VACCINES

TRIUMPHS AND TRIBULATIONS

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Vanderbilt University School of Medicine

“Never in the history of human progress has a better and cheaper method of preventing illness been developed than immunization at its best”

Dr. Geoffrey Edsall
Immunization Successes

Selected as one of 10 great public health achievements of the 20th century

- Smallpox eradication (globally)
- Polio elimination (most of the world)
- Measles elimination (western hemisphere)
- Rubella elimination (western hemisphere)

CDC, MMWR 1999;48:241-243

Estimated Return on Investment of Childhood Vaccines

For each birth cohort vaccinated against 13 diseases in accordance with the schedule of DtaP, Hib, IPV, MMR, hep B, Varicella, Hepatitis A, Pneumo-7, and Rotavirus vaccines:

- 42,000 lives are saved
- 20M cases of disease are prevented
- 13.6 billion dollars in direct costs are saved
- 68.9 billion dollars in direct plus indirect (societal) costs are saved
- For each dollar invested in these vaccinations, $10.20 is saved

See presentation by Fangjun Zhou – Tuesday Mar 29, Workshop D2 11:30am
Preliminary results of updated analysis from Zhou et al, Arch of Ped and Adolesc Med 2005
**Comparison of 20th Century Annual Morbidity and Current Morbidity: Vaccine-Preventable Diseases**

<table>
<thead>
<tr>
<th>Disease</th>
<th>20th Century Annual Morbidity</th>
<th>2010 Reported Cases</th>
<th>Percent Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallpox</td>
<td>29,005</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>21,053</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Measles</td>
<td>530,217</td>
<td>61</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>Mumps</td>
<td>162,344</td>
<td>2,528</td>
<td>98%</td>
</tr>
<tr>
<td>Pertussis</td>
<td>200,752</td>
<td>21,291</td>
<td>89%</td>
</tr>
<tr>
<td>Polio (paralytic)</td>
<td>16,316</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Rubella</td>
<td>47,745</td>
<td>6</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>Congenital Rubella Syndrome</td>
<td>152</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Tetanus</td>
<td>580</td>
<td>8</td>
<td>99%</td>
</tr>
<tr>
<td><em>Haemophilus influenza</em></td>
<td>20,000</td>
<td>270</td>
<td>99%</td>
</tr>
</tbody>
</table>

Source: CDC

**VACCINES HAVE TWO FUNCTIONS**

- **Protection of the individual vaccinated**
  - clinical function

- **Protection of the community against communicable diseases**
  - public health function

  Interrupt transmission, protection of the frail
  Permits the elimination of diseases
Estimated Vaccination Coverage Among Children Enrolled in Kindergarten – United States, 2011-12 School Year

- ≥3 Polio 95.9%
- ≥4 DTP 95.2%
- ≥1 Measles 94.8%
- ≥1 Mumps 94.8%
- ≥1 Rubella 94.8%
- ≥3 Hep B 96.6%
- ≥1 Var 93.2%

CDC, MMWR 2006; 41:1124-26

Unsung Triumph of the U.S. Infant, Childhood and Adolescent Immunization Program

Elimination of Disparities Income, race, geography urban-rural
TRIBULATIONS

Antivaccine Movement
Vaccine Hesitancy
Gaps in infant, childhood adolescent immunization
Increasing vaccines/Increasing Inoculations
More complex logistics
Increasing costs
Adult immunization

VACCINE HESITANCY

Today’s parents (and, often, grandparents) have no experience or knowledge of the diseases vaccines prevent

They have misguided ideas of vaccine-related adverse events (autism, “overload” of the infant’s immune system, etc)
Pre-school and School Immunization Laws are critical to comprehensive immunization

- All 50 states have such laws
- Without them, immunization rates of 60-70% were the best achieved
  Disease cannot be eliminated, disparities continue

What are Vaccine-hesitant Parents Doing?

- 18% of parents of young children delay or refuse some vaccines
- Parents increasingly seek non-medical exemptions (religious or personal belief) to school immunization requirements
- If non-medical exemptions are difficult to obtain, requests for medical exemptions increase
Record Measles Cases in US, 2011
Importations, especially from Europe

Vaccine Hesitancy

- No easy, quick answer
- It is not going away
- Communication, education, reassurance
- Vaccine advocacy
- Maintain the integrity of the law
Number of Vaccines in the Routine Childhood and Adolescent Immunization Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Measles</th>
<th>Rubella</th>
<th>Mumps</th>
<th>Diphtheria</th>
<th>Tetanus</th>
<th>Pertussis</th>
<th>Polio</th>
<th>Hib (infant)</th>
<th>HepB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>1994</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>16</td>
<td></td>
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Cost to Vaccinate One Child with Vaccines Universally Recommended from Birth Through 18 Years of Age: 1990, 2000, and 2011

- 1990: $70
- 2000: $370
- 2011 Male: $1,332
- 2011 Female: $1,620

2011 represents minimum cost to vaccinate a child (birth through 18) irrespective of any presumptive influenza vaccine, which is included for children 6-47 months of age.
HPV excluded for boys because it is not routinely recommended by the ACIP.
Federal contract prices as of February 1, 1990, September 27, 2000, and April 1, 2011.
TWO ANTI-CANCER VACCINES!

<table>
<thead>
<tr>
<th>HEPATITIS B</th>
<th>PRIMARY LIVER CANCER</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUMAN</td>
<td>CERVICAL CANCER</td>
</tr>
<tr>
<td>PAPILLOMAVIRUS (HPV)</td>
<td>ANAL, VAGINAL</td>
</tr>
<tr>
<td></td>
<td>HEAD AND NECK</td>
</tr>
</tbody>
</table>

Adult Vaccination

- Lags behind childhood vaccination
- No National Adult Immunization Program
- Affordable Care Act
- Increasing role of pharmacists
- New Vaccines for adults:
  - Shingles, Tdap, HPV
- New attention to adult immunization
ONE HEALTH, ONE MEDICINE

Joining of Human and Animal Health

**Rinderpest** declared eradicated from the world by U.N., June, 2011
Due to vaccinations of cattle in countries around the world

GLOBAL IMMUNIZATION

Great progress over past 10 years
14.6 million more children received DTP in 2009 then in 2000

Yet, 23 million children <1yr still missed

Decade of Vaccines
Bill and Melinda Gates Foundation $10 Billion
WHO UNICEF NIAID
GLOBAL IMMUNIZATION
DECADE OF VACCINES

Infectious diseases ~50% of all deaths

Infectious deaths:

Diarrhea        rotavirus vaccine
Respiratory     pneumococcal conjugate vaccine
                influenza vaccine
Measles         measles vaccine

TB             Research
Malaria        Research
AIDS           Research

GLOBAL IMMUNIZATION

POLIO NEAR ERADICATION

1988    WHO  POLIO ERADICATION INITIATIVE
        ~350,000 cases
1979    Last indigenously acquired case in Western
        Hemisphere
2011    650 cases
        Nigeria, Chad, Afghanistan, Pakistan
Jan2011  last case in India
### VACCINE RESEARCH

<table>
<thead>
<tr>
<th>Pertussis</th>
<th>AIDS</th>
</tr>
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<tbody>
<tr>
<td>Influenza</td>
<td>TB</td>
</tr>
<tr>
<td>Meningococcal- Group B</td>
<td>Malaria</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Leprosy</td>
</tr>
<tr>
<td>Group B Streptococcal</td>
<td>Cholera</td>
</tr>
<tr>
<td>C. difficile</td>
<td></td>
</tr>
<tr>
<td>West Nile</td>
<td>Anthrax</td>
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<tr>
<td>Campylobacter</td>
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<tr>
<td>E. coli</td>
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</tr>
</tbody>
</table>

### VACCINE RESEARCH

- **Edible vaccines**
- **Needle – free vaccines**
  - Nasal spray
  - Inhaler
  - Skin patches
  - Micro – needles

- **New Targets**
  - Alzheimer's
  - Smoking
  - Cocaine
  - Cancers
PUBLIC HEALTH AND VACCINES

Treasure vaccines

Advocate for vaccines

Protect vaccines

Give vaccines

Get vaccines
Disease is bad…

Vaccines are good!

W.S.

When meditating over a disease, I never think of finding a remedy for it, but, instead, a means of preventing it.

Louis Pasteur