Measles

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Measles in history

- Persian-born physician Rhazes (circa 865-925 A.D.) is at the bedside of a young patient afflicted with measles.
- First to describe measles and smallpox with clinical accuracy, and first to observe and report pupillary reaction to light, Rhazes wrote the earliest known book on pediatric care.
Measles in history (2)
Aztec smallpox victims in the sixteenth century

- Hernan Cortez' conquest of Mexico was greatly assisted by the decimation of the Aztec population by a measles epidemic

Historia De Las Cosas de Nueva Espana, Volume 4, Book 12, Lam. cliii, plate 114. Peabody Museum of Archaeology and Ethnology, Harvard University
Measles virus

- Rubeola (*measles*) virus
- SS-RNA Paramyxoviridae
- Infects only humans & primates
- Transmitted by aerosolized particles
- High infectivity between 7-10 days post exposure through 4 days into the rash
- Incubation 7-14 days
Measles is Highly Infectious

Reproductive Ratios ($R_o$)

<table>
<thead>
<tr>
<th>Disease</th>
<th>$R_o$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles</td>
<td>12-18</td>
</tr>
<tr>
<td>Pertussis</td>
<td>12-17</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>6-7</td>
</tr>
<tr>
<td>Mumps</td>
<td>4-7</td>
</tr>
<tr>
<td>Polio</td>
<td>6-7</td>
</tr>
<tr>
<td>Rubella</td>
<td>5-7</td>
</tr>
<tr>
<td>Smallpox</td>
<td>5-7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Countries, type of displaced population/Reference</th>
<th>Type of disaster/Year</th>
<th>Total displaced populations</th>
<th>Documentation approach</th>
<th>AR (Case/Pop. at Risk)</th>
<th>CFR (Death/Cases)</th>
<th>Documentation on laboratory confirmation</th>
<th>Documentation on malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambodian refugees in Thailand [37]</td>
<td>Conflict 1979--1980</td>
<td>Average: 53666 (Pop. in camp)</td>
<td>Not described</td>
<td>(161/924) 17.4%</td>
<td>(10/161) 6.2%</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ethiopian refugees in Wad Kowli (Sudan) [20]</td>
<td>Conflict + Famine 1985</td>
<td>85000 (Pop. in camp)</td>
<td>Not described</td>
<td>(2639/85000) 3.1%</td>
<td>(855/2639) 32.4%</td>
<td>Not described</td>
<td>Yes</td>
</tr>
<tr>
<td>Mozambican refugees in Malawi [7]</td>
<td>Conflict 1988--1989</td>
<td>78568 (Pop. in camp)</td>
<td>Passive surveillance</td>
<td>(744/78568) 0.95%</td>
<td>(103/744) 13.8%</td>
<td>Not described</td>
<td>No</td>
</tr>
<tr>
<td>Vietnamese refugees in Hong Kong [8]</td>
<td>Conflict 1991--1992</td>
<td>7017 (Pop. in camp)</td>
<td>Passive surveillance</td>
<td>(262/1026) 25.5%</td>
<td>(2/262) 0.76%</td>
<td>Not described</td>
<td>Yes</td>
</tr>
<tr>
<td>Burundian refugees in Tanzania [11]</td>
<td>Conflict 2000--2001</td>
<td>170500 (pop. in camp)</td>
<td>Passive surveillance + Active case findings</td>
<td>(1062/170500) 0.62%</td>
<td>(0/1062) 0.0%</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Attack rates of measles by week of onset in tsunami-affected and unaffected areas, Cuddalore district, Tamilnadu, India, December 2004 – January 2005

Mohan A, BMC Infect Dis. 2006 Sep 19;6:143
Incidence of measles by age in tsunami affected and un-affected villages of Cuddalore district, Tamil Nadu, December 2004- January 2005

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Tsunami affected areas</th>
<th>Tsunami un-affected areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of cases (%)</td>
<td>Population</td>
</tr>
<tr>
<td>0–4</td>
<td>31 (43.7)</td>
<td>4360</td>
</tr>
<tr>
<td>5–9</td>
<td>32 (45.1)</td>
<td>4786</td>
</tr>
<tr>
<td>10–14</td>
<td>8 (11.3)</td>
<td>5138</td>
</tr>
</tbody>
</table>

Vaccine coverage estimated at 99.5-103%
Vaccine efficacy at 85%
Cumulated susceptible population= 97,400 children
Natural History of Measles

Saul Krugman
Measles: Clinical Presentation
Measles maculo-papular confluent rash – head to toes
Koplik spots in measles
2-3 days after coryza, conjunctivitis and fever
Last 12-72 hrs
Complication Rates by Age for Reported Cases of Measles - U.S. 1987-2000

Pneumonia in a Child With Measles
Mortality Rates by Age for Reported Cases of Measles - US 1987-2000

Severe Measles in Developing Countries

David Morley

Diseases Responsible for Admission and Death of Children 1959-61

During a 2-year period at Ilesha Hospital, Nigeria

Admissions: 4473
Deaths: 849

16% Measles
15% Diarrhoea
11% Malaria
7% Tuberculosis
4% Pneumonia

Measles Case-fatality Rate = 25%

Source: Morley D. Measles in Nigerian Children
J Hyg 1963; 61:115
Measles Case-Fatality Rates By Country 1980s

WHO global estimate (2000) ~ 3%

- Guinea Bissau: ~ 35%
- Senegal: ~ 20%
- Kenya: ~ 15%
- Guatemala: ~ 10%
- India: ~ 5%
- US: ~ 0%
Young Age of Measles
Measles Cases in Infants: Malawi

Increased Case Fatality Rates for Secondary Measles in Household Contacts 1-4 Years of Age

Increased Case Fatality Rates for Secondary Measles in Household Contacts 1-4 Years of Age

Crowding = early exposure + high Innoculum
Vitamin A Deficiency

Keratitis and Corneal Scarring Following Measles

Al Sommer/WHO
Vitamin A Treatment Impact on Measles Mortality

1987 Tanzania

- Control
- Vitamin A

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Vitamin A Supplementation Recommended for All Children with Measles
Factors Contributing to Increased Severity of Measles in Developing Countries

1. Young age of infection
2. Crowding
3. Vitamin A deficiency
4. HIV infection
5. Suboptimal therapy for complications
Edmonston B (Attenuated) Measles Vaccine

- 1954: Measles virus isolated by Enders and Peebles
- Source: David Edmonston: 8 y.o boy
- Now house painter in Rockville MD
Edmonston B Measles Vaccine

1954

24 passages human kidney tissue

28 passages primary human amnion tissue

6 passages chick embryos

Vaccine

Chick embryo cells

John Enders

Sam Katz
Measles cases in England and Wales, 1940-2007

- Vaccine licensed (1968)
- MMR introduced (1988)
Measles Vaccination
Cumulative Risk of Death by Vaccination Status, Matlab Intervention Area 1982-85

Percent of Infants Immune by Age Before and After Measles Vaccine: Haiti 1982

Proportion of Children Who Developed Measles Hemagglutinin-inhibiting Antibody after Vaccination

Age (months)

% After Vaccination

- Kenya
- Taiwan
- Pernambuco
- Santiago
- Para

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Francis Black 1980
Reported measles cases by month Cuba, 1971-1998

Reported cases (thousands)

M-M-R vaccine coverage (%)

Albert Sabin

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Month and Year

Source: Ministry of Health, Cuba
Reported Measles Cases and Routine Vaccination Coverage, Region of the Americas, 1980-2005

Ciro de Quadros

Follow-up campaigns

Catch-up campaigns

Confirmed Cases (in thousands)

Routine infant vaccination coverage (%)

Year

0 20 40 60 80 100

0 50 100 150 200 250 300

80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05

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Summary

• Measles is a very contagious and severe infectious disease
• Epidemics common in under vaccinated and displaced populations
• Preventive and outbreak vaccination is paramount
• Early treatment of complications reduces morbidity and mortality