events from Smallpox Vaccination

## Today

- Same vaccine as used in the 1960's – 70's
- Higher prevalence of persons with contraindications for vaccination (e.g., cancer, organ transplant, atopic dermatitis, HIV infection)
- Estimated that ~25% of persons would be excluded from vaccination due to contraindications or contact with person with contraindications

Adapted from: Kemper et al. *Eff Clinical Prac* 2002; 5:84-90

# Estimates of Populations with Contraindications to Smallpox Vaccination

<b>Condition</b>	<b>Estimated Population</b>
Recipients of solid-organ transplantation	~184,000
Cancer patients and survivors	~8.5 million
HIV infection	
Known diagnosis	550,000
Unknown	300,000
Atopic dermatitis	28 million
Other immunodeficiency conditions	?
Persons on high dose steroids or other immunosuppressive drugs	?

Adapted from: *Eff Clinical Prac* 2002; 5:84-90

# Expected Number of Adverse Events (per million primary vaccinees)

Type of Adverse Event	Age at Vaccination (years )			
	<1	1-4	5-9	20+
Death (all causes)	5	0.5	0.5	1-5*
Post-vaccinial Encephalitis	6	2	3	4
Progressive Vaccinia	1	0.5	1	2-5*
Eczema Vaccinatum	14	44	35	30
Generalized Rashes	400	9,600	140	250
Accidental Implantation	507	577	371	606

Adapted from: J Infect Dis 1970; 122:303-309  
Pediatrics 1969; 39:916-923

# Web Site Resources

- <http://www.adph.org>
- <http://www.bt.cdc.gov/agent/smallpox/index.asp>