Uncompromising

immunocompromised patient care

With the rise of HIV infection and procedures like organ transplants, the number of immunocompromised patients is also on the rise. So it's a safe bet that you'll encounter such patients in your practice. Find out how the immune system works, what happens if there's a breakdown in the body's front line of defense, and how you can help your immunocompromised patient stay healthy.

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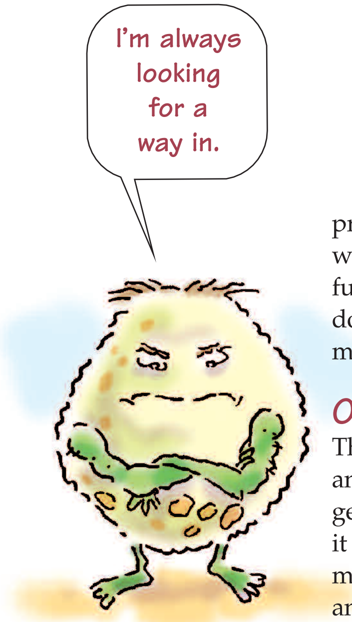
EVERY DAY, OUR BODIES are threatened by microorganisms and toxins that could make us sick. That's where the immune system—also called the host defense system—comes in. It's our best defense mechanism against these external and internal forces. In essence, the immune system is critical to our survival.

Sometimes, though, the immune system falters and disease results. Patients with deficient or dysfunctional immune systems can develop problems, such as allergic hypersensitivity, autoimmune disease, or transplant organ rejection. Those with chronic illnesses, such as rheumatoid arthritis, diabetes, inflammatory bowel disease, and chronic obstructive pulmonary disease (COPD), are also immunocompromised.

It may seem daunting to care for patients whose immune systems are compromised. This article will help by looking at how the



protective mechanism of the immune system works and what can happen when it malfunctions and by giving you tips on what to do when your patient is immunocompromised. Let's get started.

On the defensive

The immune system is made up of organs and highly specialized cells that work together to defend against infection and clear it from the body. The organs of the immune system are called lymphoid organs and they consist of bone marrow, the thymus, the spleen, and the lymph nodes (see *The organization of immunity*.) The cells of the immune system, called lymphocytes, are transported via the bloodstream to the tissues.

The immune system is always on the alert for foreign substances. In a healthy person, it's constantly differentiating *self,* what it recognizes as part of the body, from *nonself,* foreign and potentially dangerous antigens. These antigens are what the immune system targets for attack, and they include toxins and exogenous microorganisms, such as bacteria and viruses.

Once the immune system identifies foreign elements, it immediately goes into action to defend the body. It recruits, activates, and releases appropriate cells and mediators to the site of the invasion, destroying the foreign element. It also screens cells that are normally present in the body. Whenever these cells show signs of becoming abnormal, such as with tumors, the immune system goes into action, just as it does with foreign elements.

The *organ*ization of immunity

Certain body organs are responsible for producing, differentiating, maturing, and storing the components of the immune system. Let's take a closer look.

- ***Bone marrow*.** Blood cells, including cells necessary for immune function, are produced inside the bone marrow. Marrow cells are initially stem cells, capable of becoming any number of body cell types. Some will develop into myeloid stem cells, which further separate in the bone marrow to form mast cells, basophils, neutrophils, eosinophils, macrophages, monocytes, and erythrocytes. Other cells migrate to and mature in the thymus to become lymphocytes, which play an important role.
- ***Thymus*.** The thymus lies in the mediastinum of the chest, and it's responsible for producing mature and competent T cells. Early in life, the thymus provides T cells to the rest of the immune system. Hormones in the thymus attract circulating stem cells (T cell precursors) and promote maturation, enabling T cells to produce antibodies on their cell wall, which provides T cell immunity. These antibodies can then interact with antigens on nonself cells. If the thymus gland is absent at birth, the infant won't be able to fight infections because of profound immunodeficiency.
- ***Spleen*.** The spleen is located in the left upper quadrant of the abdomen, lying under the rib cage and diaphragm. Both T and B cells are found in the spleen. The spleen also stores platelets (20% to 30% of total platelet volume); removes old, damaged, or abnormal red blood cells; and filters and processes antigens in the blood. Despite this seemingly important role, the spleen doesn't appear to be essential to survival: Patients who've undergone a splenectomy usually go on to live normal lives.
- ***Lymph nodes*.** Lymph nodes are found all over the body, including the head, neck, axillae, abdomen, pelvis, and groin. Many types of cells are produced or stored in the lymph nodes, including T cells, B cells, plasma cells with immunoglobulin, and macrophages. Lymph nodes perform a rather deliberate filtration process for the body, allowing careful inspection, destruction, and removal of antigens. They also localize and prevent the spread of infection. Lymph tissue is found in the tonsils, small intestine, and appendix.

But how does the immune system keep a person safe from foreign invaders? Let's take a closer look.

An elephant's memory

A normally functioning immune system consists of three specific aspects: memory, tolerance, and biologic amplification. Here's how they work.

- ***Memory*** describes the immune system's ability to remember a specific antigen and respond to reexposure. How does it do this?

  From conception, lymphocytes—the immune system's gatekeepers—construct a DNA code for each antigen they encounter. These codes become part of a fully developed immune system. Lymphocytes can recognize millions of different antigens, in each case distinguishing self from nonself. Immune system memory evolves throughout the body's lifetime. Even if reexposure doesn't occur for many years, the immune system retains the DNA code for each antigen encountered. For example, a person who was stung by a bee as a child may experience a severe reaction when stung by another bee 30 years later because of immune system memory.
- ***Tolerance*** is the immune system's ability to ignore and preserve certain body tissues and cells but still mount an attack on antigens that endanger the body's health. Without tolerance, the immune system might destroy all body cells rather than just those cells that are potentially harmful. In some individuals, autoimmune diseases such as rheumatoid arthritis destroy helpful body cells. Just as with immune system memory, tolerance is an evolving and lifelong process.
- ***Biologic amplification*** refers to the efforts of lymphocytes working with other immune components to boost T cell strength. This is because T lymphocytes (T cells), the primary cells of the immune system, can't recognize, isolate, destroy, and eliminate antigens on their own.

Granting immunity

There are several different types of immunity, including:

- ***Antibody-mediated immunity.*** In this type of immunity (also known as humoral immunity), the body makes antibodies in response to an introduction of foreign cells (antigens).
- ***Innate humoral immunity.*** This type of immunity is specific to an individual and can't be transferred.
- ***Acquired humoral immunity.*** Every person's body makes this type of immunity in response to an antigen being introduced. It can occur naturally or artificially (vaccines).
- ***Active immunity.*** This type of immunity occurs when antigens enter the body and the body actively makes antibodies in response. It can be natural or artificial.
- ***Cell-mediated immunity.*** Many cell actions, reactions, and interactions work together in this type of immunity to embody the self versus nonself concept of recognizing and fighting diseases.

So what can T cells, and their lymphocyte cousins, B cells, do to keep the immune system running smoothly? I'll take a look at them next.

Mounting a counterattack

T cells are the most common type of lymphocytes, making up 70% to 80% of total lymphocytes. B cells, on the other hand, account for only 10% to 15% of lymphocytes. Here's a snapshot of what these cells do.

- ***T cells*** regulate B cells and help them produce antibodies. The two broad categories of T cells are *helper T cells* (for example, $CD4^+$) and *suppressor T cells* ($CD8^+$ is one type).

  When the immune system detects an antigen, it's pursued by a macrophage—another type of immune system cell—and presented to the T cell. The T cell in turn delivers the antigen to a B cell, which generates antibodies.

  By making direct contact with offending cells, T cells defend against viruses, bacteria, fungi, intracellular organisms, tumor antigens, and host-versus-graft reactions. (A tuberculosis skin test is an example of a T cell–mediated immune response.) They also produce cytokines, proteins that regulate immune function activities. Examples of cytokines include interleukins, interferon,

transforming growth factor, and tumor necrosis factor.

- ***B cells*** are essential to the body's humoral immunity, which is formed when an antigen produces an antibody (see *Granting immunity*). B cells in the thymus gland migrate to the bone marrow, where they mature. They then activate and become *memory B cells* and *plasma cells*. The plasma cells secrete immunoglobulins (Ig), also known as antibodies (see *Antibodies for a healthy body*).

Some lymphocytes, called *null cells*, are neither T cells nor B cells. These powerful cells can destroy foreign agents without using antibodies. They also influence the activity of other components of the immune system. And lymphocytes aren't the only type of immune system cells. Others include *macrophages, eosinophils,* and *basophils.* These cells are phagocytic, which means that they destroy foreign cells by surrounding and ingesting them.

Now that you know what goes on at the cellular level in the immune system, I'll clue you in on what happens when the immune system is somehow impaired or dysfunctional.

The pathogen threat

Chronic illnesses impair the body's immune system in a multitude of ways. Let's look at a few examples:

- With increased amounts of readily available glucose and an increase in blood viscosity, *diabetes* creates opportunity for bacteria to thrive.
- In *COPD,* a decrease in gas exchange alters tissue integrity and creates a more welcoming atmosphere for foreign organisms.
- *Cancer treatments,* such as chemotherapy and radiation therapy, decrease the immune system's ability to synthesize new protective cells.

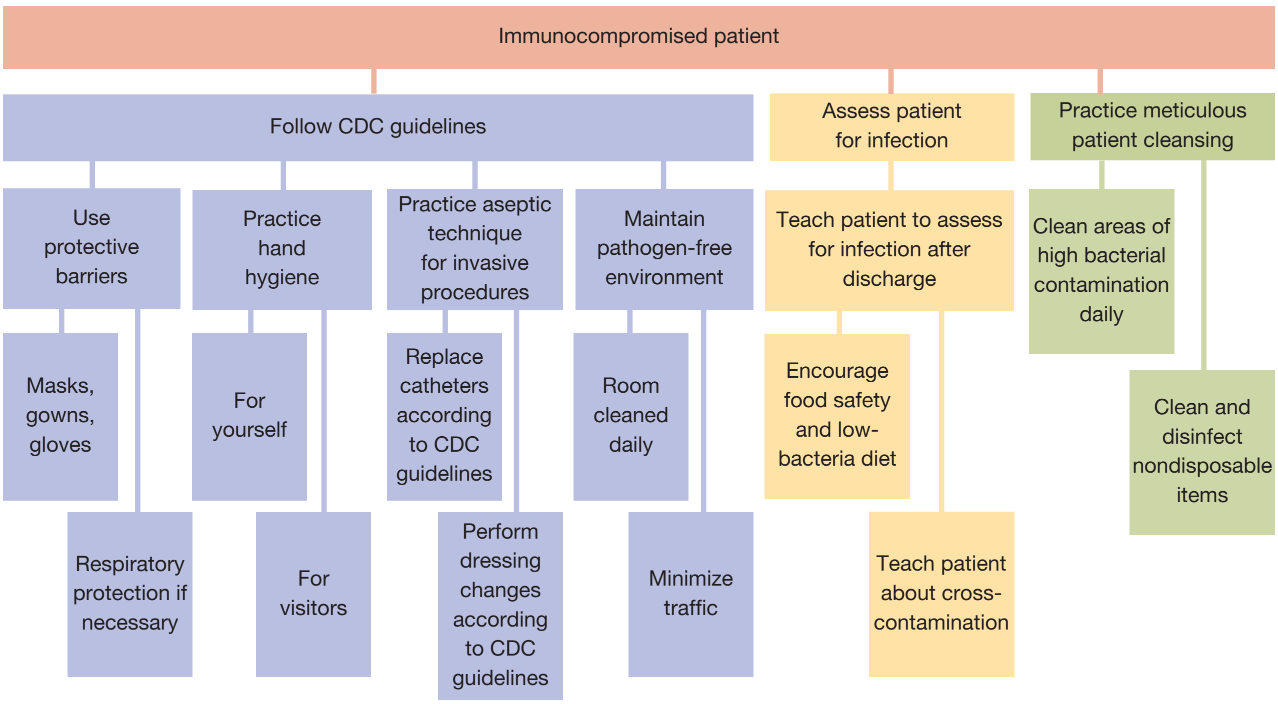
Age affects the immune system as well. A newborn with maternal antibodies receives what's called passive acquired immunity through the placenta and via breastfeeding. After maternal antibodies have subsided, though, a child's immature immune system

Antibodies for a healthy body

Immunoglobin (Ig) antibodies are critical to disease prevention and recovery. There are five types of serum Ig: IgG, IgA, IgM, IgD, and IgE. Although all of them work by finding and destroying foreign bodies, each has a specific role.

- ***IgG*** is the most common type of antibody. About 75% of circulating Ig is IgG. It's found in all body fluids and it crosses the placenta to the fetus during pregnancy. IgG activates the complement system of immunity—a series of proteins that complement antibody activity in destroying bacteria. Subtypes of IgG, such as IgG4, have even more specialized functions; they're usually measured specifically when a patient with immune deficiency is being evaluated.
- ***IgA*** appears in blood, saliva, tears, and breast milk; it's also found in pulmonary, gastrointestinal (GI), prostatic, and vaginal secretions. IgA comprises up to 15% of Ig in the body. Scientists believe that it prevents antigens from attaching to epithelial surfaces, which means it's an essential defense for the skin. It also protects against respiratory, GI, and genitourinary infections. IgA deficiency is the most common cause of immune deficiency.
- ***IgM*** accounts for about 10% of the body's Ig. It's present at birth and circulates in the blood as an important immune protector for newborns. A patient who has an acute infection, such as Epstein-Barr virus, will usually have his IgM level tested for a specific antigen.
- ***IgD*** and ***IgE*** are found in very small amounts (0.2% and 0.004%, respectively). The function of IgD, which is found on the surfaces of B cells, isn't clearly understood, but it's believed to regulate antibody synthesis. IgE protects the body against parasitic infections. People who have allergies have greater amounts of IgE; it's associated with allergic hypersensitivity.

Conceptualize immunocompromised patient care

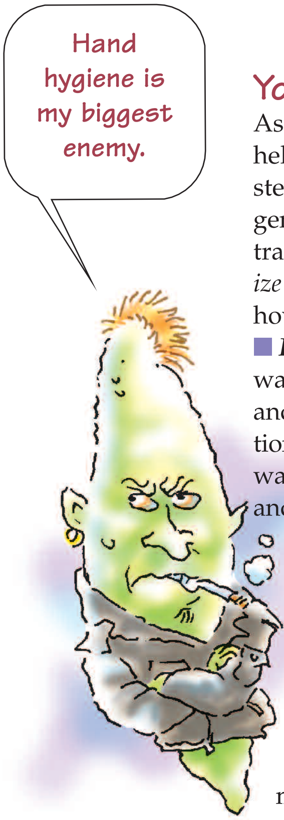


is less able to fight off disease. Older patients also have a lower level of natural immunity. As we age, the body's subcutaneous fat lessens and makes skin more susceptible to breakdown. Poor nutrition in older patients also contributes to a weakened immune system.

While the number of helper T cells in the body doesn't decrease with age, these cells may no longer function as effectively as when the body was younger. The typical signs and symptoms of infection that you might see in an otherwise healthy adult, such as fever or chills, may be absent in an older patient who's developed an infection. The result may be more opportunity for disease or illness to take hold in older adults. Other factors of aging, such as changing mental status, decreased mobility, falls, poor nutrition, and incontinence, can increase the likelihood that an older patient may become immunocompromised with an illness, such as a urinary tract infection or pneumonia.

A patient who's immunocompromised is under constant threat from pathogens. Some of these organisms, like the flora in the intestines, are harmless or even beneficial. But when the body's immune system can't function at peak effectiveness, such as with chemotherapy, HIV infection, or prescribed antibiotics used to kill other bacteria, pathogens that are usually held in check can proliferate and cause infection. This type of invasion is called an opportunistic infection. Examples of opportunistic infections in immunocompromised patients include *Candida*, cytomegalovirus, and tuberculosis. The patient's health care provider will individualize treatment based on these infections.

Now, let's review practical steps you can take to help your patient whose immune system is compromised.



You can never be too careful

As a nurse, you're in an ideal position to help prevent the complications that can stem from immune compromise by diligently observing practices that prevent the transmission of pathogens (see *Conceptualize immunocompromised patient care*). Here's how.

- ***Practice appropriate hand hygiene.*** Hand washing remains the quickest, least costly, and simplest way to avoid spreading infection. You already know about frequent hand washing; be sure to tell patients, families, and visitors about its importance as well.

Make sure the patient's room has soap and water and an alcohol-based hand sanitizer available. Encourage family members and caregivers to take the same precautions at home.

Anyone who enters the room of a hospitalized patient who's immunocompromised, such as a medical staff member, a housekeeper, a repair person, or a visitor, should use an alcohol-based hand rub or wash his or her hands before having contact with the patient, his belongings, or any equipment or surfaces in the room. Likewise, the patient should wash his hands frequently, especially after contact with others and after he's used the bathroom.

While you're promoting hand washing, remember to keep your own fingernails short and free of chipped polish to help limit areas where pathogens can collect. Advise patients and their families to do so as well. Health care providers should also avoid artificial nails, which often harbor pathogens.

- ***Use protective barriers,*** such as masks, gowns, and gloves, whenever necessary. For example, if another patient in your care has an active infection, you'll want to wear a fresh gown when you return to the immunocompromised patient. Use gloves for all dressing changes and whenever you come in contact with bodily fluids or pathogenic substances.

The Centers for Disease Control and Prevention (CDC) also recommends personal respiratory protection for people entering the room of an immunocompromised patient, especially when a patient has tuberculosis or smallpox, or when staff members lack immunity to airborne viral diseases, such as measles or varicella zoster virus infection.

According to guidelines from the CDC, immunocompromised patients may be placed in airborne infection isolation (AII) units. These are areas in which patients are isolated after they've been infected with organisms spread via airborne droplet nuclei less than 5 microns in diameter. An AII area receives numerous air changes per hour and is under negative pressure, which means that the direction of air flow is from the outside adjacent space (for example, the corridor) into the patient's room. The air in an AII room should be exhausted to the outside. However, it may be recirculated if the return air is filtered through a high-efficiency particulate air filter.

- ***Practice meticulous patient cleansing.*** When bathing an immunocompromised patient, pay special attention to areas of high bacterial contamination, such as the armpits, groin, and perineal area. Cleanse these areas with an antimicrobial solution at least once a day; more frequently if the area is soiled or if the patient is incontinent. Also, remember to stress good oral hygiene.

Remember to clean and disinfect any nondisposable equipment that you need to move between patients. If you can, use a dedicated stethoscope, blood pressure cuff, and thermometer for your immunocompromised patient and keep these items in the room. Clean and disinfect the stethoscope and thermometer before and after use.

If you can, keep supplies you know you'll need, such as paper cups, straws, gloves, and supplies for dressing changes, in the patient's room as well.

- ***Observe CDC guidelines for patient proce-***

dures, such as dressing changes and intravenous (I.V.) tubing changes. The CDC recommends that peripheral venous catheters be replaced at least every 72 to 96 hours in adults to prevent phlebitis. Leave peripheral venous catheters in place in children until I.V. therapy is completed, unless complications occur.

When it's not possible to adhere to aseptic techniques, such as when a venous catheter is inserted during a medical emergency, the catheter should be replaced as soon as possible and no later than 48 hours after the emergency is resolved. Urinary catheters shouldn't be routinely replaced in patients whose only indication of infection is fever. Similarly, a urinary catheter shouldn't be replaced in a patient who has a bacterial or fungal infection if the source of the infection is unlikely to be the catheter.

The CDC also recommends replacing a short-term central venous catheter if purulent drainage is observed at the insertion site. All central venous catheters should be replaced if a patient is hemodynamically unstable or if a catheter-related bloodstream infection is suspected. Guidewire techniques shouldn't be used to replace catheters in patients suspected of having a catheter-related infection because the newly inserted catheter would reside in a tract that's already colonized.

■ ***Keep the patient's environment as pathogen-free as possible.*** The patient's room and the bathroom or commode in the room should be thoroughly cleaned and disinfected daily. Also, try to minimize traffic in and out of the room to help prevent exposure to multiple sources of potential pathogens.

Explain to visitors and family members that plants and flowers should be avoided because they often contain pollen and may frequently carry mold and bacteria.

■ ***Monitor outside contact.*** Encourage healthy adults to visit the immunocompromised patient, but limit or discourage visits by children. They may pose a greater danger to your patient than healthy adults, and limiting contact with the patient will help protect the children from health care-acquired infection as well.

■ ***Closely monitor the patient's vital signs.*** Vital signs in a hospitalized immunocompromised patient should be checked frequently. Even a slight elevation in temperature may indicate infection. Inspect the patient's mouth and other openings of the body for signs of inflammation, infection, or breakdown. Any drainage should be cultured and sent to the lab. Also, remember to assess the patient's nutritional status; stress level; use of alcohol, drugs, or tobacco; and general hygiene practices.

■ ***Practice strict aseptic technique with invasive procedures.*** To prevent urinary tract infections, immunocompromised patients generally don't have urinary catheters. But you'll need to use strict aseptic technique with other invasive procedures such as central line insertion. Because central venous catheters carry a

Assessing for infection

cheat sheet

Be on the lookout for these signs and symptoms of infection in immunocompromised patients:

- fever with or without chills
- cough with or without sputum
- shortness of breath
- difficulty breathing
- difficulty swallowing
- white patches in the mouth
- swollen lymph nodes
- nausea with or without vomiting
- persistent diarrhea
- frequency, urgency, or pain when urinating
- change in the character of urine
- lesions on the face, lips, or perianal area
- redness, swelling, or drainage from skin lesions
- persistent vaginal discharge with or without perianal itching
- persistent abdominal pain.

substantially greater risk for infection than peripheral venous catheters, the CDC recommends a more stringent level of barrier precautions to prevent infection during their insertion. If you assist with this type of procedure, you'll need maximal sterile barrier precautions, including a cap, mask, sterile gown, sterile gloves, and a large sterile drape for the patient. Maximal barrier precautions are also recommended for insertion of peripherally inserted central venous catheters.

With any type of invasive procedure, watch the patient carefully for signs of infection. Any drainage should be cultured and sent to the lab.

Home is where the infection isn't

Besides taking steps to prevent infection while your immunocompromised patient is in your care, you can also educate your patient and his family about the steps they can take to prevent infection after discharge. Focus on the following:

- ***Prepare your patient for discharge*** as soon as possible. Warn him to avoid large crowds and gatherings. It's not necessary to place strict restrictions on his activities, but he needs to be aware of situations in which he may be exposed to greater numbers of pathogens, such as when cleaning out a pet's litter box or when working in the garden.
- ***Promote a low-bacteria diet and encourage food safety techniques.*** Tell your patient to stay away from raw foods, meat that hasn't been thoroughly cooked, and pepper and paprika as seasonings (they can harbor bacteria). Warn him to steer clear of homemade desserts, protein milkshakes, and ice cream because they may contain raw eggs. Canned vegetables from a commercial cannery are preferred over frozen or fresh vegetables, which may harbor potential pathogens. Immunocompromised patients should also avoid buffets and fast-food restaurants; both carry a high risk of contamination because foods tend to be held at temperatures that encourage pathogen growth.

  Remind your patient not to drink water that's been standing at room temperature uncovered for longer than 15 minutes because it may have become contaminated by airborne pathogens. Tap water should be filtered or boiled for 10 minutes, then cooled, before it's consumed. Because municipal water supplies in different areas of the country have varying resident pathogens, he should be especially careful when drinking water while traveling. Similarly, plumbing that's more than a year old carries certain pathogens, such as *Pseudomonas*, 100% of the time. This can be hazardous to immunocompromised patients.

  Encourage your patient to wash his hands before and after eating and drinking, after he shakes hands or has other physical contact, and after he uses the bathroom.

  Suggest that your patient use disposable utensils for eating. If metal or nondisposable utensils must be used, he should wash them after every use in very hot, soapy water (preferably in a dishwasher) to avoid infection or contamination. He should do the same with dishes, cups and glasses, and his toothbrush.
- ***Teach your patient about cross-contamination.*** Remind your patient to avoid sharing toothbrushes, toothpaste, soap, towels, razors, deodorant, or other items that come in close contact with the body. This precaution will help prevent cross-contamination by other members of the household. Your patient should also be advised not to have unprotected sex and to use good judgment to avoid contamination with flora that can cause urinary tract infection.
- ***Encourage your patient to monitor himself for signs and symptoms of infection.*** Your patient should check his temperature and pulse daily, or more often if he believes he may be developing an infection or isn't

feeling well. Tell him to contact his health care provider right away if his temperature is higher than 100° F (37.7° C) or if his pulse is lower than 60 beats/minute or higher than 100 beats/minute. He should also call his health care provider if he develops a persistent cough or has sputum or discharge that's foul-smelling or appears yellow, green, or tan. Any break in the skin, such as a boil or abscess, requires attention. So does cloudy or foul-smelling urine.

Tipping the balance

The immune system is a vigilant defender against foreign substances, both from within and outside the body. Immune function is innate, dynamic, and complex, and the body's survival depends on the normal activity of all its components. With your care and advice, the balance of immune function can be successfully tipped in your immunocompromised patient's favor. ■

Learn more about it

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