

Global Problems, Global Solutions

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

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# 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)





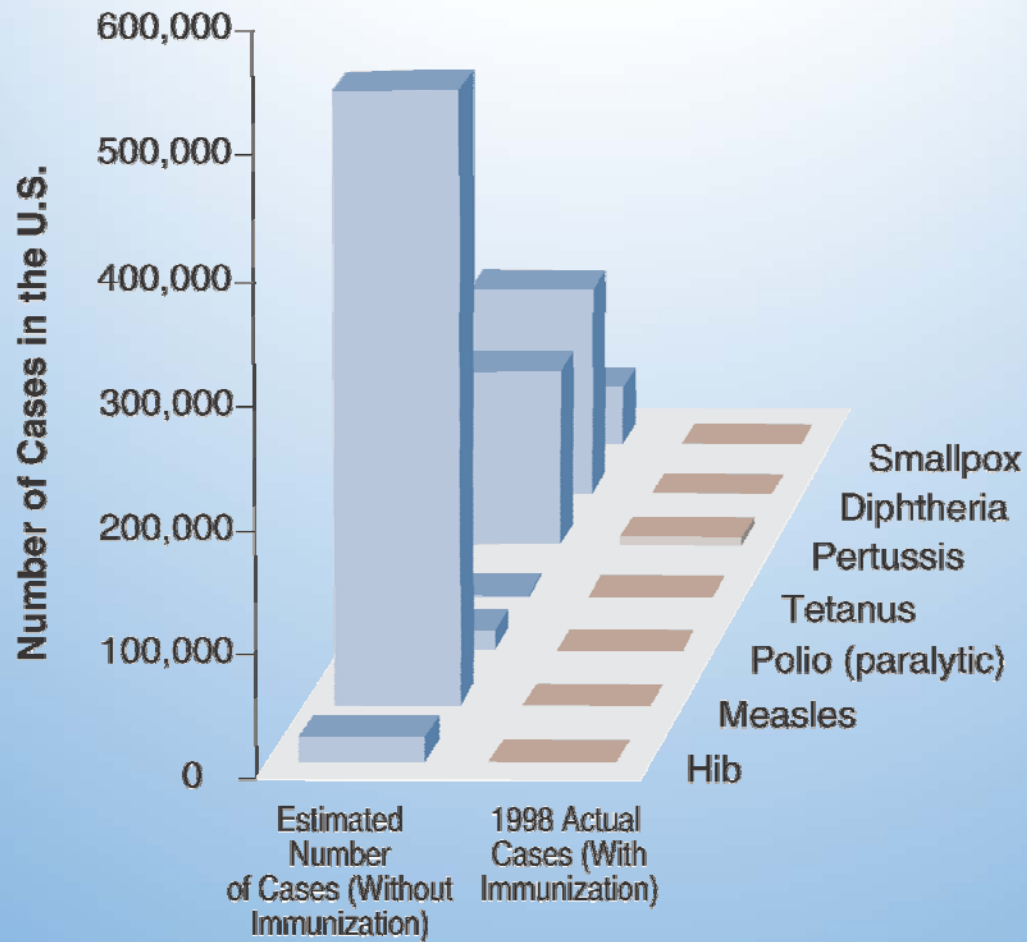
# Development of Immunity



# 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



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



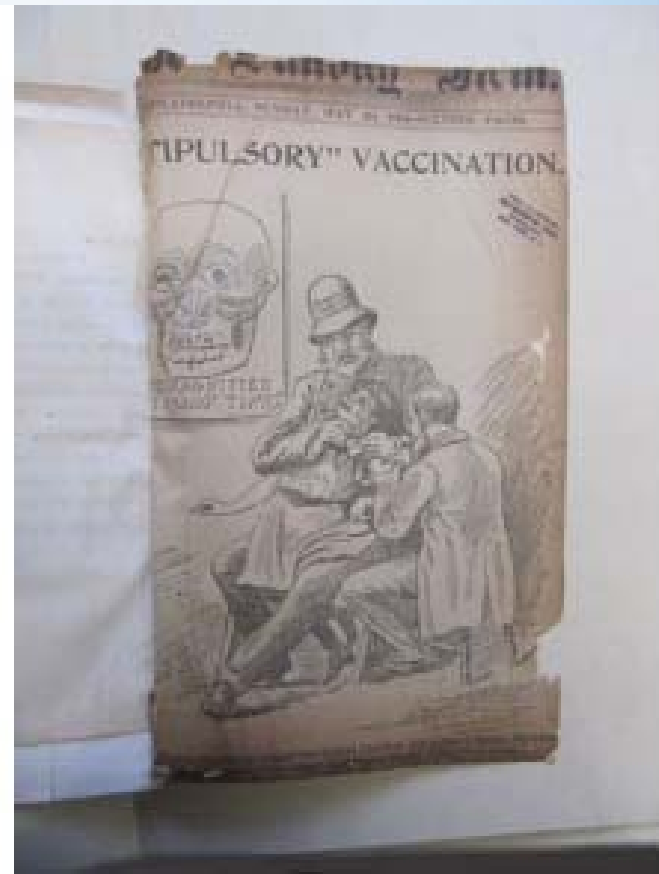
OPV, Sudan (WHO photo)

# 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

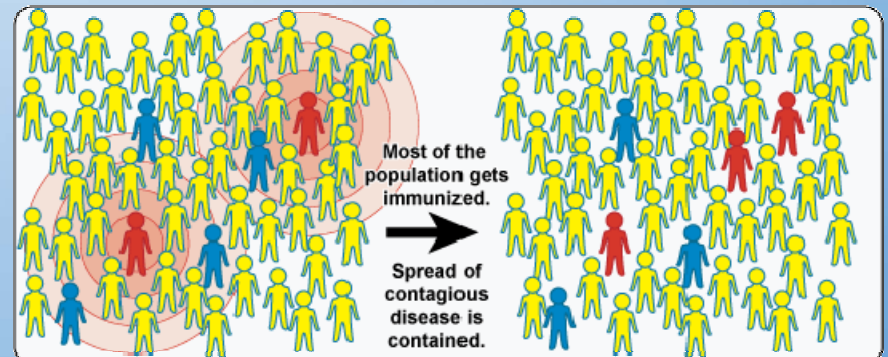
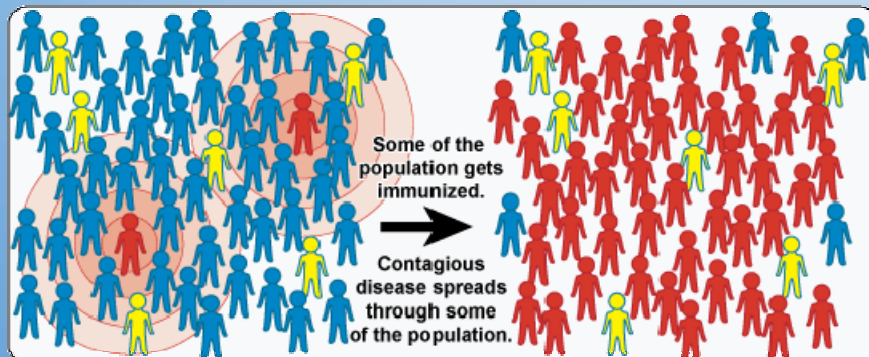
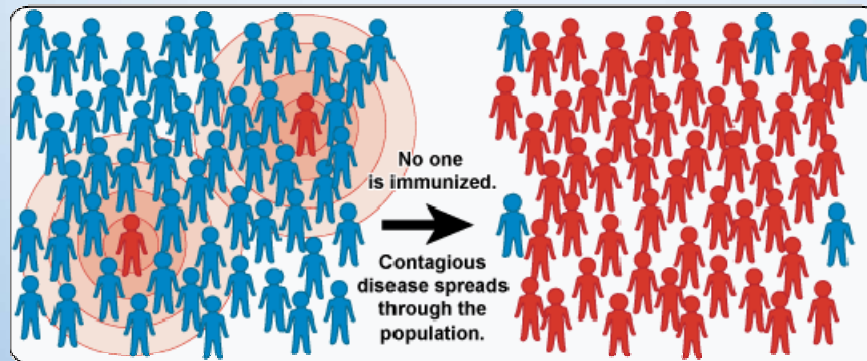
- When most members of the community are protected against a disease, spread of contagious disease is contained
- Little opportunity for outbreak
- Lessens exposure risk for those not eligible for vaccine
  - Infants
  - Pregnant women
  - Immunocompromised
- Vaccination protects more than the vaccinated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

# Herd Immunity

 = not immunized but still healthy

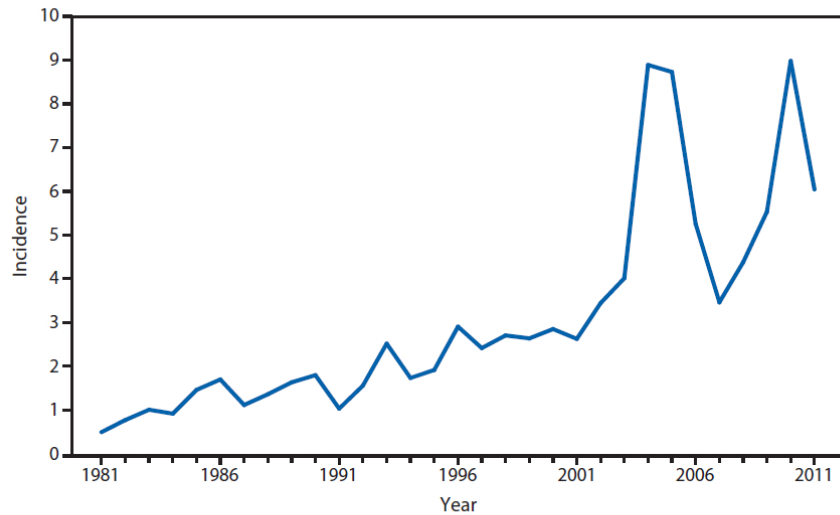
 = immunized and healthy

 = not immunized, sick, and contagious



# Pertussis (Whooping Cough) USA, 1981-2011

PERTUSSIS. Incidence,\* by year — United States, 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



## Not Vaccinated? No Kisses!

Get the adult whooping cough vaccine.  
[www.VaccinateYourFamily.org](http://www.VaccinateYourFamily.org)

vaccinate your baby  
a program of ECBT  
every child by two

**Vaccine-preventable diseases  
are just a plane ride away.**



[www.VaccinateYourBaby.org](http://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<sup>0</sup> 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.

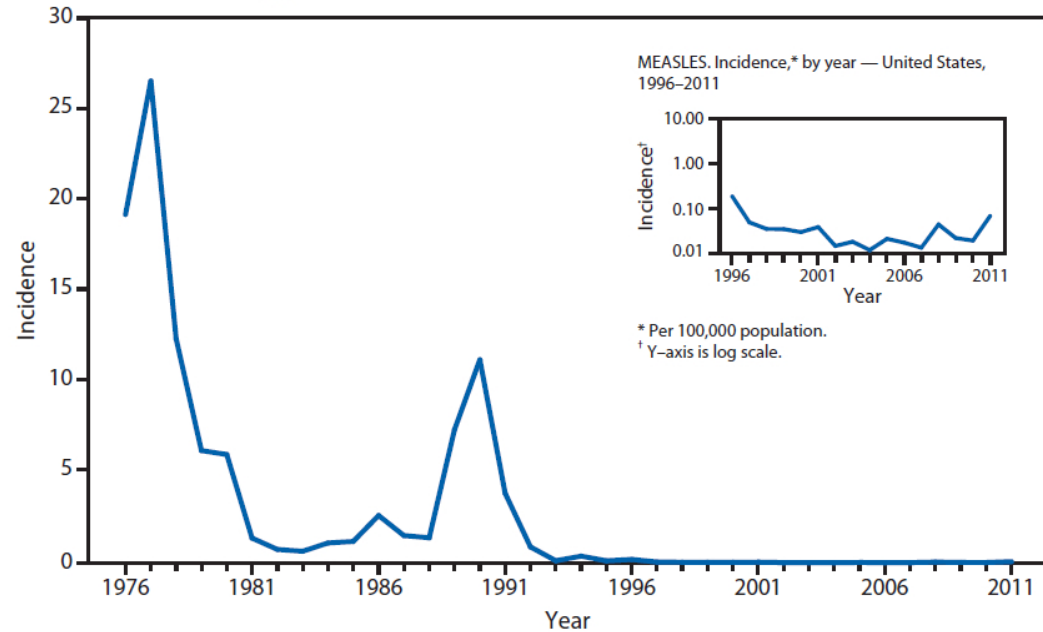
In an hour, she was unconscious. In twelve hours she was dead.

*-Roald Dahl, 1986*

# Measles (Rubeola) USA, 1976-2011



MEASLES. Incidence,\* by year — United States, 1976–2011



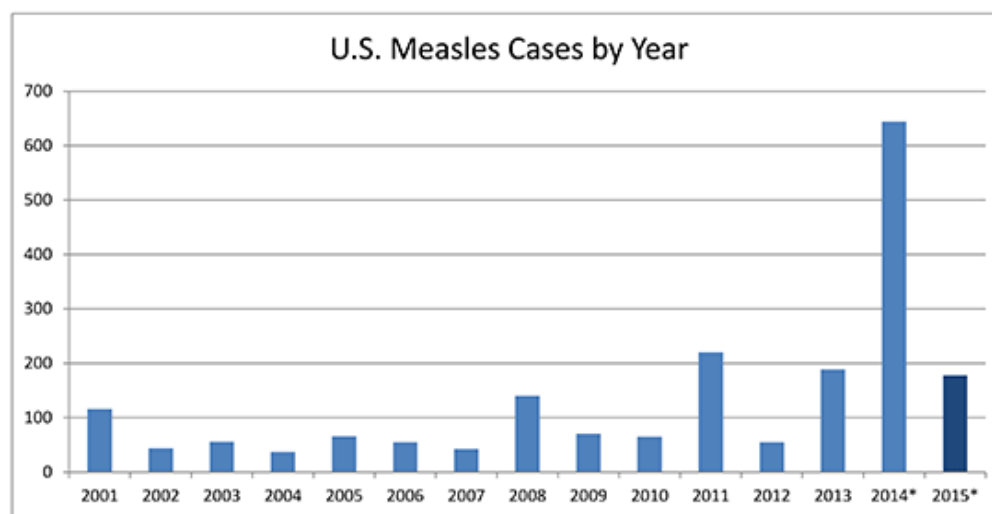
\* Per 100,000 population.

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  $\geq 12$  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

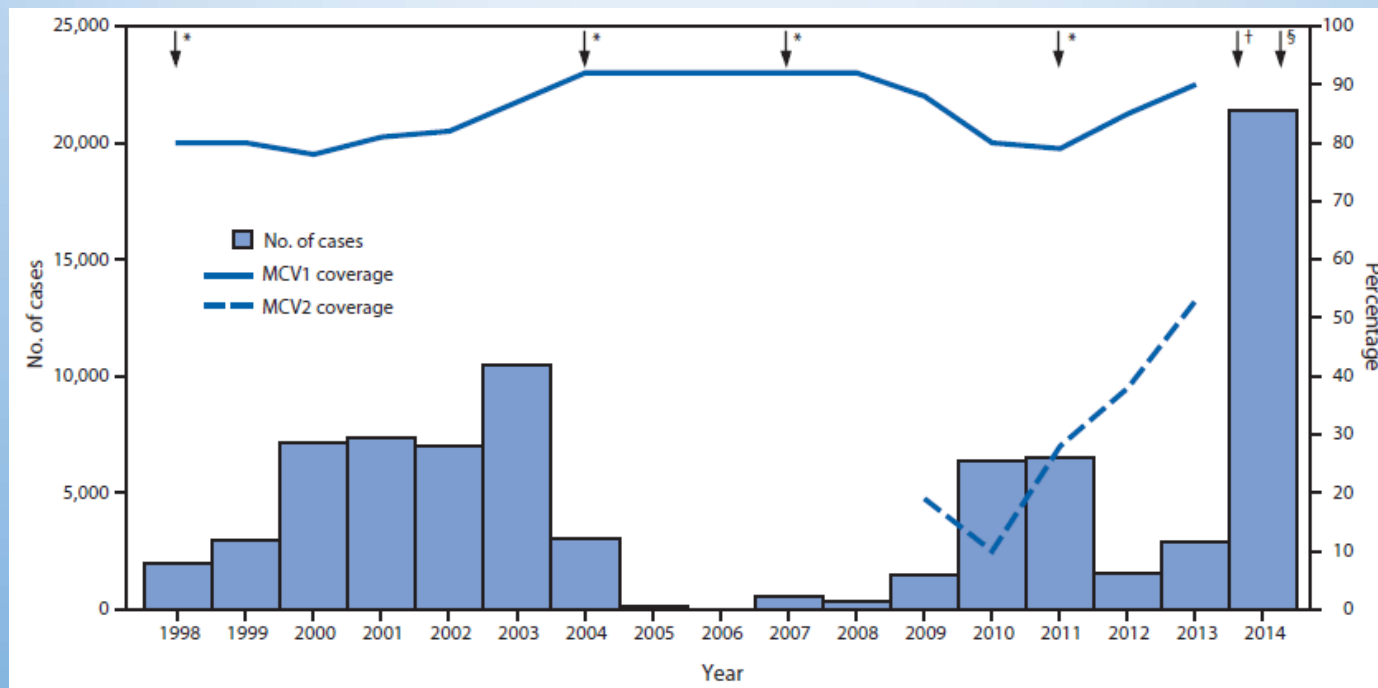


\*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases



# Progress Toward Measles Elimination — Philippines, 1998–2014

*MMWR Weekly* April 10, 2015 / 64(13);357-362





# 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  $\leq 2$  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>

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# Diphtheria

4680 reported cases in 2013 (globally)



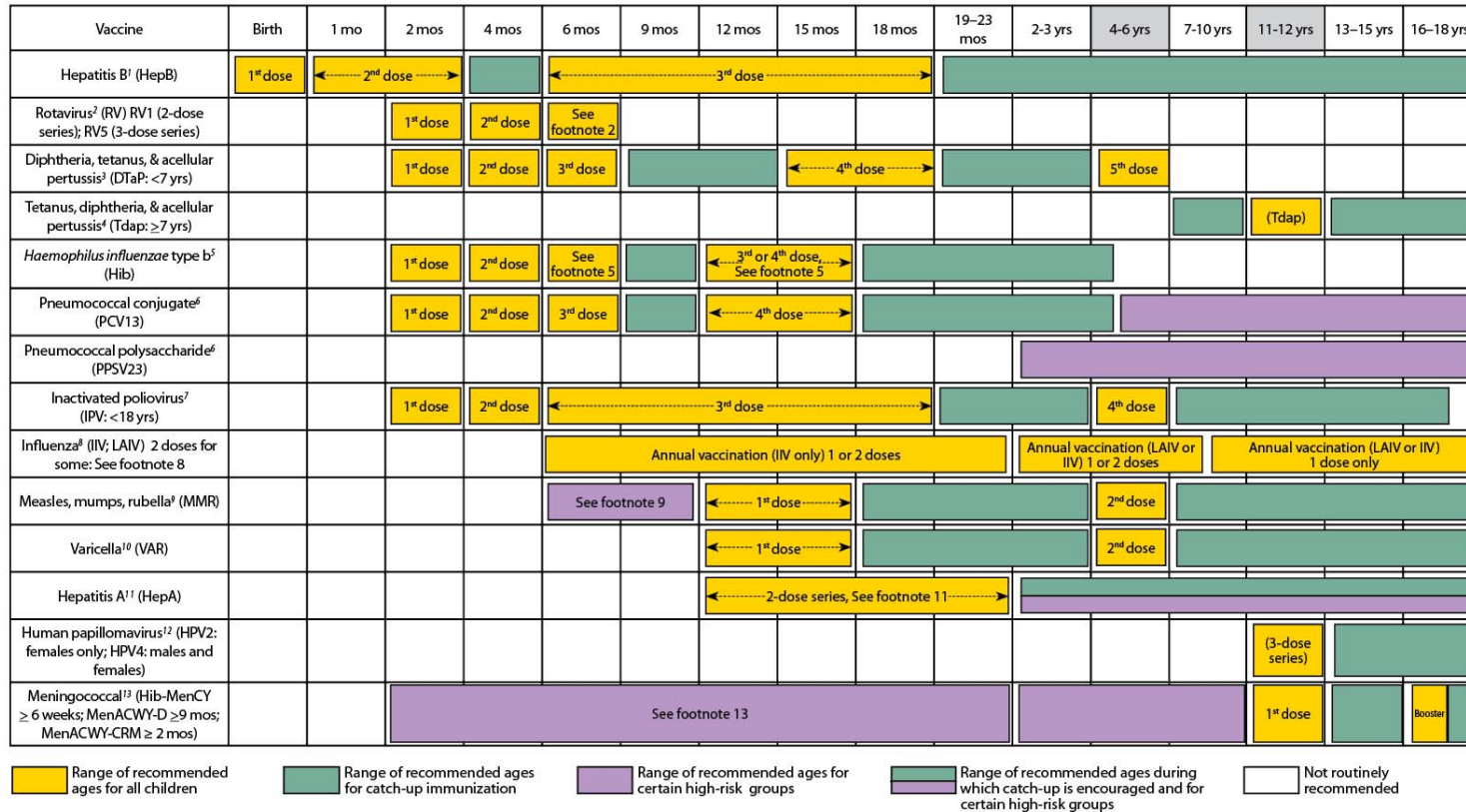
Balto



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.



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-INFO [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\*

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

\*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*

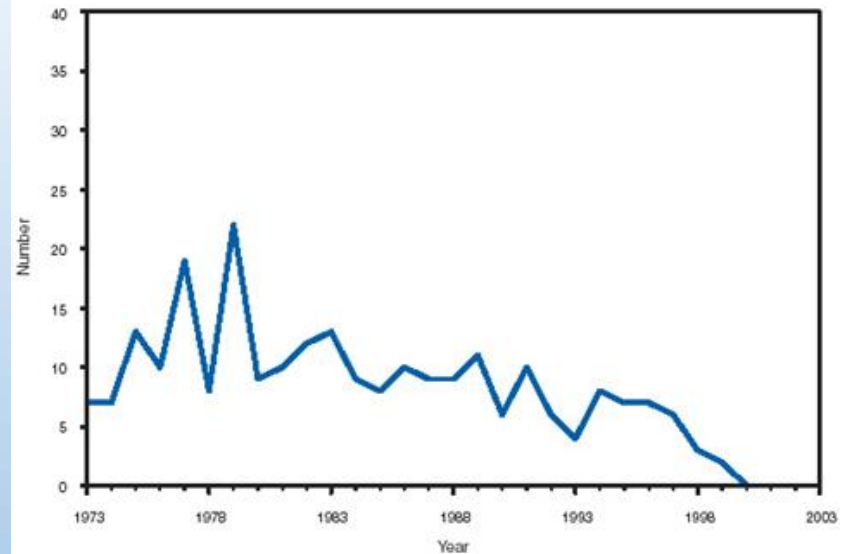


# Paralytic Poliomyelitis, 1973 - 2000



Patients in iron lungs, 1952, Los Angeles, California

POLIOMYELITIS, PARALYTIC. Number of reported cases, by year — United States, 1973–2003



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.

HCD-608-2MM-3-56

STATE PURCHASED VACCINE  
COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF HEALTH  
POLIOMYELITIS VACCINE REPORT

MANUFACTURER

Sharp & Dohme

LOT OR CONTROL NO. (From Vial)

30368

NAME OF PERSON RECEIVING VACCINE

Elaine Hanna (Mrs.)

ADDRESS OF PERSON RECEIVING VACCINE

Blakeslee

SEX AGE COLOR

F 32 W

COUNTY

Monroe

CHECK BLOCK INDICATING WHICH DOSE OF VACCINE

FIRST DOSE OF VACCINE

SECOND DOSE OF VACCINE

THIRD DOSE OF VACCINE

SITE OF INOCULATION

left arm

DATE VACCINE GIVEN

2/24 4/3/57

19 57

SIGNATURE OF PHYSICIAN

ADDRESS OF PHYSICIAN

Pocco Lake, Penna.

STATE BOARD LIC. NO.

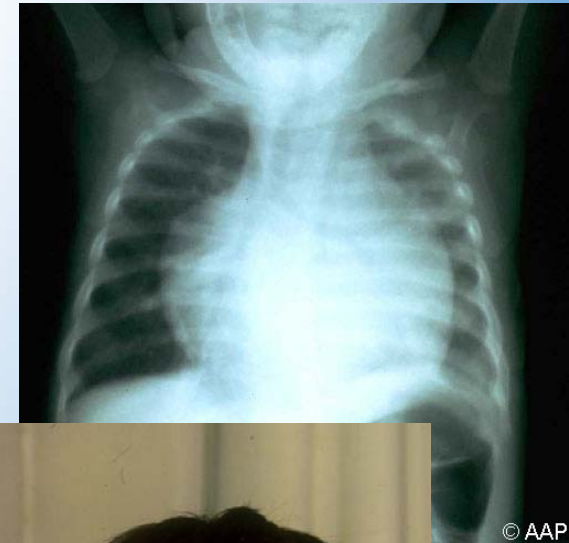
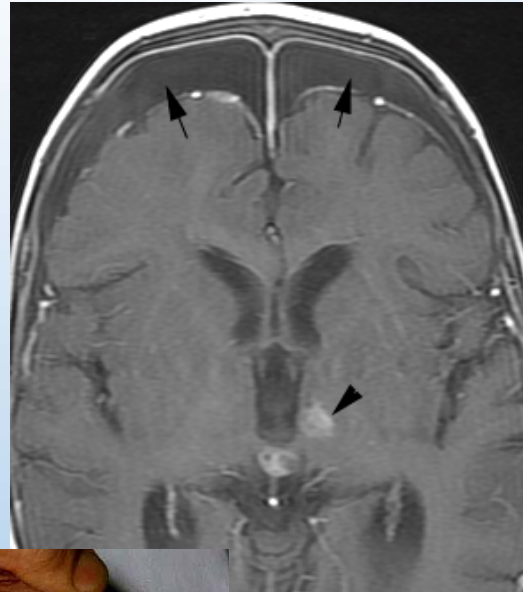
MAIL WEEKLY TO:

PENNSYLVANIA DEPT. OF HEALTH; HARRISBURG, PA

1430788



# Streptococcus pneumoniae



© AAP

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# 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

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

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.

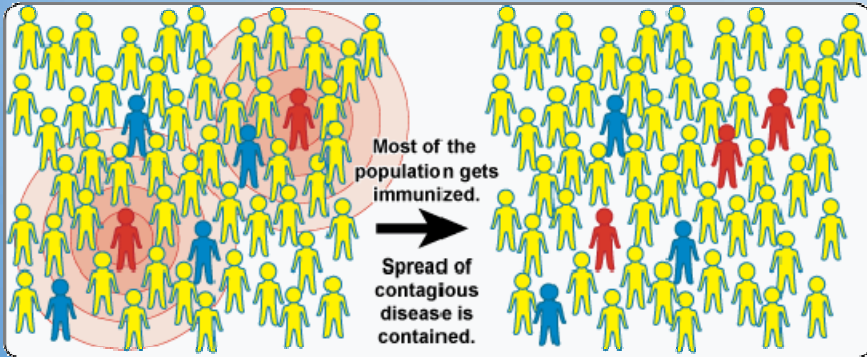
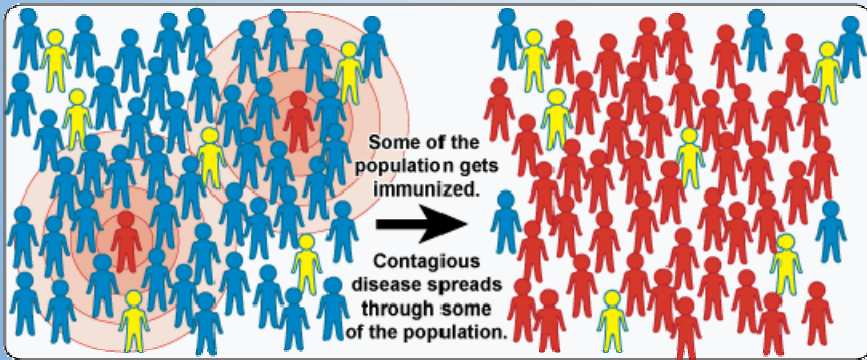
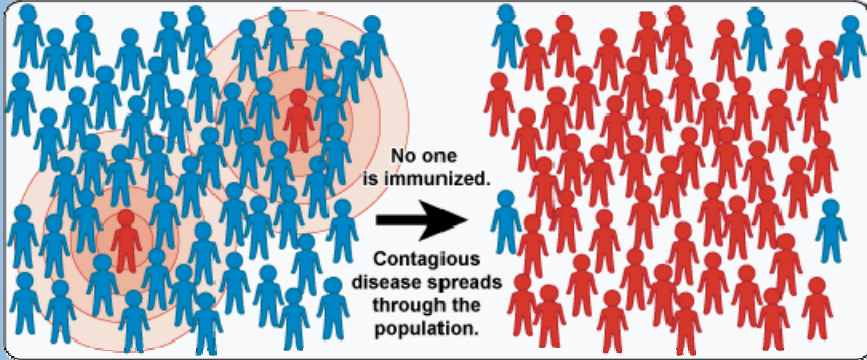
The AAP urges parents to immunize their children against dangerous childhood diseases.

# 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.



 = not immunized but still healthy    
  = immunized and healthy    
  = not immunized, sick, and contagious



# Herd Immunity

Disease	Immunity Threshold
Mumps	75-86
Polio	80-86
Smallpox	80-85
Diphtheria	85
Rubella	83-85
Pertussis	92-94
Measles	83-94