Deadly Imbalance: Social vs Medical Value of Preventative Vaccines

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Brisbane, CA, USA
Public Health Goal

Decrease or eliminate disease
Public Health Goal

Decrease or eliminate disease

.....in the shortest time possible
Outline

1. Delayed disease control - examples
2. Why? Lack of social value
3. Roles of industry and public health
4. Costs of vaccine development
5. Costs of delayed vaccine use
6. Positive changes: “push” and “pull”
Infectious Disease Mortality Rates in the U.S.
Smallpox
Vaccinia (smallpox) Vaccine
Number of Countries with Smallpox
1967 - 1977

(Smallpox and Its Eradication, WHO, 1998, pg517-38)
The Tragic Delay

<table>
<thead>
<tr>
<th>Vaccine Commercially Available</th>
<th>Eradicated:</th>
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<tbody>
<tr>
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<td>Smallpox ~1900</td>
<td>1930-1953</td>
</tr>
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<td>Delay</td>
<td>30 to 53 years</td>
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</table>
Polio
President Franklin Roosevelt
(1882-1945)

Polio at age 39
Polio
Bihar, India
2005
Dr. Jonas Salk

Vaccine licensed in 1955
Progress in Polio Eradication, Estimated and Reported Polio Cases, 1985-2003

1988: WHA Resolution to Eradicate Polio

2000: Original Target Date for Interruption of Transmission
  Reported cases: 2,971
  Estimated cases: 3,500

1999: WHA Resolution to accelerate polio eradication activities

2005: Original target date for global certification

2003: Reported cases: 784

Source: V&B/WHO October 2004
Monthly incidence of polio in India
January 1998 – December 2005*

Number of cases

1998 1999 2000 2001 2002 2003 2004 2005

NID – National Immunization Day
SNID – Sub-National Immunization Day
Large scale mop-up

* data as on 3rd March, 2006
# The Tragic Delay

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<tr>
<td>Polio 1955</td>
<td>1991</td>
</tr>
<tr>
<td>Delay</td>
<td>36 years</td>
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</tbody>
</table>
Hepatitis B
<table>
<thead>
<tr>
<th>Feature</th>
<th>&lt;5 yrs, &lt;10%</th>
<th>≥5 yrs, 30%-50%</th>
<th>&lt;5 yrs, 30%-90%</th>
<th>≥5 yrs, 2%-10%</th>
<th>15%-25%</th>
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<tbody>
<tr>
<td>Incubation period:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Average</td>
<td>60-90 days</td>
<td>Range 45-180 days</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Clinical illness (jaundice):</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>≥5 yrs, 30%-50%</td>
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<tr>
<td>Chronic infection</td>
<td></td>
<td></td>
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<tr>
<td>Acute case-fatality rate:</td>
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<tr>
<td>Chronic infection</td>
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<tr>
<td>Premature mortality from chronic liver disease:</td>
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<td>15%-25%</td>
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</table>
Estimated Cases of Hepatitis B
1978 – 1995
USA

- Vaccine licensed
- HBsAg screening of pregnant women recommended
- Infant immunization recommended
- OSHA Rule enacted
- Adolescent immunization recommended

**Estimated Cases of Hepatitis B 1978 – 1995 USA**

* Provisional date

**Cases per 100,000 Population**

- Decline among homosexual men & HCWs
- Decline among injecting drug users

**Year**

- 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95
- 0 10 20 30 40 50 60 70 80
Countries using HepB vaccine in their national infant immunization system, as of December 2003


Date of slide 20 September 2004
Why?
Social Value Drives Vaccine Development and Application

Scientific Discovery → Vaccine Development → Vaccine Application

Social Value
Expertise to Develop Vaccines

- Public/university institutes
- Private pharmaceutical companies
Academic Research versus Pharmaceutical Development

“The public sector institutions involved in vaccine R&D are primarily focused on basic science knowledge diffusion, rather than single-mindedly solving applied development problems to ensure large scale, consistent production. The incentives in the public sector reinforce this knowledge focus and are generally inconsistent with efficient production of commodities.“

# Output Measurements of Each Player

<table>
<thead>
<tr>
<th>Player</th>
<th>Output Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Institutes</td>
<td>Knowledge/Manuscripts</td>
</tr>
<tr>
<td>Private Companies</td>
<td>Products and Profits</td>
</tr>
</tbody>
</table>
Social Value Drives Vaccine Development and Application

Scientific Discovery → Vaccine Development → Vaccine Application → Social Value
Low Value Given to Vaccines:

- By vaccine industry - who makes vaccines
- By public health (society) - who uses vaccines
Public Health’s Role in Discouraging Vaccine Development

- Recognize value, but unwilling to pay for vaccines
- Little or no urgency to deliver new vaccines
# The global vaccine market

<table>
<thead>
<tr>
<th><strong>Industrialized countries</strong></th>
<th><strong>Developing countries</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>85%</td>
</tr>
<tr>
<td>7%</td>
<td>93%</td>
</tr>
<tr>
<td>82%</td>
<td>18%</td>
</tr>
</tbody>
</table>

- **Population**: 15% in Industrialized countries vs. 85% in Developing countries
- **Disease Burden**: 7% in Industrialized countries vs. 93% in Developing countries
- **Vaccine market**: $6 Billion/year for Industrialized countries vs. $500 Million/year for Developing countries
- **Vaccine R&D**: 90% in Industrialized countries vs. 10% in Developing countries
## Pricing in Low vs. High Income Countries

<table>
<thead>
<tr>
<th>Primary Disease compared to vaccine</th>
<th>Measles</th>
<th>Diptheria, Pertussis, Tetanus</th>
<th>TB</th>
<th>Hepatitis B</th>
<th>Haemophilious B</th>
<th>Polio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Income Countries</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td><strong>14c</strong></td>
<td><strong>7c</strong></td>
<td><strong>7c</strong></td>
<td><strong>32-90c</strong></td>
<td><strong>$3.10</strong></td>
<td><strong>10c</strong></td>
</tr>
<tr>
<td><strong>Middle Income Countries</strong></td>
<td>MMR</td>
<td>wholecell in combo</td>
<td>BCG</td>
<td>in combo with DTPw</td>
<td>in combo with DTPw</td>
<td>OPV</td>
</tr>
<tr>
<td><strong>High Income Countries</strong></td>
<td><strong>$15.50</strong></td>
<td><strong>$10.65</strong></td>
<td><strong>$9.00</strong></td>
<td><strong>$21.38</strong></td>
<td><strong>$8.25</strong></td>
<td></td>
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Cape Town, RSA  April 11, 2002
“Low or uncertain demand for new vaccines in developing countries, together with the low prices negotiated over the years for the traditional six vaccines (DPT, polio, measles and BCG) for use in developing countries, have deterred vaccine manufacturers from developing vaccines for use almost exclusively in what are perceived to be “low profit” countries.”

(WHO, State of the World’s Vaccines and Immunization, 2002)
Vaccine development is expensive.
Vaccine Development Costs
Licensed Product: Flumist Example

Investment
1996 – 2002 Research & Dev $145mm
2003 – 2004 Manufacture and License $200mm

Source: H. Greenberg (2004)
Investment Required to Develop One Vaccine

Money: $200 to $500mm

Time: 12 to 15 years
Why Vaccines Fail to Compete
Vaccine/Therapeutic Market Comparison

Lipitor = atorvastatin calcium
Prilosec = omepraxole

Source: Piers Whitehead: Vaccine market data 2000, pharma sales 2001
Costly Result

Lack of social value

↓

Costly

↑

Lack of political (government) leadership
Costs of Vaccine Delay

- Continued disease occurrence
Costs of Vaccine Delay

• Continued disease occurrence
• Increased infected pool – more difficult to control
Costs of Vaccine Delay

- Continued disease occurrence
- Increased infected pool – more difficult to control
- Small market further reduces incentives for industry to make vaccines → more delay
Adjusting market forces.
Altering the Market

Failure

- Push
- Pull
Push: Public Private Partnerships in the Past

Pasteur Institute
diphtheria, TB, pertussis, tetanus

Rockefeller Foundation
yellow fever

March of Dimes Foundation
polio
Push: Recent Public-Private Partnerships for Vaccines

Aeras Global Tuberculosis Vaccine Foundation (Aeras)
European Malaria Vaccine Initiative (EMVI)
Global Solutions for Infectious Diseases (GSID)
Human Hookworm Vaccine Initiative (HHVI)
International AIDS Vaccine Initiative (IAVI)
Malaria Vaccine Initiative (MVI)
Pediatric Dengue Vaccine Initiative (PDVI)
Pneumococcal Vaccine ADIP
Rotavirus Vaccine ADIP
South African AIDS Vaccine Initiative (SAVI)
Pull: Vaccine Purchase Funds

- State and National Governments
- International Organizations
Summary: Adverse Factors

Vaccine development, like other pharmaceutical development, is costly ranging from $200 to $500 million per vaccine;

Vaccine development is slow taking 12 to 15 years;

The skills necessary to develop vaccines rest primarily within the private sector;

For the same cost and effort, pharmaceutical companies can develop therapeutic drugs that are far more profitable;

Public health leaders are cheap and unwilling to pay reasonable prices for valuable vaccines;

The lack of social value given to vaccines makes them unattractive products for the pharmaceutical industry to develop;

Vaccines, once developed, are often applied very slowly;
Summary: Positive Changes

Public-private vaccine development partnerships, having pharmaceutical development expertise, are being established;

Funding is being provided, most notably by the Bill and Melinda Gates Foundation;

Foundation support is driving public health authorities to deliver existing vaccines;