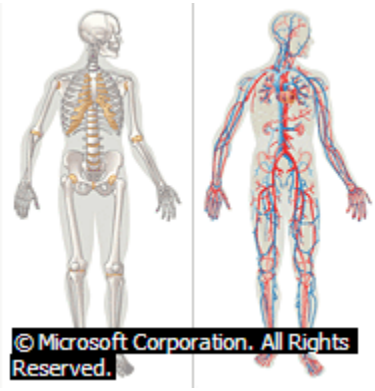
HIV EXAMINER

A Monthly Newsletter of Writers Against Aids and Tobacco Smoking

December Edition

Immune System

I Introduction



Human Anatomy Illustrations

Learn about the ten systems in the human body.

Immune System, group of cells, molecules, and organs that act together to defend the body against foreign invaders that may cause disease, such as bacteria, viruses, and fungi. The health of the body is dependent on the immune system's ability to recognize and then repel or destroy these invaders.

II IMMUNITY: INNATE AND ADAPTIVE

Most animals have systems that resist disease. The disease resistance provided by these systems is called immunity. There are two types of immunity: innate and adaptive. *Innate*, or *nonspecific*, *immunity* is the body's first, generalized line of defense against all invaders. Innate immunity is

furnished by barriers such as skin, tears, mucus, and saliva, as well as by the rapid inflammation of tissues that takes place shortly after injury or infection. These innate immune mechanisms hinder the entrance and spread of disease but can rarely prevent disease completely.

If an invader gets past this first line of defense, the cells, molecules, and organs of the immune system develop specifically tailored defenses against the invader. The immune system can call upon these defenses whenever this particular invader attacks again in the future. These specifically adapted defenses are known as *adaptive,* or *specific, immunity.*

Adaptive immunity has four distinguishing properties: First, it responds only after the invader is present. Second, it is specific, tailoring each response to act only on a specific type of invader. Third, it displays memory, responding better after the first exposure to an invader, even if the second exposure is years later. Fourth, it does not usually attack normal body components, only those substances it recognizes as nonself.

Adaptive immune responses are actually reactions of the immune system to structures on the surface of the invading organism called *antigens*. There are two types of adaptive immune responses: humoral and cell mediated. During *humoral immune responses, proteins* called *antibodies,* which can stick to and destroy antigens, appear in the blood and other body fluids. Humoral immune responses resist invaders that act outside of cells, such as bacteria and *toxins* (poisonous substances produced by living organisms). Humoral immune responses can also prevent viruses from entering cells.

During *cell-mediated immune responses,* cells that can destroy other cells become active. Their destructive activity is limited to cells that are either infected with, or producing, a specific antigen. Cell-mediated immune responses resist invaders that reproduce within the body cells, such as viruses. Cell-mediated responses may also destroy cells making *mutated* (changed) forms of normal molecules, as in some cancers.

III COMPONENTS OF THE IMMUNE SYSTEM

The ability of the immune system to mount a response to disease is dependent on many complex interactions between the components of the immune system and the antigens on the invading *pathogens*, or disease-causing agents.

A Macrophages

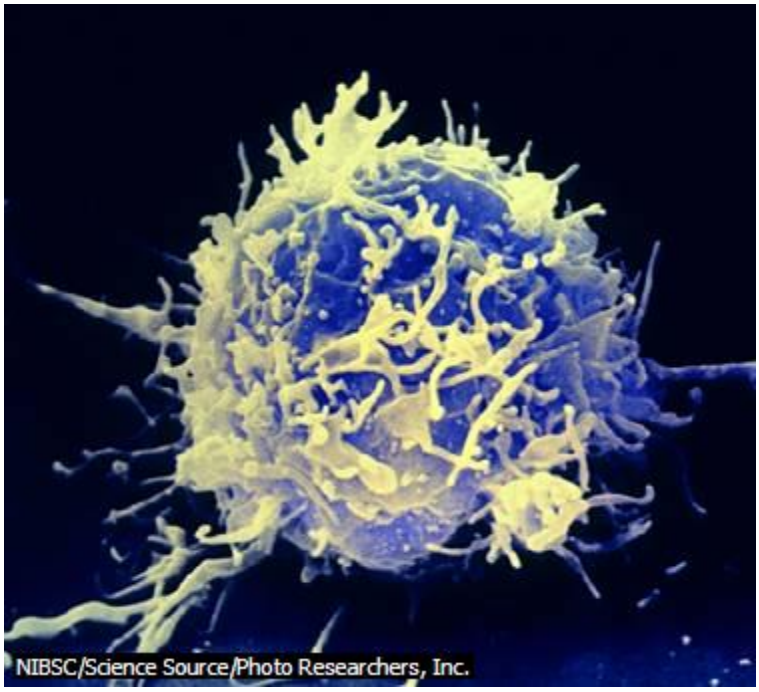
Macrophage Engulfing Bacterium

A macrophage, in yellow, engulfs and consumes a bacterium. Macrophages are large phagocytes, cells that wander through the body consuming foreign particles such as dust, asbestos particles, and bacteria. They help protect the body against infection.

Dennis Kunkel/CNRI/Phototake NYC

White blood cells are the mainstay of the immune system. Some white blood cells, known as *macrophages*, play a function in innate immunity by surrounding, ingesting, and destroying invading bacteria and other foreign organisms in a process called *phagocytosis* (literally, "cell eating"), which is part of the inflammatory reaction. Macrophages also play an important role in adaptive immunity in that they attach to invading antigens and deliver them to be destroyed by other components of the adaptive immune system.

B Lymphocytes



Lymphocyte

Scanning electron micrograph of a normal T lymphocyte. T lymphocytes are specialized white blood cells that identify and destroy invading organisms such as bacteria and viruses. Some T lymphocytes directly destroy invading organisms, whereas other T lymphocytes regulate the immune system by directing immune responses.

NIBSC/Science Source/Photo Researchers, Inc.

Lymphocytes are specialized white blood cells whose function is to identify and destroy invading antigens. All lymphocytes begin as "stem cells" in the *bone marrow,* the soft tissue that fills most bone cavities, but they mature in two different places. Some lymphocytes mature in the bone marrow and are called B lymphocytes. *B lymphocytes,* or *B cells,* make *antibodies,* which circulate through the blood and other body fluids, binding to antigens and helping to destroy them in humoral immune responses.

Other lymphocytes, called *T lymphocytes,* or *T cells,* mature in the thymus, a small glandular organ located behind the breastbone. Some T lymphocytes, called *cytotoxic* (cell-poisoning) or *killer T lymphocytes,* generate cell-mediated immune responses, directly destroying cells that have specific antigens on their surface that are recognized by the killer T cells. *Helper T*

lymphocytes, a second kind of T lymphocyte, regulate the immune system by controlling the strength and quality of all immune responses.

Most contact between antigens and lymphocytes occurs in the *lymphoid organs*—the lymph nodes, spleen, and tonsils, as well as specialized areas of the intestine and lungs (*see* Lymphatic System). Mature lymphocytes constantly travel through the blood to the lymphoid organs and then back to the blood again. This recirculation ensures that the body is continuously monitored for invading substances.

C Antigen Receptors

One of the characteristics of adaptive immunity is that it is specific: Each response is tailored to a specific type of invading antigen. Each lymphocyte, as it matures, makes an *antigen receptor*—that is, a specific structure on its surface that can bind with a matching structure on the antigen like a lock and key. Although lymphocytes can make billions of different kinds of antigen receptors, each individual lymphocyte makes only one kind. When an antigen enters the body, it activates only the lymphocytes whose receptors match up with it.

D Antigen-Presenting Cells

When an antigen enters a body cell, certain transport molecules within the cell attach themselves to the antigen and transport it to the surface of the cell, where they "present" the antigen to T lymphocytes. These transport molecules are made by a group of genes called the major histocompatibility complex (MHC) and are therefore known as *MHC molecules.* Some MHC molecules, called *class I MHC molecules,* present antigens to killer T cells; other MHC molecules, called *class II MHC molecules,* present antigens to helper T cells.

IV HUMORAL IMMUNE RESPONSE

The humoral immune response involves a complex series of events after antigens enter the body. First, macrophages take up some of the antigen and attach it to class II MHC molecules, which then present the antigen to T helper cells. The T helper cells bind the presented antigen, which stimulates the T helper cells to divide and secrete stimulatory molecules called *interleukins.* The

interleukins in turn activate any B lymphocytes that have also bound the antigen. The activated B cells then divide and secrete antibodies. Finally, the secreted antibodies bind the antigen and help destroy it.

A Antibodies

Antibodies are Y-shaped proteins called immunoglobulins (Ig) and are made only by B cells. The antibody binds to the antigen at the ends of the arms of the Y. The area at the base of the Y determines how the antibody will destroy the antigen. This area is used to categorize antibodies into five main classes: IgM, IgG, IgA, IgD, and IgE. During the humoral immune response, IgM is the first class of antibody made. After several days, other classes appear. Exactly which other Ig classes a B cell makes depends on the kind of interleukins it receives from the T helper cells.

Antibodies can sometimes stop an antigen's disease-causing activities simply by *neutralization*—that is, by binding the antigen and preventing it from interfering with the cell's normal activities. For example, the toxin made by tetanus bacteria binds to nerve cells and interferes with their control of muscles. Antibodies against tetanus toxin stick to the toxin and cover the part of it that binds to nerve cells, thereby preventing serious disease. All classes of antibodies can neutralize antigens.

Antibodies also help destroy antigens by preparing them for ingestion by macrophages in a process called opsonization. In *opsonization,* antibodies coat the surface of antigens. Since macrophages have receptors that stick to the base of the antibody's Y structure, antigens coated with antibodies are more likely to stick to the macrophages and be ingested. Opsonization is especially important in helping the body resist bacterial diseases.

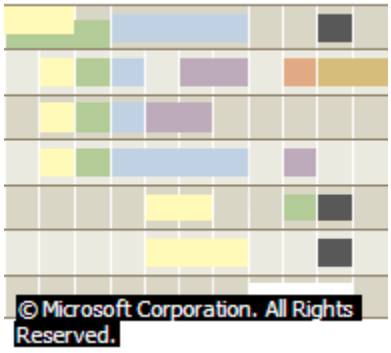
Finally, IgM and IgG antibodies can trigger the *complement* system, a group of proteins that cause cells to disintegrate by cutting holes in the cell membrane. Complement is important in resisting bacteria that are hard to destroy in other ways. For example, some of the bacteria that cause pneumonia have a slimy coating, making it hard for macrophages to ingest and eliminate them. However, if IgM and IgG antibodies bind to the pneumonia bacteria and activate the complement system, it is able to cut holes in the bacteria to destroy them.

Although the IgM and IgG classes of antibodies work best in the circulatory system, IgA can exit the bloodstream and appear in other body fluids. IgA is thus important in preventing infection at mucosal surfaces, such as the intestine and the lung. Since these are the sites where most infectious agents enter, IgA is particularly important in resistance to many diseases. IgA is also found in mother's milk and may help nursing newborns resist disease.

V CELL-MEDIATED IMMUNE RESPONSE

As with the humoral immune response, the cell-mediated immune response involves a complex series of events after antigens enter the body. Helper T cells are required, so some of the antigen must be taken up by macrophages and presented to helper T cells. The helper T cells bind the presented antigen and thereby become activated to divide and secrete interleukins. The interleukins in turn activate any killer T cells that have already bound antigen attached to class I MHC molecules on infected cells. The activated killer T cells can then kill any cells displaying antigen attached to class I MHC molecules, effectively eliminating any cells infected with the antigen.

VI IMMUNIZATION



Immunization Schedule for Infants and Children

Physicians recommend that infants and children receive vaccinations to protect them from highly contagious diseases. Many vaccines require more than one dose to provide full immunity, and sometimes combination vaccines are used to lessen the number of injections a child receives. This chart provides the ages for immunization with specific vaccines that the American Academy of Pediatrics recommends for children living in the United States.

When the body is first exposed to an antigen, several days pass before the adaptive immune response becomes active. Immune activity then rises, levels off, and falls. During following exposures to the same antigen, the immune system responds much more quickly and reaches higher levels. Because the first, or *primary,* immune response is slow, it cannot prevent disease, although it may help in recovery. In contrast, subsequent, or *secondary,* immune responses usually can prevent disease because the pathogen is detected, attacked, and destroyed before symptoms appear. This complete resistance to disease is called *immunity* and may be achieved through either active or passive immunization.

A Active Immunization

Active immunization occurs when a person's own immune system is activated and generates a primary immune response. Active immunization can be triggered in two ways, either by natural immunization or by vaccination.

In *natural immunization,* the body contracts a disease and recovers. Because a primary immune response occurs during the illness, the immune system will mount a disease-preventing secondary response every time it is subsequently exposed to the disease. Natural immunization is developed during childhood diseases, such as chicken pox. After having had the disease once, a person is no longer susceptible to it.

Vaccination is intentional immunization against a particular disease by the use of *vaccines,* substances that are structurally similar to the actual disease-producing agents but that do not produce disease themselves. Most vaccines take one of two forms. The first type of vaccine, such as the vaccines for tetanus and whooping cough, contains chemically killed bacteria or other pathogenic organisms. The other type, such as the oral polio vaccine, contains weakened forms of living organisms that have been genetically selected so they do not produce disease.

B Passive Immunization

Another way to provide immunity is by means of *passive immunization.* Passive immunization does not engage the person's own immune system. Instead, the individual receives antibodies that were created in another person or animal. Such antibodies can be lifesaving when a disease progresses too rapidly for natural immunization to occur. For example, if a person who has not been immunized against tetanus bacteria is exposed to tetanus, the toxin produced by these bacteria would reach a deadly level before a primary immune response could begin. Administering antibodies against tetanus toxin quickly neutralizes the toxin and prevents death.

Passive immunization has two drawbacks: First, the person does not mount an active immune response, so the immunizing effect is temporary and the person is not immune after recovery. Second, if passive immunization is used repeatedly, it occasionally produces side effects.

VII IMMUNE SYSTEM DISORDERS

Disorders of the immune system can range from the less serious, such as mild allergy, to the life threatening, such as more serious allergy, transplant rejection, immune deficiencies, and autoimmune diseases.

A Allergy

Allergy, sometimes called hypersensitivity, is caused by immune responses to some antigens. Antigens that provoke an allergic response are known as *allergens.* The two major categories of allergic reaction, rapid and delayed, correspond to the two major types of immune responses.

Rapid allergic reactions, such as those to bee venom, pollen or pets, are caused by humoral immune mechanisms. These immediate hypersensitivity reactions result from the production of IgE antibodies when a person is first exposed to an allergen. The IgE antibodies become attached to *mast cells*—white blood cells containing *histamine,* the chemical that causes the familiar allergic symptoms of runny nose, watery eyes, and sneezing. Mast cells are particularly abundant in the lungs and intestine. If the antigen-binding sites of mast cells become filled with an allergen, the mast cells release histamine.

Allergic reactions that are slow in onset (known as *delayed-type hypersensitivity,* or DTH), such as those to poison ivy or poison oak, are cell mediated. Extreme examples of DTH occur when macrophages cannot easily destroy invading substances. As a result, T cells are activated, leading to inflammation of the body tissue. This inflammation continues for as long as the T cells are activated. The bacterium that causes tuberculosis also falls into this category because this bacterium is covered with a waxy coat that macrophages cannot destroy. The resulting DTH leads to the lung and liver damage associated with tuberculosis.

B Transplant Rejection

The immune system recognizes and attacks anything different from the substances normally present within an individual, even substances that are only slightly different, such as transplanted tissues and organs (*see* Transplantation, Medical).

When an organ is transplanted, the MHC of the donor organ is recognized as foreign and attacked by the recipient's immune system. To minimize the chances of transplant rejection, physicians seek transplant donors who share as many MHC genes as possible with the transplant recipient. Even then, most transplant recipients are given drugs to suppress their immune response and prevent rejection of the transplant.

If the transplanted tissue contains T lymphocytes from the donor, as in bone marrow transplants, these donor T lymphocytes may recognize the recipient's tissues as foreign and attack them. Physicians can reduce or prevent this potentially fatal *graft-versus-host (GVH) reaction* by removing all mature T lymphocytes from the organ or tissue before performing the transplant.

C Immune Deficiency

Deficiencies in immune function may be either inherited or acquired. Inherited immune deficiencies usually reflect the failure of a gene important to the generation or function of immune system components.

Some inherited diseases damage a person's innate immunity by making macrophages incapable of ingesting or breaking down invading organisms. Individuals affected by these diseases are

especially susceptible to *opportunistic infections*—that is, infections by normally harmless organisms that can flourish in a person whose immune system has been weakened.

DiGeorge syndrome is an inherited immune disorder in which a person has no thymus and, therefore, cannot produce mature T lymphocytes. People with this disorder can mount only limited humoral immune responses, and their cell-mediated immune responses are severely limited.

The most extreme example of a hereditary immune deficiency is severe combined immunodeficiency (SCID). Individuals with this disease completely lack both T and B lymphocytes and thus have no adaptive immune responses. People with SCID must live in a completely sterile environment, or else they will quickly die from infections.

Acquired immune deficiencies can be caused by infections and also other agents. For example, radiation therapy (*see* Radiology) and some kinds of drugs used in treating disease reduce lymphocyte production, resulting in damaged immune function. People undergoing such therapies must be carefully monitored for lowered immune function and susceptibility to infections. Environmental and lifestyle factors, such as poor nutrition or stress, can also affect the immune system's general status.

An infectious agent resulting in fatal immune deficiency is the human immunodeficiency virus (HIV). This virus causes acquired immunodeficiency syndrome (AIDS) by infecting and eventually destroying helper T cells. Because helper T cells regulate all immune responses, their loss results in an inability to make adaptive immune responses. This complete lack of immune function makes individuals with AIDS highly susceptible to all infectious agents.

D Autoimmune Diseases

Autoimmunity is the immune response of the body turned against its own cells and tissues. Autoimmune diseases may involve either cell-mediated responses, humoral responses, or both. For example, in Type 1 diabetes, the body makes an immune response against its insulin-producing cells and destroys them, with the result that the body cannot use sugars. In myasthenia gravis, the immune system makes antibodies against the normal molecules that control

neuromuscular activity, causing weakness and paralysis. In rheumatic fever, the immune system makes antibodies that bind to the heart's valves, leading to permanent heart damage. In systemic lupus erythematosus, commonly known as lupus, the body makes antibodies against many different body tissues, resulting in widespread symptoms.

The mechanisms of autoimmune diseases are poorly understood, and thus the basis for autoimmunity is unclear. Much research focuses on trying to understand these mechanisms and should eventually result in cures.

Contributed By:
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Blood Transfusion

Blood Transfusion, in medicine, the procedure of introducing the blood of a donor or blood predonated by the recipient (autologous transfusion) into the bloodstream. It is a highly effective form of therapy and has saved the lives of incalculable numbers of people suffering from shock, hemorrhage, or blood diseases. Blood transfusion is employed routinely in cases of surgery, trauma, gastrointestinal bleeding, and in childbirths that involve great loss of blood.

In the 17th century, the French physician Jean Baptiste Denis performed the first recorded transfusion by infusing sheep's blood into a human. Most later attempts were unsuccessful. Even when human blood was used, the majority of recipients died because of blood incompatibility. With the discovery of the major blood groups and the introduction of blood typing in the 20th century, transfusion became routinely successful (*see* Blood Type).

Transfusions still tend to cause the development of sensitivity and increase the possibility that the recipient will react to any later transfusions. Transmission of viral hepatitis was a major risk until a method of screening blood for infectivity was developed in the 1960s; some other forms of hepatitis, however, are not detected by this test. In 1985 a test was introduced that screens donated blood for an antigen associated with AIDS, or acquired immunodeficiency syndrome.

For most of this century, transfusion was accomplished with whole blood. Methods of separating blood into its components (*see* Blood) were devised during the 1960s. Between 1970 and 1980 the use of these blood components became more frequent than the use of whole blood. Replacement with *packed* red blood cells (concentrated blood cells that have been separated from the blood plasma) is now the preferred treatment for most blood loss caused by injury or surgery.

In some instances the circulating blood volume can be depleted by loss of fluid but little or no loss of red cells. For example, this can occur soon after a severe burn, during peritonitis, and after a limb has suffered a crush injury. The purpose of transfusion in these instances is to bring the amount of circulating fluid back to or toward normal. For such transfusions red blood cells are not necessary; plasma or, better, serum albumin, a plasma derivative, is more appropriate. Fresh-frozen plasma can be stored for as long as a year, but it still has the potential for transmitting hepatitis and is best used only when *blood-clotting factors* (proteins in the plasma that assist in the clotting process) are needed. Albumin solution, on the other hand, is heat-treated to destroy hepatitis infectivity. It is used in the management of shock and burns, and for some patients with kidney and liver disease. A less pure fraction of plasma called *plasma protein fraction* can be used for many of the same purposes.

Clotting factors isolated from blood are used to treat some hereditary bleeding disorders such as hemophilia. Patients undergoing chemotherapy for cancer may have too few platelets, small blood components that help prevent or stop bleeding, both separate from and as part of the clotting process; they may be given an infusion of platelets to speed clotting.

Various synthetic plasma substitutes, such as the carbohydrate compound dextran, as well as various saline solutions, have been used in recent years to replenish the blood-fluid level that often falls dangerously low in cases of sudden shock. These substances, called *plasma volume expanders,* are more readily available than blood products. During the late 1970s, a synthetic blood-carrying substance called Fluosol-DA, a fluorinated hydrocarbon, was successfully used in several patients who could not or, for religious reasons, would not receive transfusions of natural blood products. Research is also being conducted into ways of converting one blood type into

another; if developed, this process would help increase the availability of blood products to all patients.

Although blood can be transferred directly, the usual practice for hospitals is to use blood that has been collected earlier and stored in so-called blood banks. The use of stored blood began during World War I (1914-1918), but the first large-scale blood bank was not created until 1937, in Chicago. Many health-care centers now maintain their own blood banks, using more than 98 percent volunteer donors; the American Red Cross also runs a large volunteer program. A donor supplies 480 ml (about 1 pint) each time, and samples are also taken for typing and screening.

Contributed By:
Paul R. McCurdy

HEMOPHILIA

Hemophilia, hereditary blood disease characterized by the inability of blood to clot, or coagulate, leading to hemorrhage, or excessive bleeding, even from minor injuries. The disease is caused by an insufficiency or absence of certain blood proteins, called factors, that participate in blood clotting. The most common form, hemophilia A, is observed in 80 percent of hemophiliacs and is caused by a lack of factor VIII; in the second most common, hemophilia B (Christmas disease), factor IX is missing. The severity of hemophilia varies greatly. The bleeding may occur as excessive bruising or persistent bleeding after a simple cut. Hemorrhaging into joints and muscles can be disabling. Before the advent of modern therapy, the chance of survival to adulthood was poor.

About 80 percent of all cases of hemophilia have an identifiable family history of the disease; in other instances, it may be attributable to a spontaneous mutation of genes. Researchers recently discovered that the spontaneous mutation of the factor VIII gene in two children was due to the attachment of a foreign “jumping gene” (*see* Genetics) that disrupted the blood-clotting ability of

the factor VIII gene. Inheritance is controlled by a recessive sex-linked factor carried by the mother on the X chromosome. A probability of one in two exists that each boy born to a normal male and a carrier female will be hemophiliac and the same chance that each girl of this union will be a carrier. Of the children of a hemophiliac male and a normal female, all the girls will be carriers and all the boys will be normal. Males cannot transmit the disability, and female carriers are free of the disease. A classic case of the transmission of hemophilia involves Queen Victoria of Britain, whose daughters married into the Spanish and Russian royal houses, thereby transmitting the gene for this disease to those lineages.

Prevention of injury is important for the patient with hemophilia. When bleeding occurs, replacement therapy may be necessary. Freshly frozen blood plasma can be used to treat mild forms of the disease. In severe cases, hemophiliacs can administer plasma extracts at home either in a freeze-dried form that is storable for six months at room temperature or for a year in the refrigerator; or else in a form called cryoprecipitate, a concentrate that is prepared from fresh blood and must be refrigerated. Cryoprecipitate and other types of concentrates are less likely to transport diseases such as hepatitis and acquired immunodeficiency syndrome (AIDS) because concentrates are prepared from the blood of a single donor, whereas plasma comes from large pools obtained from many donors. Screening of donors and heat treatment of plasma products have recently decreased the risk of disease transmission. The cloning of factor VIII by genetic engineering allowed the development of a completely safe replacement product that was approved by the Food and Drug Administration (FDA) for commercial production in 1992. Unfortunately, a high percentage of hemophiliacs have already been exposed to the AIDS virus.

Contributed By:
Mark Abramowicz

1983: PUBLIC HEALTH

Archives consist of articles that originally appeared in Collier's Year Book (for events of 1997 and earlier) or as monthly updates in Encarta Yearbook (for events of 1998 and later). Because

they were published shortly after events occurred, they reflect the information available at that time. Cross references refer to Archive articles of the same year.

1983: Public Health

The most newsworthy public health story of 1983 was the accelerating epidemic of AIDS (acquired immune deficiency syndrome). Other events occurred that may influence the course of public health in the future, especially the new federal reimbursement mechanism for hospitalized Medicare patients.

Epidemic.

In 1981, epidemiologists at the U.S. Centers for Disease Control in Atlanta became aware of outbreaks of certain previously rare diseases—a cancer called Kaposi's sarcoma and a form of pneumonia caused by the organism *Pneumocystis carinii*—in young homosexual men in New York and California. Since the CDC is the facility in the United States that stockpiles an antibiotic used to treat *Pneumocystis* pneumonia, scientists there began to research past requests for the drug. They found there had recently been increased demands for it, indicating widespread occurrence of the pneumonia; the type in question is classified as an 'opportunistic' infection, one that seldom afflicts an individual with a healthy immune system. The CDC began requesting case reports of the pneumonia and Kaposi's sarcoma; as a result, AIDS—or acquired immune deficiency syndrome—became recognized as a new and serious disease syndrome.

AIDS, which was soon seen in intravenous drug users as well as in male homosexuals, involves a loss of the body's ability to fight certain kinds of infections and cancers. For instance, Kaposi's sarcoma used to be considered of low malignancy and was almost never fatal in the past. In AIDS patients, though, it has shown itself to be quite malignant, and death usually results. Other symptoms seen in AIDS patients include a diffuse enlargement of the lymph glands and infections with various organisms, including the tuberculosis bacterium, the herpes simplex virus, and the cytomegalovirus (which is common in the homosexual community).

Male homosexuals and intravenous drug users are not the only individuals in danger of contracting AIDS; Haitians and hemophiliacs are also said to be at risk. Most other people appear to have an exceedingly low risk; exceptions include infants of mothers in the high-risk

groups (particularly intravenous drug users), female sexual partners of AIDS patients, and prison inmates with a prior history of drug use.

According to the classic definition of an epidemic as 'an unusual occurrence of disease,' AIDS should be considered a true epidemic. Reported cases by three-month periods have increased from fewer than 25 in the first quarter that reporting was done (April to June 1981) to approximately 525 in the April-June quarter of 1983. Moreover, the rate of increase itself appears to be on the rise. Some of the rise is undoubtedly the result of better diagnosis and reporting, but it is unlikely that these alone account for the whole increase. One of the most worrisome things about the epidemic is the suggestion that the underlying infection, suspected by most scientists to be the cause of AIDS, may occur months or even years before AIDS symptoms appear. Hence it is not known how many persons are now incubating the disease and could develop symptoms over the next two or three years. The current rates of disease may therefore be just a fraction of the rates that may be reported in the future. This possibility is causing great anxiety among persons in the high-risk groups and in the public health community.

The underlying medical problem in AIDS appears to be a defect in the body's T cells, white blood cells that are vital in protecting people from infection. There are at least two kinds of T cells: helper T cells, which stimulate the production of infection-fighting antibodies, and suppressor T cells, which inhibit the production of these antibodies. Usually there are two or three times as many helper T cells as suppressor T cells. However, in the immunodeficiency state associated with AIDS, there are more suppressor than helper cells, and there is now evidence that the few remaining helper cells are not normal.

It is not known for certain why this deficiency occurs, but most health officials believe the cause is an infectious agent, such as a virus. (One source of evidence is the fact that the pattern of distribution of AIDS in the population bears many similarities to that of hepatitis B, which is known to be caused by a virus.) This year, investigators found evidence of human T-cell leukemia virus in the lymphocytes of AIDS patients (lymphocytes are a type of white blood cells); it has not been determined whether the virus caused AIDS or is merely another opportunistic infection.

If an infectious agent is responsible for AIDS, the infection could be transmitted in a number of ways. For male homosexuals, intimate sexual contact might be responsible, and the transmission of infected blood may provide the route for spread in intravenous drug users and some recipients

of blood products. Research is planned in which apparently healthy persons in the high-risk groups, especially male homosexuals, will have their blood and immune functions studied periodically over a span of years; the expectation is that some will eventually develop AIDS, so that changes associated with its development can be scrutinized. In addition, the CDC is investigating AIDS cases that do not belong to the high-risk groups. Much of the funding for ongoing AIDS research came from the federal government, which has put considerable effort and resources into AIDS research.

While research continued, health agencies responded to the plight of AIDS victims by providing clinics, counseling, diagnosis, and, to the extent possible, treatment of the disease. However, no specific or very effective treatment has thus far been found, and most AIDS patients eventually die of their disease.

One of the negative impacts of the AIDS epidemic for the general public resulted from a misunderstanding of the disease. People were apparently confused by reports linking AIDS with blood transfusions, and the rate of blood donations dropped significantly, especially in areas like New York City that have high AIDS rates. As public health officials have assured prospective donors, there is *no* risk of acquiring AIDS from donating blood.

Prospective reimbursement for Medicare patients.

On April 20, President Ronald Reagan signed into law a statute altering the system by which U.S. hospitals are reimbursed by the government for care given to Medicare patients. Under the new policy, known as prospective reimbursement or payment, hospitals will be reimbursed with fixed fees set in advance for each patient, based on the problem diagnosed, rather than being reimbursed for the services and treatment the patient is actually given. The basis for deciding the amount of reimbursement is a list of 467 categories of illness called 'diagnosis-related groups' (DRG's). The plan, which currently applies only to inpatient Medicare services, will be phased in over a period of years, beginning October 1. The reimbursement rate will be adjusted depending on which of nine U.S. regions the hospital is in and whether it is considered urban or rural. A number of states have been exempted from the system because they already have cost-containment programs that incorporate the DRG system in some way.

Under the new system, if a hospital can devise ways to provide care for a particular patient economically, spending less than the government has determined that that patient's condition

requires, the hospital might well make a profit on that patient. On the other hand, if more care is given than the government estimates is needed, the hospital is likely to lose money. It is hoped that hospitals will be forced to improve their internal efficiency monitoring and will then provide more cost-efficient patient care.

One of the strengths of the system is that it provides an incentive for hospitals to determine what care is really necessary for patients, and it may well decrease the number of unnecessary tests and procedures done. Fears were voiced, though, that patients might be denied necessary tests or care, or that diagnoses might be 'padded' in order to get patients into more costly diagnosis-related groups—a phenomenon informally known as 'DRG creep.'

The DRG system was originally developed at Yale University as a tool for hospital administrators to improve their efficiency; it was not designed as a nationwide reimbursement mechanism. However, the federal government, desperate to find a better way to control skyrocketing medical care costs, in 1980 established a demonstration project in New Jersey using DRG's as the basis for reimbursement. The experiment was considered a success, and the government decided to apply the method nationwide. Many in the health field are worried that the application may be premature.

Plague.

In a two-month period from mid-April to mid-June, 16 cases of human plague were reported to the CDC by the health departments of four western states—New Mexico, Arizona, Utah, and Oregon. Four patients reportedly died of the disease, which is caused by a bacterium and is also known as bubonic plague.

The cases were the result of exposure to wild-rodent plague. Fleas bite the rodents—including ground squirrels, chipmunks, and prairie dogs—and become infected with the plague bacteria. The fleas then transmit the disease by biting people. In addition to the four states with cases of human plague, animal plague was reported this year in Nevada, California, Colorado, Wyoming, Texas, and Washington.

Rabies in raccoons.

Years ago in the United States, most rabies cases in raccoons were confined to Georgia and northern Florida. However, over the last few years, raccoon rabies has moved up the Appalachian mountains, and in 1983 it struck hard in the Virginia and Washington, D.C., area. Raccoon rabies—which is potentially fatal if transmitted to humans—remained a problem in the Georgia and Florida area, and it also became a problem in sections of the Great Plains from Texas to Montana.

Residents of areas with animal rabies should have all domestic animals vaccinated against rabies, make sure children are carefully monitored when they play outside, and avoid any suspiciously behaving animal; if possible, such an animal should be trapped or killed, so that its brain can be examined in a laboratory for signs of the disease. Scientists are worried that animal rabies will continue to move up the Appalachians to the northeastern United States, where many more people will be potentially exposed.

Toxins.

Dioxin, a dangerous by-product of certain chemical manufacturing processes, has been found to be a contaminant at more and more sites in the United States. The most dramatic contamination was reported in the small town of Times Beach, Mo., which lies on the bank of the Meramec River. In late 1982 floodwaters from the river almost destroyed the town. During the cleanup, unacceptably high levels of dioxin were found in the refuse spread throughout the town streets, the result of spraying of dirt roads more than ten years earlier with a dioxin-contaminated oil mixture. The flood apparently helped spread the toxin. The contamination was so bad that the town was deemed not fit for human habitation, and in February, the U.S. Environmental Protection Agency announced that the federal government would buy up property in the town and relocate its residents. Since then, Times Beach has become a virtual ghost town. Meanwhile, elevated levels of dioxin from the same kind of contaminated oil were found in other Missouri towns.

Not all news from the toxin front was bad, however. A study released in May by the CDC, Brookhaven National Laboratory, and Oak Ridge National Laboratory found no increase in chromosomal abnormalities in 46 residents or former residents of the Love Canal area of Niagara Falls, N.Y., where chemical contamination was discovered in 1978 from a leaking waste dump. A group of 50 people who lived in Niagara Falls but not near the canal served as controls.

Health goals.

In 1980 the U.S. Public Health Service established 226 measurable objectives for the prevention of disease. Fifteen priority areas were identified: high blood pressure, family planning, maternal and child health, immunization, sexually transmitted disease, toxic agents, occupational safety and health, accidental injuries, dental health, infectious diseases, smoking, misuse of alcohol and drugs, stress and violent behavior, better nutrition, and physical fitness. In late 1982 the CDC, which is the lead federal agency in this effort, held a national conference to obtain guidance on how to carry out its mandate for achieving objectives in all of these areas by 1990. The recommendations included a number of projects that would require increased resources the Reagan administration may be unwilling to provide. One goal—the elimination of measles in the United States by October 1982—has already been missed, although it may be achieved within the next few years.

Erosion of teeth among swimmers.

In September 1982, a dentist in Charlottesville, Va., discovered that two competitive swimmers were suffering from an erosion of tooth enamel. The swimmers trained at the same private club pool, and questionnaires were sent to all club members asking if they had symptoms compatible with enamel erosion. A significant proportion of frequent and competitive swimmers were found to suffer from such erosion.

Examination of the swimming pool led to the finding that the water was extremely acid, the pH reaching levels as low as 2.7, which is 100,000 times the acidity recommended for swimming pools by the American Public Health Association. The acidity occurred despite the use of soda ash when the pH meters showed the water was acidic. Apparently, though, pool managers had erred in not rechecking after use of the soda ash to make sure the pools were in the appropriate acid range for swimming.

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