Smallpox: A Brief Introduction

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The following material is borrowed and slightly modified from the National Immunization Program of the Centers for Disease Control and Prevention
Smallpox

- First described in Chinese text in 4th century AD
- Vaccine developed in late 18th century
- Last case in U.S. in 1949
- Last “natural” case on earth in 1977
- Lab accident in U.K. in 1978
Variola Virus

- Terminology: variola = smallpox
- Infects only humans in nature
- May remain viable in crusts for years at room temperature
- Rapidly inactivated by UV light, chemical disinfectants
Epidemiology

• Most transmission is from face-to-face contact with infected person (household & hospital contacts)
• Transmission most frequent during first week of rash
• RARE instances of less direct transmission (e.g. Germany 1970)
• Communicable from rash onset until all scabs separate from skin
Clinical Presentations

• Variola major
  – Severe illness
  – Case fatality rate of $\geq 30\%$

• Variola minor
  – Less severe
  – Case fatality of $\leq 1\%$
Variola Major -- Clinical

• **Ordinary** (>90% of cases in unvaccinated people)

• **Modified** (mild; occurs in previously vaccinated people)

• **Flat** (uncommon; usually fatal)

• **Hemorrhagic** (uncommon; usually fatal)
Onset of Smallpox

- Incubation 12 days (range 7-19 days)

- Prodrome ( = earliest symptoms)
  - abrupt onset of fever $\geq 101^\circ F$
  - malaise, headache, muscle pain, nausea, vomiting, backache
  - lasts 1-4 days
  - not infectious until lesions develop in mouth
Smallpox Rash

- “Enanthem” (= mucous membrane lesions) approx. 24 hours before “exanthem” (= skin rash)
- Tiny red spots on tongue and oral/pharyngeal mucosa
- Lesions enlarge and ulcerate quickly
Smallpox Rash

• Exanthem (= skin rash) appears 2-4 days after start of fever

• First appears as flat macules, usually first on the face

• Spreads to extremities and trunk

• Characteristic spread pattern helps to distinguish from other diseases like chickenpox
# Smallpox Rash Evolution

<table>
<thead>
<tr>
<th>Stage</th>
<th>Days after Rash Onset</th>
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<tbody>
<tr>
<td>Macules</td>
<td>0-1</td>
</tr>
<tr>
<td>Papules</td>
<td>2-3</td>
</tr>
<tr>
<td>Vesicles</td>
<td>3-5</td>
</tr>
<tr>
<td>Pustules</td>
<td>6-12</td>
</tr>
<tr>
<td>Crusts</td>
<td>13-20</td>
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<tr>
<td>All crusts</td>
<td>21-28</td>
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<tr>
<td>separated</td>
<td></td>
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</tbody>
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Typical pustules (day 8-9)
Scabs (day 10-14)

WHO:

“Gradually the pustules dry up and dark scabs form.

The scabs begin to appear between 10 and 14 days after the rash first develops.

The scabs contain live smallpox virus. Until all scabs have fallen off, the patient may infect others.”
Complications

• Bacterial infection of skin lesions
• Arthritis
• Respiratory
• Encephalitis
• Eye scarring (may cause blindness)
• Death:
  30% overall for ordinary smallpox
  40%-50% for children <1 year
  >90% for flat & hemorrhagic smallpox
Medical Management

• Clinicians should notify public health authorities immediately for suspected case
• Strict respiratory and contact isolation
• Supportive care
• Antiviral agents?
Smallpox Vaccine

Terminology: vaccinia = vaccine virus
variola = smallpox virus

1796   Edward Jenner develops vaccine from related disease, cowpox

1960s  Worldwide eradication campaign starts

1971   Routine vaccination stopped in U.S.

1983   Vaccine removed from civilian market
Smallpox Eradication

• Intensified Global Eradication program begun in 1967
• Initial strategy was mass vaccination
• Strategy evolved to “surveillance and containment”
• Last indigenous case in Somalia in October 1977