

Hospital Associated Infections

Hospital Associated Infections

- Nosocomial infections are now more commonly referred to as Hospital or Healthcare Associated Infections (HAI).
- They are defined as infections that develop in a patient who has been hospitalized for at least 48-72 hours and who was not incubating at the time of admission.
 - It is acceptable if they were incubating at the time of admission if they were *recently* hospitalized.

Hospital Associated Infections

- In 2002, the estimated number of HAIs in U.S. hospitals, adjusted to include federal facilities, was approximately 1.7 million:
 - 33,269 HAIs among newborns in high-risk nurseries,
 - 19,059 among newborns in well-baby nurseries,
 - 417,946 among adults and children in ICUs
 - 1,266,851 among adults and children outside of ICUs.
- The estimated deaths associated with HAIs in U.S. hospitals were 98,987:
 - 35,967 were for pneumonia,
 - 30,665 for bloodstream infections
 - 13,088 for urinary tract infections
 - 8,205 for surgical site infections
 - 11,062 for infections of other sites

Hospital Associated Infections

- Numerous factors influence differences in transmission risks among the various healthcare settings.
- These include:
 - the population characteristics (e.g., increased susceptibility to infections, type and prevalence of indwelling devices),
 - intensity of care,
 - exposure to environmental sources,
 - length of stay,
 - frequency of interaction between patients/residents with each other and with HCWs.

Hospital Associated Infections

- Infection transmission risks are present in all hospital settings.
- However, certain hospital settings and patient populations have unique conditions that predispose patients to infection and merit special mention.
- These are often sentinel sites for the emergence of new transmission risks that may be unique to that setting or present opportunities for transmission to other settings in the hospital.

Hospital Associated Infections

- Intensive care units (ICUs) serve patients who are immunocompromised by disease state and/or by treatment modalities, as well as patients with major trauma, respiratory failure and other life-threatening conditions (e.g., myocardial infarction, congestive heart failure, overdoses, strokes, gastrointestinal bleeding, renal failure, hepatic failure, multi-organ system failure, and the extremes of age).

Hospital Associated Infections

- Although ICUs account for a relatively small proportion of hospitalized patients, infections acquired in these units accounted for >20% of all HAIs.
 - In the National Nosocomial Infection Surveillance (NNIS) system, 26.6% of HAIs were reported from ICU and high risk nursery (NICU) patients in 2002.
- This patient population has increased susceptibility to colonization and infection, especially with MDROs and *Candida* sp., because of underlying diseases and conditions, the invasive medical devices and technology used in their care (e.g. central venous catheters and other intravascular devices, mechanical ventilators, extracorporeal membrane oxygenation (ECMO), hemodialysis/-filtration, pacemakers, implantable left ventricular assist devices), the frequency of contact with healthcare personnel, prolonged length of stay, and prolonged exposure to antimicrobial agents.

Hospital Associated Infections

- Burn wounds can provide optimal conditions for colonization, infection, and transmission of pathogens; infection acquired by burn patients is a frequent cause of morbidity and mortality.
- In patients with a burn injury involving $\geq 30\%$ of the total body surface area (TBSA), the risk of invasive burn wound infection is particularly high.
- Infections that occur in patients with burn injury involving $< 30\%$ TBSA are usually associated with the use of invasive devices.
- Methicillin-susceptible *Staphylococcus aureus*, MRSA, enterococci, including VRE, gram-negative bacteria, and candida are prevalent pathogens in burn infections and outbreaks of these organisms have been reported.

Hospital Associated Infections

- Shifts over time in the predominance of pathogens causing infections among burn patients often lead to changes in burn care practices.
- Burn wound infections caused by *Aspergillus* sp. or other environmental molds may result from exposure to supplies contaminated during construction or to dust generated during construction or other environmental disruption.

Hospital Associated Infections

- There are two tiers of HICPAC/CDC precautions to prevent transmission of infectious agents, Standard Precautions and Transmission-Based Precautions.
- Standard Precautions are intended to be applied to the care of all patients in all healthcare settings, regardless of the suspected or confirmed presence of an infectious agent.
 - Implementation of *Standard Precautions* constitutes the primary strategy for the prevention of healthcare-associated transmission of infectious agents among patients and healthcare personnel.

Hospital Associated Infections

- Hand hygiene has been cited frequently as the single most important practice to reduce the transmission of infectious agents in healthcare settings.
- The term “hand hygiene” includes both handwashing with either plain or antiseptic-containing soap and water, and use of alcohol-based products (gels, rinses, foams) that do not require the use of water.
- In the absence of visible soiling of hands, approved alcohol-based products for hand disinfection are preferred over antimicrobial or plain soap and water because of their superior microbiocidal activity, reduced drying of the skin, and convenience.
- Improved hand hygiene practices have been associated with a sustained decrease in the incidence of MRSA and VRE infections primarily in the ICU.



Hand Hygiene

**is the #1 way to prevent
the spread of infections**

**Take action and practice
hand hygiene often.**

- Use soap and water or an alcohol-based hand rub to clean your hands.
- It only takes 15 seconds to practice hand hygiene.

**Ask those around you
to practice hand hygiene.**

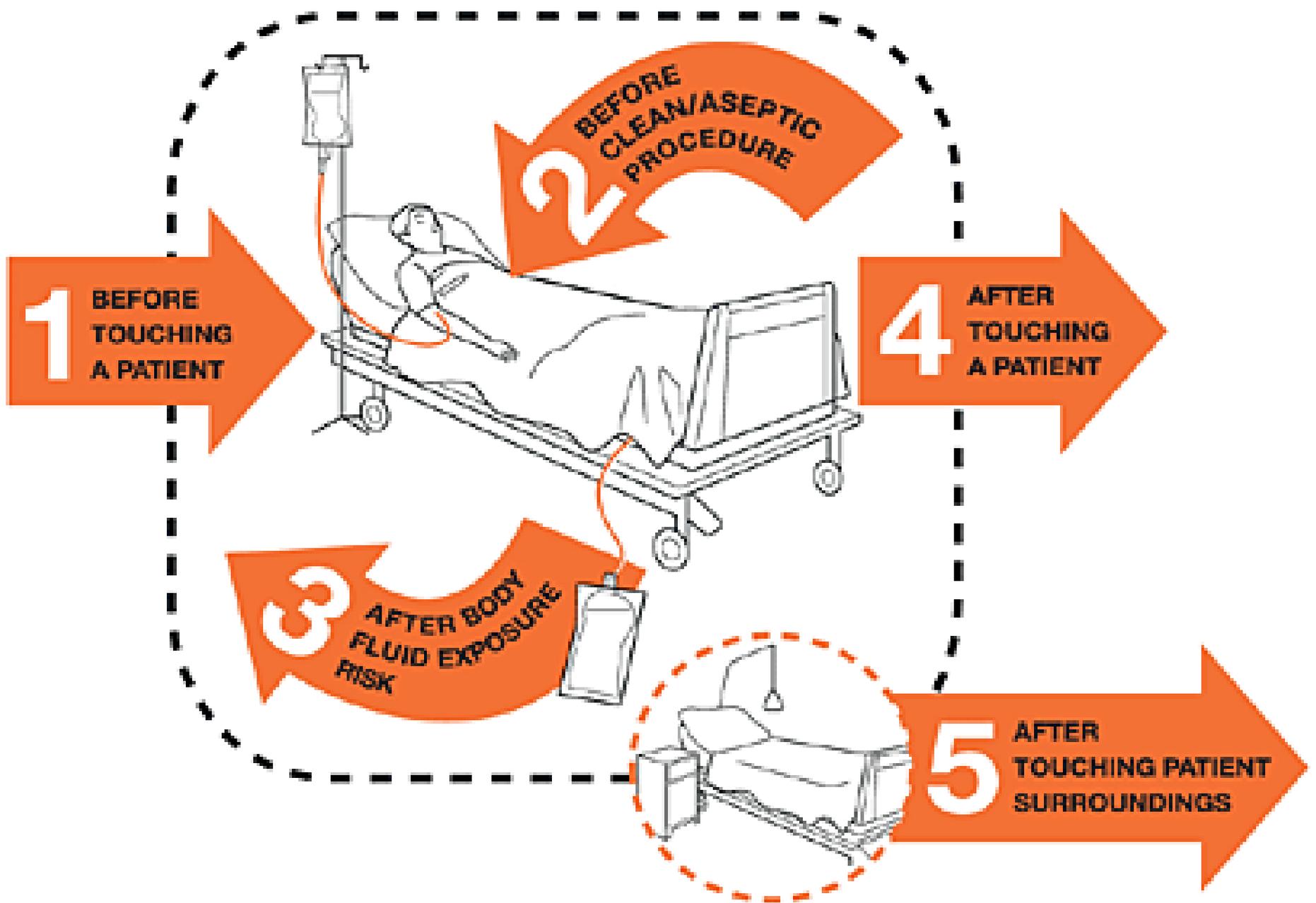
- Your doctors and nurses should practice hand hygiene every time they enter your room.
- You and your visitors should clean your hands before eating, after using the restroom, and after touching surfaces in the hospital room.

For more information,
please visit www.cdc.gov/handhygiene
or call 1-800-CDC-INFO

CDC acknowledges the following partners in the development of the *Hand Hygiene Saves Lives* video: the Association for Professionals in Infection Control and Epidemiology and Safe Care Campaign.

This poster was developed with support from the CDC Foundation and Kimberly-Clark Corporation.





Source: WHO Patient Safety Website

Hospital Associated Infections

- The effectiveness of hand hygiene can be reduced by the type and length of fingernails.
 - Individuals wearing artificial nails have been shown to harbor more pathogenic organisms, especially gram negative bacilli and yeasts, on the nails and in the subungual area than those with native nails.
- In 2002, CDC/HICPAC recommended (Category IA) that artificial fingernails and extenders not be worn by healthcare personnel who have contact with high-risk patients (e.g., those in ICUs, ORs) due to the association with outbreaks of gram-negative bacillus and candidal infections as confirmed by molecular typing of isolates.
- At this time such decisions are at the discretion of an individual facility's infection control program.
- There is less evidence that jewelry affects the quality of hand hygiene.

Standard Precautions

- Standard Precautions combine the major features of Universal Precautions (UP) and Body Substance Isolation (BSI) and are based on the principle that all blood, body fluids, secretions, excretions except sweat, nonintact skin, and mucous membranes may contain transmissible infectious agents.
- Standard Precautions include a group of infection prevention practices that apply to all patients, regardless of suspected or confirmed infection status, in any setting in which healthcare is delivered.
- These include:
 - Hand hygiene
 - Use of gloves, gown, mask, eye protection, or face shield, depending on the anticipated exposure
 - Safe injection practices

Transmission-Based Precautions

- There are three categories of Transmission-Based Precautions:
 - Contact Precautions
 - Droplet Precautions
 - Airborne Precautions.

Transmission-Based Precautions

- Transmission-Based Precautions are used when the route(s) of transmission is (are) not completely interrupted using Standard Precautions alone.
- For some diseases that have multiple routes of transmission (e.g., SARS), more than one Transmission-Based Precautions category may be used.
- When used either singly or in combination, they are always used in addition to Standard Precautions.

Transmission-Based Precautions

Contact

- Contact Precautions are intended to prevent transmission of infectious agents, which are spread by direct or indirect contact with the patient or the patient's environment.

Transmission-Based Precautions

Contact



Clean hands with alcohol-based hand rub or soap and water



Wear gloves when providing direct care



Wear gown when providing direct care

Transmission-Based Precautions

Droplet

- Droplet Precautions are intended to prevent transmission of pathogens spread through close respiratory or mucous membrane contact with respiratory secretions

Transmission-Based Precautions

Droplet

Droplet Precautions



Clean hands with
alcohol-based hand rub
or soap and water



Wear surgical mask
within 2 metres of
patient



Wear eye protection
within 2 metres of
patient

Transmission-Based Precautions

Airborne

- Airborne Precautions prevent transmission of infectious agents that remain infectious over long distances when suspended in the air

Transmission-Based Precautions

Airborne



Clean hands with
alcohol rub or soap
and water



Wear N95 mask when
entering room



Closed Door, open window if possible

Infectious Diseases that may be acquired in Healthcare facilities

- In American hospitals alone, healthcare-associated infections account for an estimated 1.7 million infections and 99,000 associated deaths each year.
- Of these infections:
 - 32 percent of all healthcare-associated infections are urinary tract infections (CAUTI)
 - 22 percent are surgical site infections (SSI)
 - 15 percent are pneumonia (VAP)
 - 14 percent are bloodstream infections (CLABSI)

Infectious Diseases that may be acquired in Healthcare facilities

- *Acinetobacter*
- Bloodborne Pathogens and HIV/AIDS
- *Burkholderia cepacia*
- *Clostridium difficile*
- *Clostridium Sordellii*
- Ebola (Viral Hemorrhagic Fever)
- Gastrointestinal (GI) Infections
- Hepatitis A, B, C
- Influenza
- MRSA - Methicillin-resistant *Staphylococcus aureus*
- Norovirus
- SARS
- Tuberculosis
- Viral Hemorrhagic Fever (Ebola)
- VISA - Vancomycin Intermediate *Staphylococcus aureus*
- VRE - Vancomycin-resistant *enterococci*

Viral Hemorrhagic Fevers

- VHF's are caused by viruses of four distinct families: arenaviruses, filoviruses, bunyaviruses, and flaviviruses.
- Each of these families share a number of features:
 - They are all RNA viruses, and have an envelope-a fatty (lipid) coating.
 - Their survival is dependent on an animal or insect host as their natural reservoir.
 - The viruses are geographically restricted to the areas where their host species live.
 - Humans are not the natural reservoir for any of these viruses.
 - Humans are infected when they come into contact with infected hosts.
 - However, with some viruses, after the accidental transmission from the host, humans can transmit the virus to one another.
 - Human cases or outbreaks of hemorrhagic fevers caused by these viruses occur sporadically and irregularly.
 - The occurrence of outbreaks cannot be easily predicted.
 - With a few noteworthy exceptions, there is no cure or established drug treatment for VHF's.

Viral Hemorrhagic Fevers

- Some viruses that cause hemorrhagic fever can spread from one person to another, once an initial person has become infected. Ebola, Marburg, Lassa and Crimean-Congo hemorrhagic fever viruses are examples.
- This type of secondary transmission of the virus can occur directly, through close contact with infected people or their body fluids.
- It can also occur indirectly, through contact with objects contaminated with infected body fluids.
- For example, contaminated syringes and needles have played an important role in spreading infection in outbreaks of Ebola hemorrhagic fever and Lassa fever.

Viral Hemorrhagic Fevers

- Specific signs and symptoms vary by the type of VHF, but initial signs and symptoms often include marked fever, fatigue, dizziness, muscle aches, loss of strength, and exhaustion.
- Patients with severe cases of VHF often show signs of bleeding under the skin, in internal organs, or from body orifices like the mouth, eyes, or ears.
- However, although they may bleed from many sites around the body, patients rarely die because of blood loss.
- Severely ill patient cases may also show shock, nervous system malfunction, coma, delirium, and seizures.
- Some types of VHF are associated with renal (kidney) failure.

Ebola

- Ebola hemorrhagic fever (Ebola HF) is a severe, often-fatal disease in humans and nonhuman primates (monkeys, gorillas, and chimpanzees) that has appeared sporadically since its initial recognition in 1976.
- The disease is caused by infection with Ebola virus, named after a river in the Democratic Republic of the Congo (formerly Zaire) in Africa, where it was first recognized.
- The virus is one of two members of a family of RNA viruses called the Filoviridae.
- There are five identified subtypes of Ebola virus. Four of the five have caused disease in humans: Ebola-Zaire, Ebola-Sudan, Ebola-Ivory Coast and Ebola-Bundibugyo.
- The fifth, Ebola-Reston, has caused disease in nonhuman primates, but not in humans.



Source: CDC Special Pathogens Branch

Ebola

- Confirmed cases of Ebola HF have been reported in the Democratic Republic of the Congo, Gabon, Sudan, the Ivory Coast, Uganda, and the Republic of the Congo.
- No case of the disease in humans has ever been reported in the United States.
- Ebola-Reston virus caused severe illness and death in monkeys imported to research facilities in the United States and Italy from the Philippines; during these outbreaks, several research workers became infected with the virus, but did not become ill.
- Ebola HF typically appears in sporadic outbreaks, usually spread within a health-care setting (a situation known as amplification).
- It is likely that sporadic, isolated cases occur as well, but go unrecognized.

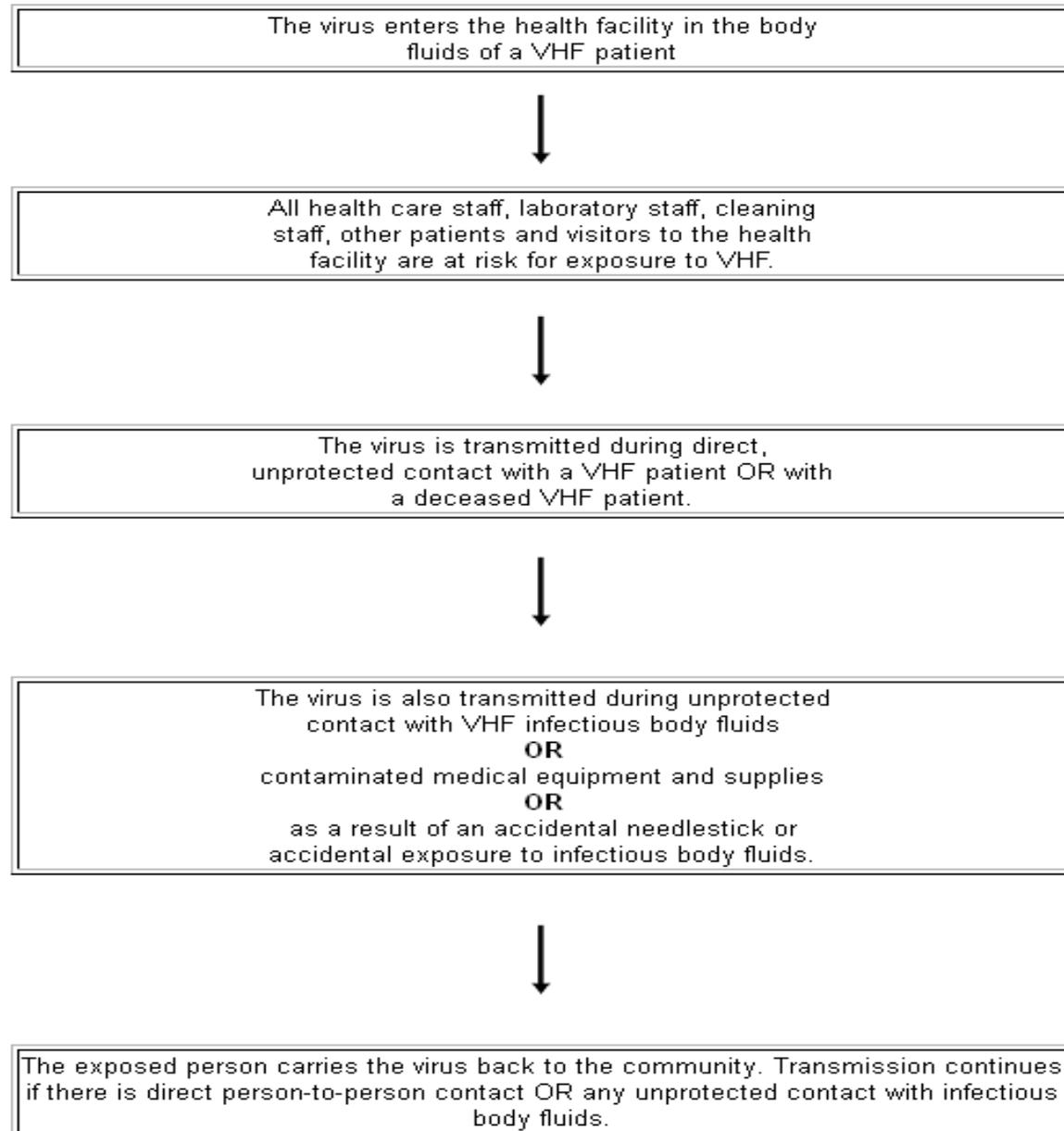
Ebola

- Infections with Ebola virus are acute.
 - There is no carrier state.
- Because the natural reservoir of the virus is unknown, the manner in which the virus first appears in a human at the start of an outbreak has not been determined.
- However, researchers have hypothesized that the first patient becomes infected through contact with an infected animal.
- After the first case-patient in an outbreak setting is infected, the virus can be transmitted in several ways.
 - People can be exposed to Ebola virus from direct contact with the blood and/or secretions of an infected person.
 - Thus, the virus is often spread through families and friends because they come in close contact with such secretions when caring for infected persons.
 - People can also be exposed to Ebola virus through contact with objects, such as needles, that have been contaminated with infected secretions.

Ebola

- The spread of a disease within a health-care setting, such as a clinic or hospital, occurs frequently during Ebola HF outbreaks.
- In African health-care facilities, patients are often cared for without the use of a mask, gown, or gloves.
- Exposure to the virus has occurred when health care workers treated individuals with Ebola HF without wearing these types of protective clothing.
- In addition, when needles or syringes are used, they may not be of the disposable type, or may not have been sterilized, but only rinsed before reinsertion into multi-use vials of medicine.
 - If needles or syringes become contaminated with virus and are then reused, numerous people can become infected.

How VHF Is Transmitted in the Health Care Setting



Ebola

- The incubation period for Ebola HF ranges from 2 to 21 days.
- The onset of illness is abrupt and is characterized by fever, headache, joint and muscle aches, sore throat, and weakness, followed by diarrhea, vomiting, and stomach pain.
- A rash, red eyes, hiccups and internal and external bleeding may be seen in some patients.

Ebola

- Antigen-capture enzyme-linked immunosorbent assay (ELISA) testing, IgM ELISA, polymerase chain reaction (PCR), and virus isolation can be used to diagnose a case of Ebola HF within a few days of the onset of symptoms.
- Persons tested later in the course of the disease or after recovery can be tested for IgM and IgG antibodies; the disease can also be diagnosed retrospectively in deceased patients by using immunohistochemistry testing, virus isolation, or PCR.

Ebola



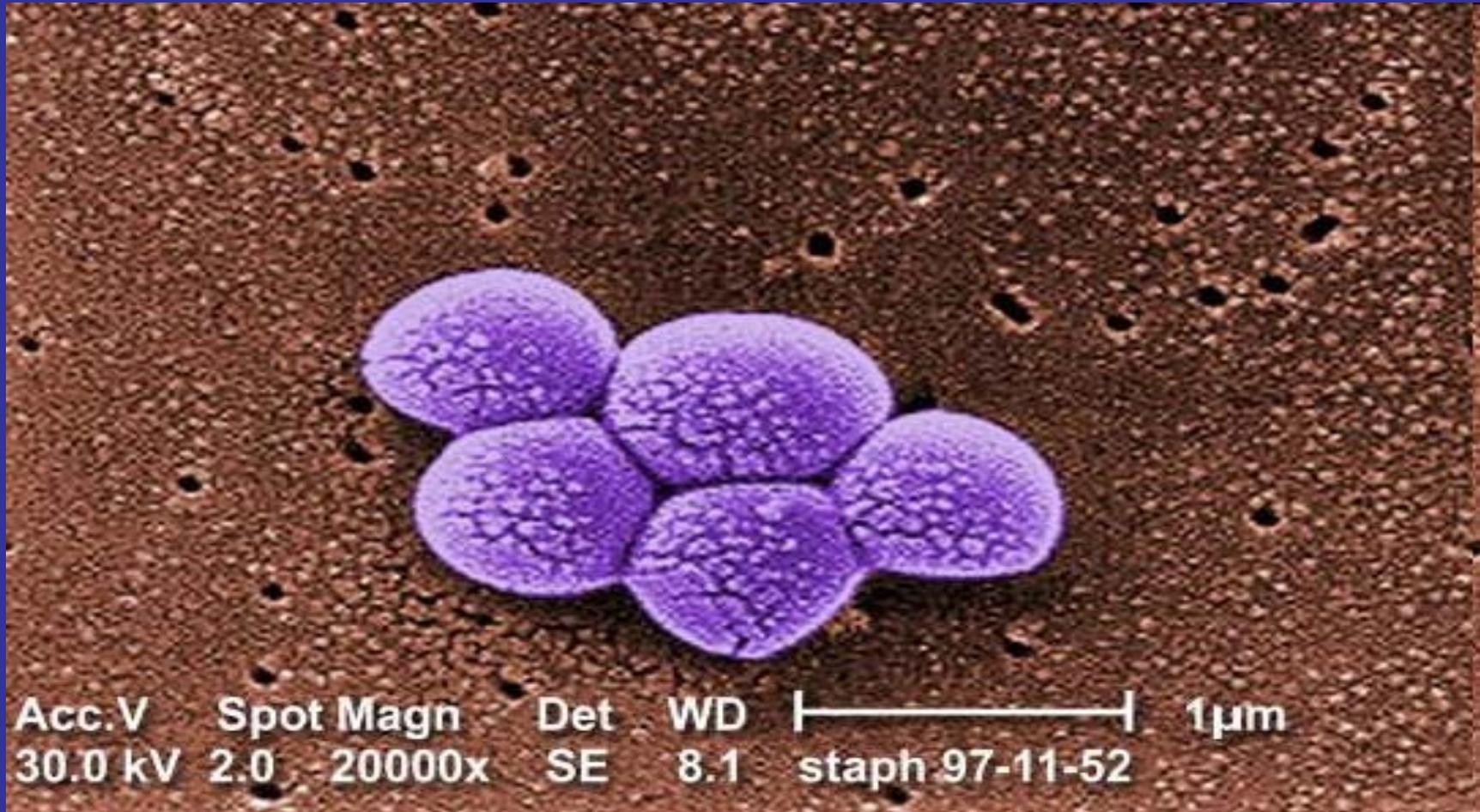
Ebola



Methicillin Resistant *Staphylococcus Aureus*

- Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of staph bacteria that does not react to certain antibiotics and will normally cause skin infections, but MRSA can also cause other infections—including pneumonia.
- In 1974, MRSA infections accounted for two percent of the total number of staph infections; in 1995 it was 22%; in 2004 it was 63%.
- CDC estimated that 94,360 invasive MRSA infections occurred in the United States in 2005; 18,650 of these were associated with death.
 - About 85% of all invasive MRSA infections were associated with healthcare, and of those, about two-thirds occurred outside of the hospital, while about one third occurred during hospitalization.
- MRSA is resistant to antibiotics including methicillin, oxacillin, penicillin, and amoxicillin.

Methicillin Resistant *Staphylococcus Aureus*



Source: PHIL

Methicillin Resistant *Staphylococcus Aureus*

- Studies show that about 33% of the population are carriers of *Staph* in their anterior nares.
 - 2% of the population are carriers of MRSA.
- In the healthcare setting, MRSA can cause severe problems such as bloodstream infections, pneumonia and surgical site infections and it is usually spread by direct contact with an infected wound or from contaminated hands, usually those of healthcare providers.

Methicillin Resistant *Staphylococcus Aureus*

- The infection can be spread by skin-to-skin contact, sharing or touching a personal item with someone with infected skin, or touching a surface or item that has been in contact with someone with MRSA.
- MRSA infections that occur in otherwise healthy people who have not been recently (within the past year) hospitalized or had a medical procedure (such as dialysis, surgery, catheters) are known as community-associated MRSA infections (CA-MRSA).
 - These infections are usually skin infections such as abscesses, boils, and other pus-filled lesions, but these infections may also lead to more serious illness, such as pneumonia.

Methicillin Resistant *Staphylococcus Aureus*

- Most cutaneous staph infections, including MRSA, will grow as a bump or infected area on the skin.
- Skin will usually appear:
 - Red
 - Swollen
 - Painful
 - Warm to the touch
 - Full of pus or other drainage
 - Accompanied by a fever

Methicillin Resistant *Staphylococcus Aureus*



Photo Credit: Gregory Moran, M.D.

Pneumonia

- Pneumonia has accounted for approximately 15% of all hospital-associated infections and 27% and 24% of all infections acquired in the medical intensive-care unit (ICU) and coronary care unit, respectively.
- It has been the second most common hospital-associated infection after that of the urinary tract.
- For hospital-associated pneumonia, attributable mortality rates of 20%-33% have been reported.
- The primary risk factor for the development of hospital-associated bacterial pneumonia is mechanical ventilation (with its requisite endotracheal intubation).

Vancomycin Resistant *Enterococci*

- *Enterococci* are bacteria that are normally present in the human intestines and in the female genital tract and are often found in the environment.
- Vancomycin is an antibiotic that is often used to treat infections caused by enterococci.
- In some instances, enterococci have become resistant to this drug and thus are called vancomycin-resistant enterococci (VRE).
- Most VRE infections occur in hospitals.
- Information collected by the Centers for Disease Control and Prevention during 2006 and 2007 showed that enterococci caused about 1 of every 8 infections in hospitals and only about 30% of these are VRE.

Vancomycin Resistant *Enterococci*

- The following persons are at an increased risk becoming infected with VRE:
 - People who have been previously treated with the antibiotic vancomycin or other antibiotics for long periods of time
 - People who are hospitalized, particularly when they receive antibiotic treatment for long periods of time
 - People with weakened immune systems such as patients in Intensive Care Units, or in cancer or transplant wards
 - People who have undergone surgical procedures such as abdominal or chest surgery
 - People with medical devices that stay in for some time such as urinary catheters or central intravenous (IV) catheters
 - People who are colonized with VRE

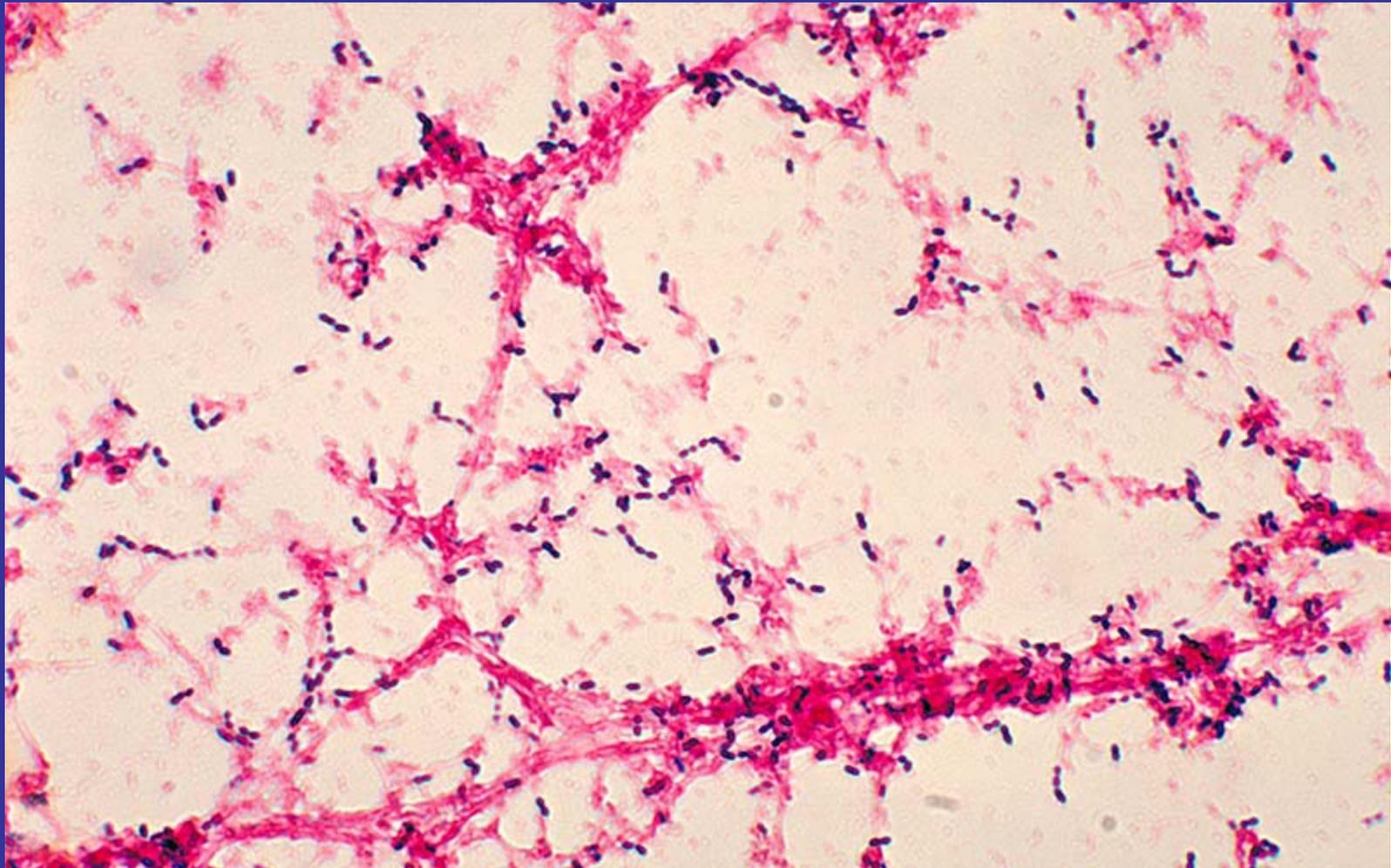
Vancomycin Resistant *Enterococci*

- VRE is often passed from person to person by the hands of caregivers.
- VRE can get onto a caregiver's hands after they have contact with other people with VRE or after contact with contaminated surfaces.
- VRE can also be spread directly to people after they touch surfaces that are contaminated with VRE.

Streptococcus pneumoniae

- *Streptococcus pneumoniae* are lancet-shaped, gram-positive, facultative anaerobic bacteria with over 90 known serotypes.
- Most *S. pneumoniae* serotypes have been shown to cause disease, but only a minority of serotypes produce the majority of pneumococcal infections.

Streptococcus pneumoniae



Streptococcus pneumoniae

- Pneumococci are common inhabitants of the respiratory tract and may be isolated from the nasopharynx of 5-70% of adults, depending on the population and setting.
- Only 5-10% of adults without children are carriers.
- In schools and orphanages, 25-50% of students and residents may be carriers.
- On military installations, as many as 50-60% of service personnel may be carriers.
- The duration of carriage varies and is generally longer in children than adults.

Streptococcus pneumoniae

- Transmission of *S. pneumoniae* occurs as a result of direct person-to-person contact via respiratory droplets and by autoinoculation in persons carrying the bacteria in their upper respiratory tract.
- The pneumococcal serotypes most often responsible for causing infection are those most frequently found in carriers.
- The spread of the organism within a family or household is influenced by such factors as crowding, season, and the presence of upper respiratory infections or pneumococcal disease such as pneumonia or otitis media.

Streptococcus pneumoniae

- The major clinical syndromes of pneumococcal disease are pneumonia, bacteremia, and meningitis.
 - The immunologic mechanism that allows disease to occur in a carrier is not clearly understood.
- However, disease most often occurs when a predisposing condition exists, particularly pulmonary disease, and, if it is going to occur at all, shortly after carriage is acquired.

Streptococcus pneumoniae

- Pneumococcal pneumonia is the most common clinical presentation of pneumococcal disease among adults, although pneumonia without bacteremia or empyema is not considered to be “invasive” disease.
 - The incubation period of pneumococcal pneumonia is short, about 1 to 3 days.
 - The period of transmissibility is unknown although theoretically, people are infectious as long as they carry the organism in their respiratory tract.

Streptococcus pneumoniae

- Symptoms generally include:
 - Abrupt onset of fever and chills or rigors
 - Typically there is a single rigor, and repeated shaking chills are uncommon.
 - Pleuritic chest pain
 - Cough productive of mucopurulent rusty sputum
 - Dyspnea
 - Tachypnea
 - Hypoxia
 - Tachycardia
 - Malaise, and weakness
 - Nausea, vomiting, and headaches occur less frequently.

Streptococcus pneumoniae

- As many as 400,000 hospitalizations from pneumococcal pneumonia are estimated to occur annually in the United States.
- Pneumococci account for about 30% of adult community-acquired pneumonia.
- Bacteremia occurs in up to 25–30% of patients with pneumococcal pneumonia.
- The case-fatality rate is 5-7% and may be higher than 50% among elderly persons.
 - Complications of pneumococcal pneumonia include empyema (infection of the pleural space), pericarditis (inflammation of the sac surrounding the heart), and respiratory failure.

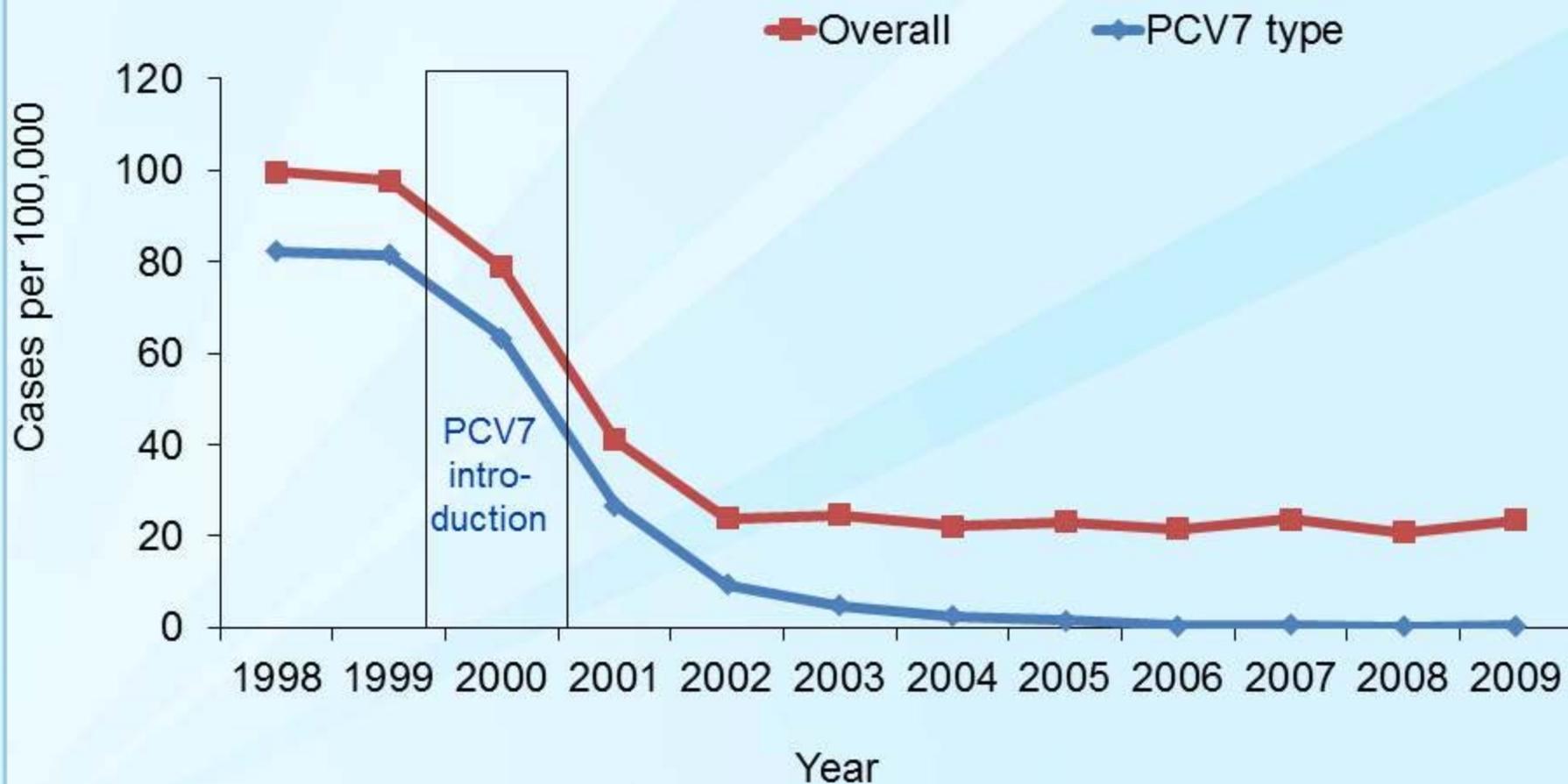
Streptococcus pneumoniae

- Conditions that increase the risk of invasive pneumococcal disease among adults include:
 - Decreased immune function from disease or drugs
 - Functional or anatomic asplenia
 - Chronic heart, pulmonary (including asthma), liver, or renal disease
 - Smoking cigarettes
 - Cerebrospinal fluid leak
 - Daycare
 - Children with functional or anatomic asplenia, particularly those with sickle cell disease, and children with HIV infection are at very high risk for invasive disease.

Streptococcus pneumoniae

- The pneumococcal conjugate vaccine (PCV13 or Prevnar 13®) provides protection against the 13 serotypes responsible for most severe illness in children.
 - The vaccine can also help prevent some ear infections.
- PCV13 is administered as a four-dose series at 2, 4, 6, and 12 through 15 months of life.
- PCV13 should also be administered to some adults with immunocompromising conditions.

Impact of 7-valent pneumococcal conjugate vaccine on invasive pneumococcal disease among children <5 years old, 1998-2009



Moore, IDSA, 2009 & CDC Unpublished

Streptococcus pneumoniae

- The pneumococcal polysaccharide vaccine (PPSV23 or Pneumovax 23®) is a 23-valent polysaccharide vaccine that is currently recommended for use in all adults who are 65 years and older and for persons who are 2 years and older and at high risk for disease.
- It is also recommended for use in adults 19 through 64 years of age who smoke cigarettes or who have asthma.