

Vaccine Concerns, Myths, and Safety Issues on the Web

Now that vaccines have virtually eliminated many once-feared diseases, the possibility of vaccine side effects or adverse reactions loom larger in some people's minds than the diseases that vaccines prevent. Most parents today have never seen a case of diphtheria or measles, and some wonder why their children must receive so many shots. Rumors and misinformation about vaccine safety abound. For example, many parents are concerned that multiple vaccines may weaken or overwhelm an infant's immune system or that certain vaccines may cause autism, multiple sclerosis, or diabetes.

For information about vaccine concerns, myths, and safety issues, try the following sources.

AIDSinfo

A service of the U.S. Department of Health and Human Services
aidsinfo.nih.gov
800-448-0440

Centers for Disease Control and Prevention

National Immunization Program
www.cdc.gov/nip
800-232-2522

Immunization Safety Review Committee of the Institute of Medicine

www.iom.edu/imsafety
202-334-1342

Institute for Vaccine Safety

Johns Hopkins Bloomberg School of Public Health
www.vaccinesafety.edu

National Network for Immunization Information

www.immunizationinfo.org
409-772-0199

National Partnership for Immunization

www.partnersforimmunization.org
703-836-6110

Vaccine Education Center at The Children's Hospital of Philadelphia

www.vaccine.chop.edu
215-590-9990

NIAID Vaccine Research

Despite many accomplishments in vaccine research over the years, much remains to be done. NIAID-supported investigators in the United States and other countries and in NIAID laboratories in Bethesda, Maryland, and Hamilton, Montana, are working to reduce the burden of illness through vaccines against diseases old and new.

Millions around the globe suffer illness and death from the relatively new disease HIV/AIDS and from the ancient scourges of malaria and tuberculosis. For this reason, NIAID has made developing new or improved vaccines for those illnesses a top priority. Other priorities include devising vaccines against disease-causing agents that either arise naturally or that might be deliberately released in an act of bioterrorism. Finding ways to quickly produce vaccines against strains of influenza that experts fear may spark a pandemic is another area in which NIAID-supported researchers are making progress.

Established Record, Continuing Efforts

Some NIAID programs in vaccine development are quite recent, while others have a distinguished record of achievement and continue to advance the field of vaccines to this day.

In 1962, NIAID revolutionized the cumbersome, piecemeal approach to vaccine studies by establishing a network of Vaccine and Treatment Evaluation Units (VTEUs). These

testing sites are based at university medical research centers, public health departments, and community clinics across the country. The network can rapidly recruit volunteers for clinical studies, and it played a major role in the studies that led to the licensing of vaccines for Hib and for a new subunit pertussis vaccine. VTEU investigators have also tested vaccines for pneumonia, influenza, cholera, whooping cough, malaria, and tuberculosis. More recently, they have been called upon to conduct critical studies of smallpox vaccines and pandemic flu.

In 1988, the world's first HIV vaccine trial began at the National Institutes of Health in Bethesda. That same year, NIAID established the AIDS Vaccine Evaluation Group (AVEG), a network of testing centers at universities in the United States devoted exclusively to HIV vaccines. In 1999, NIAID built upon AVEG by creating the HIV Vaccine Trials Network (HVTN), a collaboration of investigators in the United States and abroad that tests candidate HIV vaccines in clinical trials. The HVTN includes sites in Africa, Asia, South America, and the Caribbean. The international sites enable studies that examine differences in genetic makeup, nutrition, access to health care, and HIV subtypes in various populations, all crucial factors in creating a vaccine that is effective worldwide.

In 2000, NIAID established the Dale and Betty Bumpers Vaccine Research Center (VRC) in Bethesda. At the VRC, vaccines can be developed from initial concept to final product. Scientists at the center conduct basic research on microbes and the immune system's response to them,

design candidate vaccines, and with their collaborators, test the most promising vaccines in preclinical and clinical trials. VRC scientists work on vaccines against multiple microbes, with an emphasis on developing therapeutic and preventive vaccines against HIV. A new prime-boost vaccine targeted at multiple HIV subtypes, which was developed at the VRC, entered a Phase II clinical trial in 2005, while the first human trial of an Ebola vaccine began in the center's clinic in 2003. In 2006, the world's first human trial of a DNA vaccine against the H5N1 avian influenza opened to volunteers.

NIAID is currently supporting the creation of a national network of laboratories that will augment our nation's capacity to develop vaccines against infectious agents, whether they arise naturally, such as West Nile virus, SARS (severe acquired respiratory syndrome), and tuberculosis, or are deliberately introduced. Vaccines against such emerging microbes must be safe, easy to administer, and fast-acting—even to the point of providing immunity shortly *after* exposure to the microbe. NIAID-funded scientists are developing improved vaccines against smallpox, anthrax, plague, avian flu, and other emerging disease threats.

Established by NIAID in 2005, the Center for HIV/AIDS Vaccine Immunology (CHAVI) is a consortium of researchers based at institutions across the country who are working together to tackle some of the biggest obstacles in developing an HIV vaccine. Among their efforts, CHAVI scientists are seeking a better understanding of the earliest events in the immune

system's response to HIV infection; identifying which immune reactions give the best indications that a candidate vaccine is eliciting a protective response; and testing new HIV vaccines in early phase clinical trials.

In recent years, researchers have increased their understanding of the immune system and how it fights off harmful microbes. Scientists working on vaccines also have advanced technology to draw on, including recombinant DNA technology and the ability to “read” and analyze the genomes of disease-causing organisms. This new knowledge and technology promises to usher in a renaissance in the already vital field of vaccinology.

More Information

**National Institute of Allergy and Infectious Diseases
National Institutes of Health**

6610 Rockledge Drive, MSC 6612
Bethesda, MD 20892-6612
301-496-5717
www.niaid.nih.gov

**Dale and Betty Bumpers Vaccine Research Center
National Institutes of Health**

40 Convent Drive
Bethesda, MD 20892
www.niaid.nih.gov/vrc

**National Library of Medicine
MedlinePlus**

8600 Rockville Pike
Bethesda, MD 20894
1-888-FIND-NLM (1-888-346-3656) or 301-594-5983
www.medlineplus.gov

Centers for Disease Control and Prevention

1600 Clifton Road
Atlanta, GA 30333
1-800-311-3435 or 404-639-3534
www.cdc.gov

Food and Drug Administration

5600 Fishers Lane
Rockville MD 20857-0001
1-888-INFO-FDA (1-888-463-6332)
www.fda.gov

World Health Organization

Avenue Appia 20
1211 Geneva 27
Switzerland
41-22-791-21-11
www.who.int

Glossary

adjuvant—a substance sometimes included in a vaccine formulation to enhance the immune-stimulating properties of the vaccine.

antibody—a molecule produced by a B cell in response to an antigen. When an antibody attaches to an antigen, it helps destroy the microbe bearing the antigen.

antigen—a molecule on a microbe that identifies it as foreign to the immune system and stimulates the immune system to attack it.

artificially acquired immunity—immunity provided by vaccines, as opposed to naturally acquired immunity, which is acquired from exposure to a disease-causing organism.

attenuation—the weakening of a microbe so that it can be used in a live vaccine.

B cell or B lymphocyte—a white blood cell, crucial to the immune defenses. B cells come from bone marrow and develop into blood cells called plasma cells, which are the source of antibodies.

bacteria—microscopic organisms composed of a single cell and lacking a defined nucleus and membrane-enclosed internal compartments.

booster shot—supplementary dose of a vaccine, usually smaller than the first dose, that is given to maintain immunity.

cell-mediated immune response (also called cellular immune response)—immune protection provided by the direct action of immune cells (as distinct from that provided by molecules such as antibodies).

clinical trial—an experiment that tests the safety and effectiveness of a vaccine or drug in humans.

complement protein—a molecule that circulates in the blood whose actions “complement” the work of antibodies. Complement proteins destroy antibody-coated microbes.

conjugate vaccine—a vaccine in which proteins that are easily recognizable to the immune system are linked to the molecules that form the outer coat of disease-causing bacteria to promote an immune response. Conjugate vaccines are designed primarily for very young children because their immune systems cannot recognize the outer coats of certain bacteria.

contagious—able to transmit disease to other people.

cytotoxic T cells or **killer T cells**—a subset of T cells that destroy body cells infected by viruses or bacteria.

dendritic cell—immune cell with threadlike tentacles called dendrites used to enmesh antigen, which it presents to T cells.

DNA vaccine or **naked DNA vaccine**—a vaccine that uses a microbe’s genetic material, rather than the whole organism or its parts, to stimulate an immune response.

edible vaccines—foods genetically engineered to produce antigens to specific microbes and safely trigger an immune response to them.

efficacy—in vaccine research, the ability of a vaccine to produce a desired clinical effect, such as protection against a specific infection, at the optimal dosage and schedule in a given population.

formalin—a solution of water and formaldehyde, used in toxoid vaccines to inactivate bacterial toxins.

gene—a unit of genetic material (DNA). Genes carry directions a cell uses to perform a specific function.

genetic material—molecules of DNA (deoxyribonucleic acid) or RNA (ribonucleic acid) that carry the directions that cells or viruses use to perform a specific function, such as making a particular protein molecule.

genomes—all of an organism’s genetic material. A genome is organized into specific functional units called genes.

***Haemophilus influenzae* type b (Hib)**—a bacterium found in the respiratory tract that causes acute respiratory infections, including pneumonia, and other diseases such as meningitis.

helper T cells—a subset of T cells that function as messengers. They are essential for turning on antibody production, activating cytotoxic T cells, and initiating many other immune functions.

herd immunity or **community immunity**—the resistance to a particular disease gained by a community when a critical number of people are vaccinated against that disease.

HIV—human immunodeficiency virus, the virus that causes AIDS.

humoral immune response or **antibody response**—immune protection provided by B cells, which secrete antibodies in response to antigen (as distinct from that provided by the direct action of immune cells, or the cellular immune response).

immune—have a high degree of resistance to or protection from a disease.

immune system—a collection of specialized cells and organs that protect the body against infectious diseases.

inactivated vaccine or **killed vaccine**—a vaccine made from a whole virus or bacteria inactivated with chemicals or heat.

live, attenuated vaccine—a vaccine made from microbes that have been weakened in the laboratory so that they can't cause disease. (See **attenuation**.)

lymph node—a small bean-shaped organ of the immune system, distributed widely throughout the body and linked by lymphatic vessels. Lymph nodes are gathering sites of B, T, and other immune cells.

lymphocyte—a white blood cell central to the immune system's response to foreign microbes. B cells and T cells are lymphocytes.

macrophage—a large and versatile immune cell that devours and kills invading microbes and other intruders. Macrophages stimulate other immune cells by presenting them with small pieces of the invaders.

memory cells—a subset of T cells and B cells that have been exposed to antigens and can then respond more readily and rapidly when the immune system encounters the same antigens again.

microbe—a microscopic organism. Microbes include bacteria, viruses, fungi, and single-celled plants and animals.

molecule—a building block of a cell. Some examples are proteins, fats, and carbohydrates.

mutate—to change a gene or unit of hereditary material that results in a new inheritable characteristic.

naturally acquired immunity—immunity produced by antibodies passed from mother to fetus (passive), or by the body's own antibody and cellular immune response to a disease-causing organism (active).

organism—an individual living thing.

passive immunity—immunity acquired through transfer of antibody or lymphocytes from an immune donor.

pertussis or **whooping cough**—a respiratory infection caused by the toxic bacterium *Bordetella pertussis*. The wracking coughs characteristic of this disease are sometimes so intense the victims, usually infants, vomit or turn blue from lack of air.

placebo—an inactive substance administered to some clinical trial participants. Other participants receive the agent being evaluated, which provides a basis for comparing the agent's effects.

plasma cell—a cell produced by a dividing B cell that is entirely devoted to producing and secreting antibodies.

polysaccharide—a long, chain-like molecule made up of a linked sugar molecule. The outer coats of some bacteria are made of polysaccharides.

preclinical testing—required laboratory testing of a vaccine before it can be given to people in clinical trials. Preclinical testing is done in cell cultures and in animals.

recombinant DNA technology—the technique by which genetic material from one organism is inserted into a foreign cell or another organism in order to mass-produce the protein encoded by the inserted genes.

recombinant subunit vaccine—a vaccine made using recombinant DNA technology to engineer the antigen molecules of the particular microbe. (See **subunit vaccine**.)

recombinant vector vaccine—a vaccine that uses modified viruses or bacteria to deliver genes that code for microbial antigens to cells of the body.

rubella or **German measles**—a viral disease often affecting children and spread through the air by coughs or sneezes. Symptoms include a characteristic rash, low-grade fever, aching joints, runny nose, and reddened eyes. If a pregnant woman gets rubella during her first 3 months of pregnancy, her baby is at risk of having serious birth defects or dying.

subunit vaccine—a vaccine that uses one or more components of a disease-causing organism, rather than the whole, to stimulate an immune response.

T cell or **T lymphocyte**—a white blood cell that directs or participates in immune defenses. (See **cytotoxic T cells** and **helper T cells**.)

tissue—a group of similar cells joined to perform the same function.

toxin—agent produced by plants and bacteria, normally very damaging to cells.

toxoid or **inactivated toxin**—a toxin, such as those produced by certain bacteria, that has been treated by chemical means, heat, or irradiation and is no longer capable of causing disease.

toxoid vaccine—a vaccine containing a toxoid, used to protect against toxins produced by certain bacteria.

vector—in vaccine technology, a bacterium or virus that cannot cause disease in humans and is used in genetically engineered vaccines to transport genes coding for antigens into the body to induce an immune response.

virulent—toxic, causing disease.

virus—a very small microbe that does not consist of cells but is made up of a small amount of genetic material surrounded by a membrane or protein shell. Viruses cannot reproduce by themselves. To reproduce, viruses must infect a cell and use the cell's resources and molecular machinery to make more viruses.



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

National Institute of Allergy and Infectious Diseases

NIH Publication No. 08-4219

January 2008
www.niaid.nih.gov