



## Fact Sheet Vaccinations

According to the CDC's Vaccines and Immunizations website, *What Would Happen If We Stopped Vaccinations?*

- For children born between 1994-2018, vaccinations will prevent 419 million illnesses, 26.8 million hospitalizations, and 936,000 deaths in their lifetime.
- Before there was a vaccine, more than 15,000 Americans died from diphtheria in 1921. Only two cases of diphtheria have been reported to the CDC between 2004 and 2014.
- An epidemic of rubella (German measles) in 1964-65 infected 12½ million Americans, killed 2,000 babies, and caused 11,000 miscarriages. Since 2012, 15 cases of rubella in the U.S. were reported to the CDC.

### How Do Vaccinations Work?

Vaccines are biological substances that teach a person's own immune system to recognize and defend against a harmful bacteria or virus. A vaccine typically contains an agent that resembles a disease-causing microorganism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins.

Vaccines protect communities through "herd immunity" which is based on the theory that the more people who are vaccinated, the fewer opportunities a disease has to spread. As the number of unvaccinated people increases, so does the infection rate. Since vaccine-preventable diseases are spread from person to person, if one person in a community gets an infectious disease, the disease will be spread to others who are not immune. But if a large portion of the community are immune to a disease because they have been vaccinated, they can't get the disease, and therefore won't spread it to others who aren't. Herd immunity protects those vulnerable members of society who cannot be vaccinated because they are immune compromised, allergic to vaccines, etc., but as the number of people voluntarily opting out of vaccinations increases, so does the risk of developing disease for those who can't be vaccinated for medical reasons.

### Are Vaccinations Safe?

Vaccinations are one of the best ways we have to prevent the serious effects of contracting an infectious diseases. Modern day vaccines are rigorously tested for safety and efficacy before receiving FDA approval and licensing. The risks associated with getting vaccines are almost always mild. They typically include redness, pain or swelling

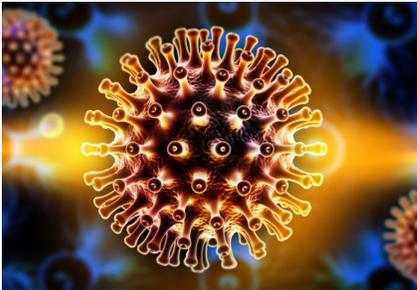
at the site of the injection, or a low-grade fever that will go away within a day or two. Serious side effects, such as an allergic reaction, are extremely rare, and if they do occur, health professionals know how to reverse the reaction with antihistamines, epinephrine, etc. In fact, you are 100 times more likely to get struck by lightning than have a severe reaction to a vaccine. For every vaccine recommended for use in the U.S., the CDC has created Vaccine Information Statements (VIS) that explain both the benefits and risks.

### **Which Diseases Can Vaccines Prevent?**

Vaccines have saved millions of lives and have prevented countless infectious diseases over the centuries (see **Important Milestones in Vaccination Research**).

Preventive vaccines are widely used to prevent diseases like polio, measles, diphtheria, pertussis (whooping cough), rubella (German measles), chicken pox, mumps, tetanus, rotavirus, Haemophilus influenzae type b (Hib), influenza (flu), herpes Zoster (shingles), hepatitis A and B, human papilloma virus (HPV), and Ebola virus. Thanks to the Salk and Sabine vaccines, paralytic polio no longer paralyzes school age children in the U.S., while smallpox, one of the most devastating diseases in the history of mankind, has been totally eradicated from the planet.

### **What Disease Do We Still Need Vaccines For?**



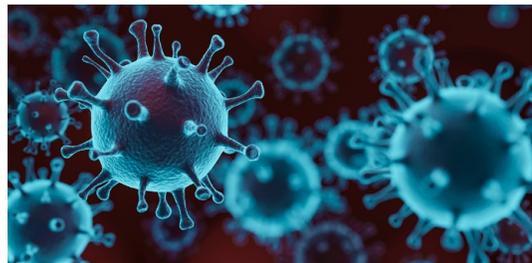
#### **HIV AIDS**

First described in 1981, HIV, or human immunodeficiency virus, is the virus that causes AIDS (acquired immunodeficiency syndrome) and can be transmitted during sexual intercourse, by sharing syringes, or perinatally during pregnancy, childbirth or breastfeeding. HIV attacks the immune system by destroying white blood cells that are vital to fighting off infections. The destruction of these cells can leave

people vulnerable to life-threatening infections and complications. Although remarkable progress has been made through the use of antiretrovirals that reduce viral levels so low that they are undetectable, HIV/AIDS continues to be one of the deadliest and most persistent pandemics, infecting 1.7 million people with HIV worldwide in 2018 alone. To control and ultimately end HIV globally, the development of a safe and effective HIV vaccine remains key to putting an end to the pandemic. One vaccine that holds some promise is RV144 which consists of a combination of two vaccine components given in sequence: ALVAC-HIV, which uses a canarypox virus as a carrier to deliver HIV genes, and AIDSVAX B/E, which contains a protein found on the viral surface. Testing continues on this and other vaccines and researchers are hopeful that an effective vaccine is on the horizon.

#### **COVID-19**

Currently, a consortium of government agencies, private corporations and academic institutions are working around the clock to develop a vaccine against the novel SARS-CoV-2 strain of



coronavirus which causes COVID-19. This rapidly reproducing and highly transmissible RNA virus has surface proteins that are primed to lock on to cell receptors in the respiratory tract. Once attached, it will insert itself into the cell's own replication machinery, making multiple copies of the virus. The virus can cause the person's immune system to go into overdrive, causing a fatal pneumonia, particularly in the elderly or those with pre-existing health problems. Many different approaches are being pursued to combat the virus, including the use of a recombinant vaccine consisting of viral spike proteins that are delivered via a fingertip-sized patch. The patch, which goes on like a Band-Aid, has "needles" made of sugar and protein pieces which will dissolve into the skin.

### **Important Milestones in Vaccination Research**

- 1600s – Chinese Emperor K'ang Hsi, who had survived **smallpox** as a child, inoculated his own children with ground up smallpox scabs blown into their nostrils.
- 1796 – Edward Jenner, an English doctor, inoculated 8-year-old James Phipps with matter from a cowpox sore on the hand of milkmaid Sarah Nelmes to prove that previous illness with a disease called cowpox could protect someone from **smallpox**.
- 1836 – In an effort to boost the potency of **smallpox** vaccines, English physician Edward Ballard reintroduced the pustule matter (lymph) from infected cows back into cows. This method came to be used to supply sufficient material for vaccination.
- 1879 – Louis Pasteur produced the first laboratory-developed vaccine for **chicken cholera** (*Pasteurella multocida*).
- 1881 – Pasteur develops an **anthrax** vaccine for livestock by attenuating or reducing the virulence of the anthrax bacteria with carbolic acid.
- 1884 – Pasteur announces to the French Academy of Sciences that he has successfully protected dogs from fatal **rabies** by use of his attenuated rabies vaccine.
- 1885 – Four boys bitten by a rabid dog in Newark, NJ are sent to France to receive Pasteur's post-exposure **rabies** vaccine and return home healthy in January of 1886.
- 1885 – Spanish physician Jaime Ferrán develops a live, attenuated **cholera** vaccine, the first vaccine to immunize humans against a bacterial disease. Over his career, Ferrán developed vaccines for **plague, tetanus, typhus, tuberculosis, and rabies**.
- 1896 – Wilhelm Kolle developed a heat-inactivated **cholera** vaccine that came to serve as a model for cholera vaccines for the next century.
- 1909 – Frederick F. Russell developed the first U.S. **typhoid** fever vaccine to vaccinate the troops in World War I. By 1914, typhoid vaccination had moved beyond military forces in the U.S. and into use for the general public.
- 1926 – Alexander Glennie increased the effectiveness of **diphtheria** toxoid by treating it with aluminum salts, an early example of adding adjuvants to vaccines.
- 1936 – Max Theiler and his colleagues developed a live attenuated vaccine for **yellow fever** using tissue cultures prepared from embryonated chicken eggs.
- 1944 – Maurice Hilleman helped develop a Japanese **encephalitis** vaccine to protect American troops in the World War II Pacific theater of operations.

- 1945 – Thomas Francis Jr. and Jonas Salk helped develop the first whole-virus, inactivated **influenza A and B** vaccine.
- 1948 – The first combined DTP (**diphtheria, tetanus, and pertussis**) vaccines became available in the U.S.
- 1954 – A field test of Jonas Salk's **polio** vaccine with thousands of schoolchildren turned out being 80-90% effective against paralytic polio, paving the way for its widespread distribution and use. In 1959, Albert Sabin developed an oral vaccine with equal effectiveness that could be delivered to school children on a sugar cube.
- 1962 – Maurice Hilleman and colleagues developed an attenuated **measles** vaccine by passaging it 80 times through different cell types. The resulting vaccine, Rubeovax, was given with a dose of gamma globulin antibodies to reduce reactions.
- 1967 – The FDA licensed a **mumps** vaccine developed by Maurice Hilleman. Within five years, more than 11 million doses of Mumpsvox would be distributed.
- 1969 – The MMR vaccine was licensed, and protection against **measles, mumps** and **rubella** was provided at the same time, via one shot.
- 1974 – Meningococcal polysaccharide vaccines effective against **meningococcal group A** were introduced.
- 1983 – Robert Austrian's **pneumococcal** vaccine was expanded to offer protection against 23 different strains.
- 1985 – The first vaccine against **Haemophilus influenzae type b** (Hib) disease was licensed in the U.S.
- 1986 – FDA licenses Recombivax, the first human **hepatitis B** vaccine produced by recombinant DNA methods.
- 1995 – FDA licenses Varivax, the first **chickenpox** vaccine in the U.S.
- 2005 – A quadrivalent **meningococcal** polysaccharide-protein conjugate vaccine was licensed in the U.S.
- 2006 – FDA licenses Gardasil, the first vaccine against human **papillomavirus**.
- 2014 – FDA licenses Trumenba, a vaccine for **group B meningococcal** disease.
- 2019 – FDA licenses Ervebo, a vaccine for the prevention of **Ebola** virus disease (EVD), caused by Zaire ebolavirus in individuals 18 years of age and older.