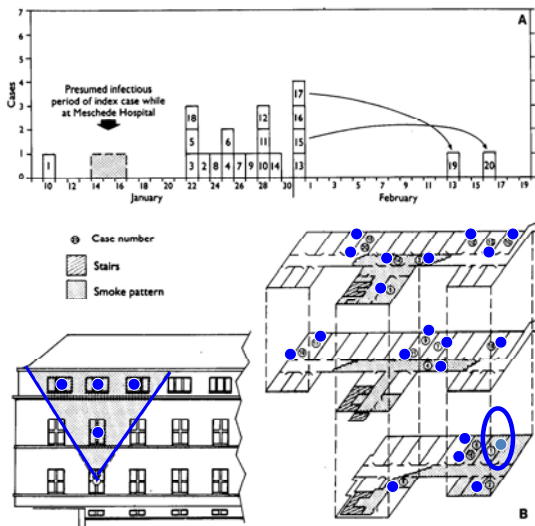


天花在現時醫院之感染控制原則

衛福部 疾病管制署
中區傳染病防治醫療網
王任賢 指揮官

Principles of Isolation Smallpox Transmission

- Most transmission through direct, face-to-face contact
 - Respiratory droplet with close contact
- Rarely airborne transmission
 - Cough
- Rarely fomite transmission
 - Clothing contaminated with dried respiratory secretions or lesion drainage



Airborne Spread of Smallpox in the Meschede Hospital

Fenner. 1988. Fig. 4.9

Recovery of Variola Virus from the Area Around Smallpox Patients

Recovery of variola virus from the vicinity of patients with variola major^a

Source of Sample	Number of patients	Number of Specimens	Positive	
			Number	%
Impinger, near mouth	29	47	5	11
Settling-plate, near mouth	13	30	12	40
Circumoral swab	32	58	42	72
Pillow Swab	40	67	41	61
Impinger, near bedclothes	9	15	5	33
Settling-plates, near bedclothes	13	20	11	55
Bedclothes Swab	11	16	15	94
Back Swab	35	66	25	38
Urine	16	34	17	50

^a Based on on Downie et al. (1965a).

General Principles and Goals of Isolation and Infection Control

- Protect the Community - Remove patients
- Protect Healthcare Workers – Vaccinate and Implement Personal Precautions
- Protect Other Patients – In Hospital Setting (Different categories of facilities, separate wards, confine classes of patients, etc.)

Goals of Smallpox Isolation

- **Protect others from becoming infected**
 - Healthcare personnel
 - Response personnel
 - Other patients
 - Others in community
- **Isolate smallpox patient**
 - Prevent sharing of airspace (respiratory isolation)
 - Prevent direct contact (protective clothing)
 - Prevent contact with infectious materials (decontamination)

Administrative Controls

- Many of the strategies of smallpox infection control reduce worker risk for exposure:
 - Work practices that limit number of workers potentially exposed:
 - Assign only vaccinated workers to jobs with exposure.
 - Putting possibly infectious patients in isolation.
 - Work practices that limit exposure to the hazard:
 - Procedures for handling waste, laundry, specimens.

Standard Precautions

- **Constant** use of gloves and handwashing (plus face-shields, masks, or gowns if splashes are anticipated) for any contact with blood, moist body substances (except sweat), mucous membranes, or non-intact skin.

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- **Additional**, Transmission-based Precautions

Standard Precautions

Transmission-based Precautions

- Airborne (TB, Chicken pox, Measles, Smallpox)
- Droplet (Diphtheria, Pertussis, Meningococcus)
- Contact (Enteric infections, Respiratory infections, Skin infections)

Standard Precautions

Transmission-based Precautions for Smallpox:

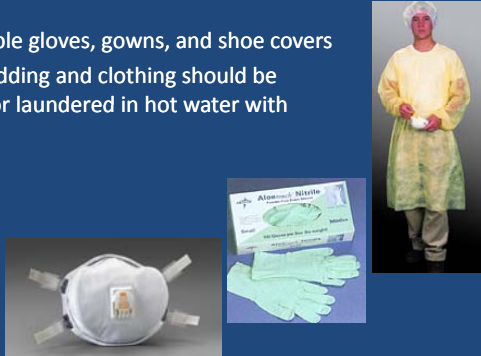
- Airborne
- Droplet
- Contact

Prevent Infection from Patients or Materials

- Standard Precautions:
 - Prevents direct contact during care.
 - Prevents transmission of other infections.
- Contact Precautions:
 - Prevents dispersal of potentially infectious material by care-providers
- Airborne Precautions:
 - Prevents transmission via airborne route to other parts of hospital
 - Provides respiratory protection for workers who must share airspace with infectious patient

Personal Protective Equipment

- Use disposable gloves, gowns, and shoe covers
- Reusable bedding and clothing should be autoclaved or laundered in hot water with bleach



Respiratory Protection - Smallpox



- Airborne precautions
- Recommendation: fitted NIOSH N95 or greater respirators for personnel entering patient room

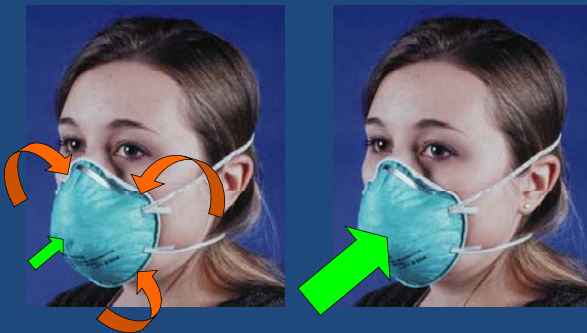


Properly Fitted – air goes through mask filter

How Effective is the Respiratory Protection?

Without fit testing

With fit testing

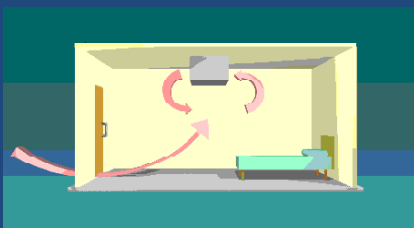


Prevent sharing of airspace with potentially infectious patients

- Negative pressure isolation rooms.
- Separate facilities for larger groups.
- Respirators for unvaccinated care-providers.

Engineering Controls: Isolation Rooms

- Patients housed in rooms under negative pressure compared to hall.
- At least 6 to 12 air changes/hour.
- Air not recirculated to other rooms.



Source: CDC, 1994

Testing Negative Pressure



The smoke tube



Isolation Strategies

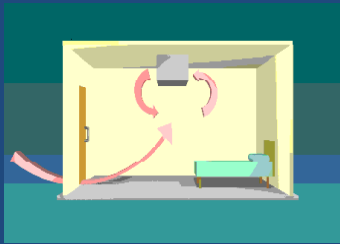
- 3 groups to consider:
 - Confirmed or suspected smallpox cases
 - Infectious
 - Febrile vaccinated contacts
 - Unknown if infectious
 - Asymptomatic (vaccinated) contacts under surveillance
 - Not infectious

Strategies for Isolation Smallpox cases

- Smallpox cases (infectious)
 - Confirmed and probable
- Hospital in isolation rooms
 - Negative airflow rooms
- Other facility designated only for care of cases
 - No special isolation rooms needed
 - No shared ventilation with other structures
 - Capability to provide medical care
 - All persons entering facility vaccinated (including patients)

Confirmed/Suspected Smallpox Cases (Few)

- Known or presumed infectious individuals
- Hospital isolation room(s)
- Rooms under negative pressure
- At least 6 to 12 air changes/hour
- Air vented to outside
- Air not re-circulated to other rooms or areas



Confirmed/Suspected Smallpox Cases (Many)

- Designated Facility for smallpox patients
- Individual isolation not needed if:
 - only potential smallpox cases in facility
 - no shared ventilation system with other facilities
 - all entering facility vaccinated (including patients)



Strategies for Isolation Febrile Contacts

- Febrile contacts to smallpox cases
 - Two successive temperature readings $\geq 101^{\circ}\text{F}$ (38.5C)
 - Not yet developed rash
- Hospital isolation rooms
 - Negative airflow rooms
- Other facility for only cases and/or contacts
 - All entering facility vaccinated
 - No shared ventilation with other structures
- Home isolation
 - All in home vaccinated
 - Transfer to designated facility if rash develops

Strategies for Isolation Asymptomatic contacts

- Vaccinated contacts to smallpox patients
 - no symptoms
 - not infectious
- Home
 - Monitor for 2 successive fevers $\geq 101^{\circ}\text{F}$ (38.5C)
 - Travel restrictions during surveillance period for symptoms (incubation period)
 - No special ventilation requirements
 - All in home must be vaccinated
 - Household members with contraindications to vaccination should stay outside of home during surveillance period

Hospital Treatment Issues in a Smallpox “Event”

- Existing services and isolation capabilities could be overwhelmed
 - Ill will present to hospitals
 - In-hospital spread to others may occur if infection control measures not followed
- Plans need to include medical treatment capabilities for cases possibly in non-hospital facilities

Decontamination

- Air:
 - Virus UV Light Sensitive
 - Exhaust, Good Air Flow
- Surfaces:
 - Diluted bleach solution (Fresh every day)
 - Hospital disinfectants
- Blood, pus:
 - Wash before disinfecting

Decontamination

- Laundry:
 - Contain
 - Dissolving laundry bags if available
 - Don't sort first, wash, then sort
- Household:
 - Basic cleaning, wipe down surfaces
 - Wash all contaminated clothing in hot water w/ bleach if possible
 - Vaccinate all contacts in household
 - Public health review of home

Infection Control in Places without Infrastructure

- Mask, Eyes and Face Shield, even if vaccinated
- Good air circulation/ Open Windows
- Cohort once you have rash:
 - Segregate as much as possible
 - Must be vaccinated if cohorted
- MSF style clean water supply:
 - Secondary staph infection

Infection Control in Places without Infrastructure

- Waste disposal – incinerator
- More durable virus,
 - surface cleaning with bleach solution
- Contain soiled items on site
 - decontaminated or incinerate

Burial Issues

- Contain and seal remains
- No open funeral
- Cremate, if possible:
 - If not, bury, but no embalming
 - Put in ground, not “on surface.”
 - If you can't bury in ground, move remains

Quarantine Measures Planning and Operational Issues

Quarantine and Isolation Definitions

- Quarantine
 - restriction of activities or limitation of freedom of movement of those presumed exposed to a communicable disease in such a manner as to prevent effective contact with those not exposed (usually associated with population)
- Isolation
 - separation of a person or group of persons infected or believed to be infected with a contagious disease to prevent the spread of infection (usually associated with hospital setting)
- Cordon Sanitaire
 - Geographic isolation of area where outbreak occurring

Isolation in Practice

- Isolation or quarantine can be implemented on a voluntary basis
- When necessary, might require enforcement if laws and authorities allow

Modeling Potential Responses to Smallpox as a Bioterrorist Weapon

Strategy	Days to Contain	Required Strategy Targets	Number of Cases
Quarantine Alone	240	50% removal rate	2,300
Vaccination Alone	365	Reduce transmission to 0.85 infected/case	2,857
Quarantine and Vaccination	365	25% removal rate; transmission reduced 33% by vaccination	4,200

Meltzer M, Damon I, Le Duc J, Millar J. EID 2001 (Nov-Dec);7(6)

Modeling Potential Responses to Smallpox as a Bioterrorist Weapon

- Theoretically, quarantine alone stopped outbreak:
 - level of quarantine needed probably impossible to achieve
- Relying solely on one strategy likely unwise
- Relying on combined strategy:
 - decrease total cases with improvement in either part of strategy (quarantine or vaccination)
 - stopped transmission, controlled outbreak
 - less vaccinations needed:
 - limited supplies
 - decrease serious vaccine adverse events

Modeling Potential Responses to Smallpox as a Bioterrorist Weapon

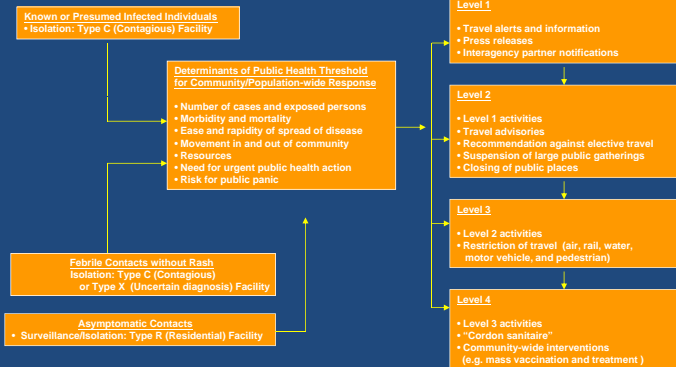
- Post-release intervention should include combined isolation/quarantine and vaccination strategy
- Planning strategies should take into account:
 - number infected/cases initially
 - likely rate of transmission (# of secondary transmissions/smallpox case)
- Delay in comprehensive intervention would greatly increase total number of cases

Meltzer M, Damon I, Le Duc J, Millar J. EID 2001 (Nov-Dec);7(6)

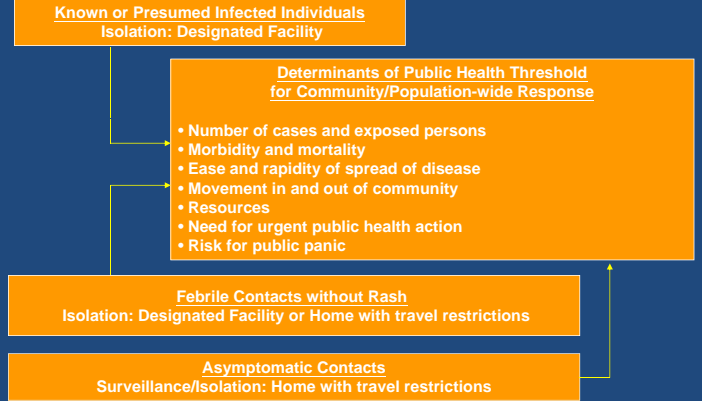
Public Health Measures in a Smallpox Outbreak

Responses for Individual Cases

Responses for Community



Isolation and Quarantine Measures in a Suspected Smallpox Outbreak Individual Case Response



Isolation and Quarantine Measures in a Suspected Smallpox Outbreak Community Response



Isolation and Quarantine Measures in a Suspected Smallpox Outbreak Community Response



Considerations During a Smallpox Response

- Communication strategies.
- Movement of critical/essential personnel and materials.
- Provision of essential services.
- Enforcement activities.
- Community/population-wide intervention strategies (e.g., mass vaccination).

Operationalizing Community Measures

- **No experience with dense, highly mobile, and unvaccinated population of today:**
- **Limited recent experience with population quarantine:**
 - thresholds, feasibility, and impact of various approaches untested.
 - states may have experience with quarantine of individual TB patients.
 - precludes inclusion of standardized guidelines.
 - issues surrounding protection of civil liberties need to be addressed.

Operationalizing Community Measures

- Effective planning /implementation of potential use of community measures paramount:
 - current limited vaccine supplies.
 - potential for multiple cases in different geographic locations.
 - potential for genetically modified strain.