SUFFER THE LITTLE CHILDREN: THE RE-EMERGENCE OF VACCINE-PREVENTABLE DISEASE

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Newborn Medicine Program, UPMC
Baby’s Death

• Centennial International Exhibition, 1876

• Swedish Exhibit: Scenes in the home life of the Swedes

• Infant mortality
  • 100/1000 LB (1900)
  • 6.1/1000 LB (2010)
Development of Immunity
Vaccinations

• Vaccination is a method of giving antigen to stimulate the immune response to produce specific protection against a given disease without the morbidity and mortality risk of that disease.

• Vaccine effectiveness can be measured by preventing disease in the individual and by preventing disease spread in the community
  • Example: Measles-containing vaccine effectiveness
  • 93% after 1 dose
  • 97% after 2 doses
Cases of Vaccine-Preventable Diseases
With and Without Immunization, United States

Number of Cases in the U.S.

Estimated Number of Cases (Without Immunization)
1998 Actual Cases (With Immunization)

Smallpox
Diphtheria
Pertussis
Tetanus
Polio (paralytic)
Measles
Hib

Adapted from MMWR, April 2, 1999, Vol. 48, No. 12.
Paralytic Poliomyelitis

- No cases in USA since 2000
- Wild-type virus remains epidemic in 3 countries
  - Pakistan
  - Afghanistan
  - Nigeria

Polio survivors, Nigeria

OPV, Sudan (WHO photo)
Anti-Vaccination: Then and Now

• Caption: “The outrageous manner in which our school children are to have deadly microbes [??] their systems. Let Mayor Stuart forbid it at once.”
  -Sunday Item, 1894, Philadelphia

• 70% US children age 19-35 months were immunized as per ACIP/AAP/AAFP/ACOG (2013)
• 0-7% non-medical exemptions
• Libertarian (autonomy), Religious
Community “Herd” Immunity

- When most members of the community are protected against a disease, spread of contagious disease is contained
- Little opportunity for outbreak
- Lessens exposure risk for those not eligible for vaccine
  - Infants
  - Pregnant women
  - Immunocompromised
- Vaccination protects more than the vaccinated person
- More spreading in communities with pockets of unvaccinated people
Herd Immunity

- **Not immunized but still healthy**
- **Immunized and healthy**
- **Not immunized, sick, and contagious**

No one is immunized. Contagious disease spreads through the population.

Some of the population gets immunized. Contagious disease spreads through some of the population.

Most of the population gets immunized. Spread of contagious disease is contained.
Pertussis (Whooping Cough) USA, 1981-2011


* Per 100,000 population.

Pertussis continues to have cyclic peaks every 3 to 5 years. Incidence in 2011 declined 32% following the peak in 2010.
Pertussis

• 16 million cases/year worldwide
• 195,000 deaths/year
• Adolescents and adults have mild disease, often unrecognized
• 50% of infant cases require hospitalization, esp. <6 months
• California
  • 10 deaths in 2010
  • 28,000 cases in 2014
• Tdap vaccine in pregnancy (27-36 weeks gestation)
  • Passive infant immunity
  • Cocooning
vaccinate your baby

a program of ECBT
every child by two

Not Vaccinated? No Kisses!
Get the adult whooping cough vaccine.
www.VaccinateYourFamily.org

Vaccine-preventable diseases are just a plane ride away.

www.VaccinateYourBaby.org
Measles

• Highly contagious
  • Coughing, sneezing
  • Direct contact with secretions
  • 4 days before – 4 days after rash

• Incubation period
  • 7-21 days after exposure

• Clinical presentation
  • High fever (105°F) x 4-7 days
  • Malaise
  • Cough, coryza, conjunctivitis
  • Enanthema (Koplik spots)
  • Exanthem (morbilliform rash)
MEASLES: A dangerous illness

Olivia, my eldest daughter, caught measles when she was seven years old. As the illness took its usual course I can remember reading to her often in bed and not feeling particularly alarmed about it. Then one morning, when she was well on the road to recovery, I was sitting on her bed showing her how to fashion little animals out of coloured pipe-cleaners, and when it came to her turn to make one herself, I noticed that her fingers and her mind were not working together and she couldn’t do anything.

“Are you feeling all right?” I asked her.
“I feel all sleepy,” she said.

In an hour, she was unconscious. In twelve hours she was dead.

-Roald Dahl, 1986
Measles (Rubeola) USA, 1976-2011

Measles vaccine was licensed in 1963. Evidence suggests that measles is no longer endemic in the United States.
Measles declared to be eliminated from US in 2000

- Measles elimination is defined as the absence of endemic measles virus transmission in a defined geographical area (e.g. region or country) for ≥12 months in the presence of a well-performing surveillance system
- Fewest cases = 37 (2004)
- Most cases = 644 (2014)
  - 23 Outbreaks
  - Ohio Amish, 383 cases
- 2015 (as of 3/27)
  - 4 Outbreaks
  - CA amusement park, 146 cases
    - Likely from traveler overseas
    - Unvaccinated

*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases*

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Saving our Children: A Global Issue

- **Nutrition**
  - Breastfeeding
  - Protein – calorie
  - Micronutrients
    - Vitamin A, Vitamin D, Zinc, Selenium
- **Sanitation**
- **Immunizations**
  - Avoid preventable deaths (>2 million/yr)
  - Avoid preventable lifelong disability
  - Cost effective: direct and societal
- **Access to medical care**
Global Health Leaders Launch the Decade of Vaccines Collaboration (2010)

- Bill and Melinda Gates Foundation
- World Health Organization (WHO)
- UNICEF
- National Institute of Allergy and Infectious Diseases (NIAID)

- Coordination of international vaccine community
- Global Vaccine Action Plan
  - Discovery
  - Development
  - Delivery
  - To save >20M lives, prevent ~1Billion illnesses by 2020-saving nearly $12 billion in treatment costs, achieve >$800 billion in economic gains as vaccinated children live longer, healthier, more productive lives

- First Global Vaccine Summit, April 2013 in Abu Dhabi
National Infant Immunization Week
April 18–25, 2015

• Annual observance to promote the benefits of childhood immunizations and their role in improving the health of children aged ≤2 years

  • http://www.cdc.gov/vaccines/events/niiw/index.html

• CDC’s new *Born with Protection* campaign, to promote whooping cough vaccination during the third trimester of each pregnancy to help protect babies during their first few months of life when they are most vulnerable

  • http://www.cdc.gov/pertussis/pregnant/index.html

*MMWR Weekly* April 10, 2015 / 64(13);357-362
Diphtheria
4680 reported cases in 2013 (globally)

Balto

Togo
Figure 1. Recommended immunization schedule for persons aged 0 through 18 years – United States, 2015.

(FOR THOSE WHO FALL BEHIND OR START LATE, SEE THE CATCH-UP SCHEDULE [FIGURE 2]).

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are shaded.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth</th>
<th>1 mo</th>
<th>2 mos</th>
<th>4 mos</th>
<th>6 mos</th>
<th>9 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>19-23 mos</th>
<th>2-3 yrs</th>
<th>4-6 yrs</th>
<th>7-10 yrs</th>
<th>11-12 yrs</th>
<th>13-15 yrs</th>
<th>16-18 yrs</th>
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<tbody>
<tr>
<td>Hepatitis B (HepB)</td>
<td>1st dose</td>
<td>2nd dose</td>
<td>3rd dose</td>
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<tr>
<td>Rotavirus (RV) R1/R2 (2-dose series); RV3 (3-dose series)</td>
<td>1st dose</td>
<td>2nd dose</td>
<td>See footnote 3</td>
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<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis (DtaP, ≤ 7 yrs)</td>
<td>1st dose</td>
<td>2nd dose</td>
<td>3rd dose</td>
<td>4th dose</td>
<td>5th dose</td>
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<tr>
<td>Tetanus, diphtheria, &amp; acellular pertussis (Tdap, ≥ 7 yrs)</td>
<td>1st dose</td>
<td>2nd dose</td>
<td>See footnote 5</td>
<td>3rd or 4th dose</td>
<td>See footnote 3</td>
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<tr>
<td>Hemophilius influenza type b (Hib)</td>
<td>1st dose</td>
<td>2nd dose</td>
<td>See footnote 6</td>
<td>3rd dose</td>
<td>4th dose</td>
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<td>Pneumococcal conjugate (PCV13)</td>
<td>1st dose</td>
<td>2nd dose</td>
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<td>Pneumococcal polysaccharide (PPSV23)</td>
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<tr>
<td>Inactivated poliovirus (IPV) ≥18 yrs</td>
<td>1st dose</td>
<td>2nd dose</td>
<td>3rd dose</td>
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<td>Inactivated poliovirus (IPV) &lt;18 yrs</td>
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<td>Measles, mumps, rubella (MMR)</td>
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<td>Varicella (VAR)</td>
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<td>Hepatitis A (HepA)</td>
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<tr>
<td>Human papillomavirus (HPV2; females only; HPV1: males and females)</td>
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<td>Meningococcal (MenB-MenCY)</td>
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<tr>
<td>Meningococcal (MenA/CYW/CRM) ≥ 2 mos</td>
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</table>

**Range of recommended ages for all children**

**Range of recommended ages for catch-up immunization**

**Range of recommended ages for certain high-risk groups**

**Range of recommended ages during which catch-up is encouraged and for certain high-risk groups**

**Not routinely recommended**

This schedule includes recommendations in effect as of January 1, 2015. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at http://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (http://www.vaers.hhs.gov) or by telephone (800-822-7967). Suspected cases of vaccine-preventable diseases should be reported to the state or local health department. Additional information, including precautions and contraindications for vaccination, is available from CDC online (http://www.cdc.gov/vaccines/recs/vac-admin/contraindications.htm) or by telephone (800-CDC-INF0 (800-232-4636).

This schedule is approved by the Advisory Committee on Immunization Practices (http://www.cdc.gov/vaccines/acip), the American Academy of Pediatrics (http://www.aap.org), the American Academy of Family Physicians (http://www.aafp.org), and the American College of Obstetricians and Gynecologists (http://www.acog.org).

**NOTE:** The above recommendations must be read along with the footnotes of this schedule.
### “Classical” Childhood Exanthems*

<table>
<thead>
<tr>
<th>First disease</th>
<th>Disease Name(s)</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubeola, Measles, 14-day measles</td>
<td>Measles virus</td>
<td></td>
</tr>
<tr>
<td>Second disease</td>
<td>Scarlet Fever, Scarlatina</td>
<td><em>Streptococcus pyogenes</em></td>
</tr>
<tr>
<td>Third disease</td>
<td>Rubella, German measles, 3-day measles</td>
<td>Rubella virus</td>
</tr>
<tr>
<td>Fourth disease</td>
<td>Filatow-Dukes’ Disease, Staph Scalded Skin?</td>
<td>XXX, <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>Fifth disease</td>
<td>Erythema infectiosum</td>
<td>Parvovirus B19</td>
</tr>
<tr>
<td>Sixth disease</td>
<td>Exanthem subitum, Roseola infantum, 3-day fever</td>
<td>Human Herpes Virus 6B or Human Herpes Virus 7</td>
</tr>
</tbody>
</table>

*Other causes of widespread rash and fever: CMV, Epstein-Barr virus, Enterovirus, Adenovirus, Group C Strep, Varicella zoster*
In 1845, when I was ten years old, there was an epidemic of measles in the town and it made a most alarming slaughter among the little people. There was a funeral almost daily, and the mothers of the town were nearly demented with fright.

I grew very tired of the suspense I suffered on account of being continually under the threat of death....I made up my mind to end this suspense and be done with it. Will Bowen was dangerously ill with the measles and I thought I would go down there and catch them....

It was a good case of measles that resulted. It brought me within a shade of death’s door....The word had been passed and the family notified to assemble around the bed and see me off.

- Autobiography of Mark Twain
Paralytic Poliomyelitis, 1973 - 2000

Patients in iron lungs, 1952, Los Angeles, California

An inactivated poliomyelitis vaccine (IPV) was first licensed in 1955. An oral vaccine was licensed in 1961. No cases of vaccine-associated paralytic poliomyelitis have been reported since the IPV schedule was implemented in 2000.
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH

POLIOMYELITIS VACCINE REPORT

NAME OF PERSON RECEIVING VACCINE
Elaine Hanna (Mrs.)

ADDRESS OF PERSON RECEIVING VACCINE
Blakeslee

SEX F
AGE 32
COLOR W

COUNTY Monroe

SITE OF INOCULATION left arm

DATE VACCINE GIVEN 2/14/67

MAIL WEEKLY TO:
Pennsylvania Dept. of Health; Harrisburg, Pa.
Gates

• our goal:
• to prevent more than 11 million deaths, 3.9 million disabilities, and 264 million illnesses by 2020 through high, equitable, and sustainable vaccine coverage and support for polio eradication.
Comparison of Maximum and Recent Reported Annual Vaccine-Preventable Disease, USA

<table>
<thead>
<tr>
<th>Disease</th>
<th>Pre-vaccine</th>
<th>2000</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria</td>
<td>31,054</td>
<td>1</td>
<td>-99</td>
</tr>
<tr>
<td>Measles</td>
<td>391,852</td>
<td>86</td>
<td>-99</td>
</tr>
<tr>
<td>Mumps</td>
<td>21,342</td>
<td>338</td>
<td>-99</td>
</tr>
<tr>
<td>Pertussis</td>
<td>117,998</td>
<td>7,867</td>
<td>-93</td>
</tr>
<tr>
<td>Polio (wild)</td>
<td>4,953</td>
<td>0</td>
<td>-100</td>
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<tr>
<td>Rubella</td>
<td>9,941</td>
<td>176</td>
<td>-98</td>
</tr>
<tr>
<td>Congenital Rubella syndrome</td>
<td>19,177</td>
<td>9</td>
<td>-99</td>
</tr>
<tr>
<td>Tetanus</td>
<td>1,314</td>
<td>35</td>
<td>-97</td>
</tr>
<tr>
<td>Invasive Hib disease</td>
<td>24,856</td>
<td>112</td>
<td>-99</td>
</tr>
<tr>
<td>Total</td>
<td>566,706</td>
<td>8,624</td>
<td>-98</td>
</tr>
</tbody>
</table>

Adverse events reported after vaccines against these diseases: 5,296
American Academy of Pediatrics Stance on Immunizations

The American Academy of Pediatrics (AAP) believes that immunizations are the safest and most cost-effective way of preventing disease, disability, and death, and that the benefits of immunizations far outweigh the risks incurred by childhood diseases, as well as any risks of the vaccine themselves.

The AAP urges parents to immunize their children against dangerous childhood diseases.
Levels of protectiveness

• Absolutely protective (100%): yellow fever vaccine
• Almost absolutely protective (99%): Variola, measles, mumps, rubella vaccines, and diphtheria and tetanus toxoids.
• Highly protective (80-95%): polio, BCG, Hepatitis B, and pertussis vaccines.
• Moderately protective (40-60%) TAB, cholera vaccine, and influenza killed vaccine.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Immunity Threshold</th>
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<tbody>
<tr>
<td>Mumps</td>
<td>75-86</td>
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<tr>
<td>Polio</td>
<td>80-86</td>
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<tr>
<td>Smallpox</td>
<td>80-85</td>
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<tr>
<td>Diphtheria</td>
<td>85</td>
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<tr>
<td>Rubella</td>
<td>83-85</td>
</tr>
<tr>
<td>Pertussis</td>
<td>92-94</td>
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<tr>
<td>Measles</td>
<td>83-94</td>
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