Vaccination Strategies to Contain a Smallpox Outbreak

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Public Health Factors in Choosing a Vaccination Strategy

- Vaccine Supply
- Extent of Outbreak
- Risk and acceptability of vaccine-related adverse events
Eradication Strategy of the 1970s

- Vaccination of close contacts of cases
- Occasionally supplemented with broader campaigns
- Vaccine was readily available
Smallpox Realities in 2002

- No cases of smallpox
- Threat unknown
- Susceptible population
- Many people at risk for adverse events from vaccination
- Limited vaccine supplies
Smallpox (vaccinia) Vaccine

- Calf lymph with seed virus derived from NYCBOH strain
- Contains trace amounts of polymyxin B, streptomycin, chlortetracycline and neomycin
- Multiple puncture technique with bifurcated needle
Smallpox Vaccine Stockpile

- ~15 million doses, Wyeth DryvaxÆ
- 100-dose vials
- Contracts for additional 209 million doses by end of 2002
- NIH vaccine dilution study results pending
- All to be used under IND
Antibody Persistence

- Level of antibody that protects against smallpox infection unknown
- Neutralizing antibody $\geq 1:10$ persists up to 30 years following 3 doses
CFR by Vaccination Status, Europe, 1950-1971

Major Complications of Smallpox Vaccination

- Inadvertent autoinoculation
- Eczema vaccinatum
- Generalized vaccinia
- Progressive vaccinia (vaccinia necrosum)
- Postvaccinial encephalitis
Rates* of Reported Complications Following Smallpox Vaccination in U.S., 1968

<table>
<thead>
<tr>
<th>Complication</th>
<th>Primary Vaccination</th>
<th>Revaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>529</td>
<td>42</td>
</tr>
<tr>
<td>GV</td>
<td>242</td>
<td>9</td>
</tr>
<tr>
<td>EV</td>
<td>39</td>
<td>3</td>
</tr>
<tr>
<td>PV</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td>PE</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>1254</td>
<td>108</td>
</tr>
</tbody>
</table>

*Cases per million vaccinations
Ring Vaccination Strategy

Contact to Contact

Contact to Case

Case
Ring Vaccination Strategy

- Primary strategy to stop transmission
- Depends upon prompt identification of contacts
- Judicious use of vaccine supply
- Minimizes risks of adverse events
Contact Vaccination

- Face-to-face contact (<= 6.5 feet) and household members at greatest risk

- May prevent or lessen severity of disease (4-day window)

- Followed by monitoring for fever
Contraindications for Vaccination of Contacts

NONE

In general, the risk of developing smallpox for face-to-face contacts outweighs the risk of developing vaccine complications for those contacts with contraindications to vaccination.
Vaccination of Contacts of Contacts

- Household members of a contact without contraindications

- Household members of a contact with contraindications, who are not vaccinated, must avoid the contact (18 days)
Contraindications for Vaccination of Contacts of Contacts

1. Immunodeficiency *
2. Allergies to polymyxin B, streptomycin, tetracycline, or neomycin
3. Eczema; including past history *
4. Pregnancy
5. Acute or chronic skin conditions (until resolved)

* Risk of accidental inoculation from household vaccineeís site
Ring Vaccination Example
Contacts & Contacts of Contacts

Jerry
Index Patient

George
Close contact
Fiancée Susan
Contact of contact

Elaine
Close Contact
Mr. Peterman
Contact of contact
Current Boyfriend
Contact of contact

Kramer
Household Contact
Neuman
Contact of contact
Ring Vaccination Example

Would you vaccinate:
- Patrons at the comedy club where Jerry performed the night before developing rash
- Residents in Jerry’s apartment building
- Jerry’s parents who stayed at his apartment a week ago
- Patrons at the diner where the gang hangs out
- The waitress at the diner
High-Risk Priority Groups for Vaccination

- Exposure to initial virus release
- Close contacts
- Public health, medical, and transportation personnel
- Laboratory personnel
- Laundry, housekeeping, and waste management staff
- Support of response: law, military, emergency workers
- Others at hospitals
Vaccine Administration Support

- Establish vaccination sites for contacts
- Establish vaccination sites for personnel
- Establish adverse events reporting and tracking system
Vaccination Clinics

Why?
- Minimizes vaccine wastage
- Security issues
- IND product
Vaccine Mobilization

- Released by Director of CDC

- Priority given to:
  - Areas with confirmed cases
  - Areas with probable cases
Vaccine Deployment

Amount determined by:
- Number of cases
- Number of contacts
- Number of areas affected
- Number of personnel to be vaccinated
- Vaccination strategy
Federal assessment of continued need, in consultation with state officials

Vaccine availability
Supplemental Strategies

Dilution of vaccine

- May stretch vaccine supply
- Evaluation of 1:10 dilution; only 70% vaccine take
- Studies of 1:5 dilution; results pending
Dilution of Vaccine

- May provide valuable alternative for personnel with time to verify vaccine take

- Decisions will be made at the Federal level (use, dilution, vaccination group)
Supplemental Strategies

Broader vaccination campaign possible, if:

- Number of cases or locations too large for effective contact tracing
- No decline in number of new cases after 2 generations
- No decline after 30% of vaccine has been used
Mass Vaccination

- Who? When? How?

- Not a first-line strategy

- If used, would supplement ring vaccination process of search and containment
Conclusions: Vaccination Strategies

- Ring vaccination most effective
- Groups for vaccination must be prioritized
- Strategy may change as the situation develops